KC135 STUDENT FLIGHT PROGRAM

NASA

Hobgood students learning about gravity

By TOSHEENA ROBINSON-BLAIR
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— Tosheena Robinson-Blair, 278-5151

Hobgood Elementary School science teacher Chick Knitter admits he has a fear of flying.

But he's willing to fly aboard a high-tech NASA plane to help his sixth-grade students grasp a lesson about gravity.

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Knitter will travel to Houston in February to test his students' hypotheses about how eight toys will function in a no-gravity and high-gravity environment as part of NASA's Microgravity Program.

Among the toys he will test are two different types of Chinese YoYos, a mood ring, a paratrooper, Mexican jumping beans, a puppet and a Pluto dog.

Knitter will be in Houston Feb. 8-18. He is expected to fly either Feb. 13 or 14.

After the flight, he's expected to conduct a brief video conference with his students about the highlights of the mission. They'll talk more in-depth when he returns to the classroom.

"This has allowed all students to think out of the box in a unique and fun way. I've been amazed at some of the insights that these kids have had," said Knitter, who began his search for toys to play with "in space" about two months ago.

"I know these kids and sometimes, truth be known ... sometimes they can't do what you give them on paper, but this is something different. It has just amazed me some of the hypotheses they have come up with on their own."

Sixth-grader Arturo Vallejos said he has enjoyed the experiment.

"We actually get to experiment with the toys instead of just looking at a boring book," said Vallejos. "I learned more this way."

In April 1985, Carolyn Sumners of the Houston Museum of Natural Science recognized the appeal of using toys in space.

She assembled a small group of toys and placed them aboard a space shuttle mission. During the flight, crew members experimented with them. Their experiments were videotaped and have been used as an effective teaching tool in thousands of schools, according to NASA's Web site.

Hobgood's proposal to participate in the program was written this past summer by the NASA Explorer School, which is affiliated with the Marshall Space and Flight Center in Huntsville, Ala.

Hobgood students began the experiment by investigating how the selected toys functioned on earth. Students then developed a set of experimental questions about how the toys would function in microgravity, drawing upon Newton's Three Laws of Motion.

Even if all the toys aren't tested in the 60-minute flight aboard NASA's C9 microgravity plane, enough information can be gained from watching the videotape to accept, refine or develop new hypotheses and

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explanations for whatever was observed.

"We had to use a lot of math and a lot of thinking because it's not the same in microgravity. I've memorized Newton's laws (of motion)," said student Morgan Roan. "It's been really hard and really fun at the same time."

When an aircraft above the Earth is in a state of freefall, it eliminates the local effects of gravity, making objects inside appear to float. NASA refers to this environment as microgravity.

The plane, similar to a regular aircraft, flies a very specific path called a parabola.

"It goes up and down in curves. When it goes up you experience more gravity than you do on earth right now. It's 2G's — two times the earth normal gravity," said NASA scientist Liz Warren, who works with the program's Reduced Gravity Office.

"When the plane starts to fall toward the earth, you experience microgravity. Everything inside the plane begins to float, including you. It's a fabulous feeling. It's really neat to play with these toys and see how they react when you take gravity away. The plane does the up-and-down process about 30 times during the flight."

Each microgravity session lasts about 25 to 30 seconds. The experiments are carried out in the front of the plane where all the seats have been removed. The front of the plane is padded, as the experiment is conducted out of the seats.

Accompanying Knitter aboard the plane will be a doctor, representatives from other NASA Explorer schools and NASA scientists.

Robert "BJ" Jackson, a former NASA employee who lives in Murfreesboro, helped introduced the concept of microgravity to the Hobgood students and gave explanations as to what might happen with each toy.

"This is really the scientific way of doing business. Ask the question and make a hypothesis and the next step is to test the hypothesis and that's what Mr. Knitter is going to do when he flies. He will test what the children think is going to happen. They get to see the results and then we reach a conclusion," said Jackson, a former manager of the Microgravity Program at the Marshall Space Flight Center.

STORYCHAT Post a Comment View All Comments

Isn't this the plane (or one of the planes) referred to as the 'Vomit Comet' used in making films such as Apollo 13? I hope Mr. Knitter doesn't get motion sickness! Ah, the power of suggestion!

Posted: Wed Jan 24, 2007 6:33 am

Post a Comment View All Comments

Originally published January 24, 2007

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voices of innovation

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Hi Dom!
Here are the 4 programs (2-min. each) they produced with my field-recordings last summer.
cheers!
Inger Swaffar

Maria Rodriguez
3320 Powelton Avenue
Box 5026
Philadelphia PA 19104

Dear Maria,
We are pleased to announce the launch our new radio series, Voices of Innovation in September 2002. Sponsored by the American Association of Engineering Societies and NASA, the series celebrates the passion, insight and genius of engineers.

Enclosed is a cassette of the programs we've produced from your interview, earmarked for broadcast in December 2002 - January 2003. We hope you enjoy them.

By the way, we're looking for photographs to put on our web page every month at voicesofinnovation.com. To this purpose, we'd be grateful if you can send us any photographs which illustrate the programs we've done on your work.

Thank you for your participation and support.

Sincerely,
Jim Metzner
Executive Producer
Voices of Innovation
October 21, 2002

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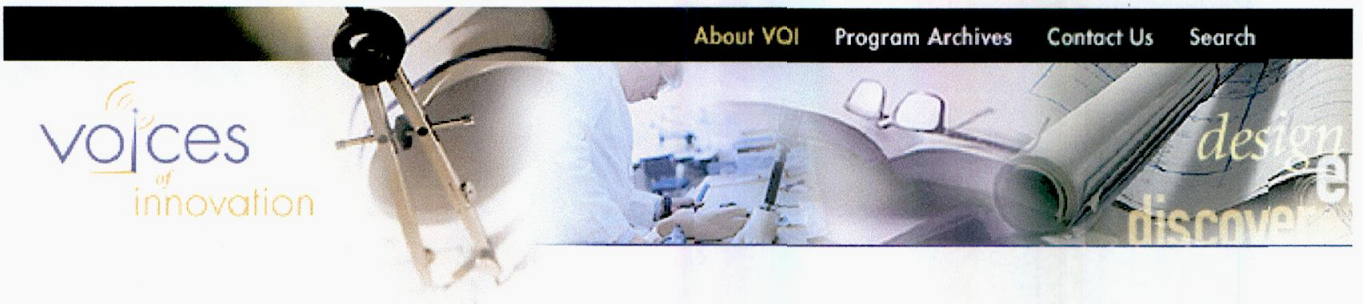

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Each weekday, **Voices of Innovation** provides its listeners with a two-minute sound portrait of engineering, providing a window into the lives of people who transform imagination and ingenuity into technological wonders. This daily program keys into the passion, excitement, and genius that inspires the men and women who make technological miracles a part of our everyday experience.

We hope that your encounter with **Voices of Innovation** fosters a greater recognition of the essential role that engineers play in society. Perhaps some of you may decide to become engineers? It's a great adventure into the endless possibilities of the human endeavor.

Voices of Innovation is broadcast to public and commercial radio stations around the world and on the Voice of America and the Armed Forces Radio Network. The series is made possible by partnership funding through the American Association of Engineering Societies. by a generous grant from the United Engineering Foundation with additional support from the National Aeronautics and Space Administration.

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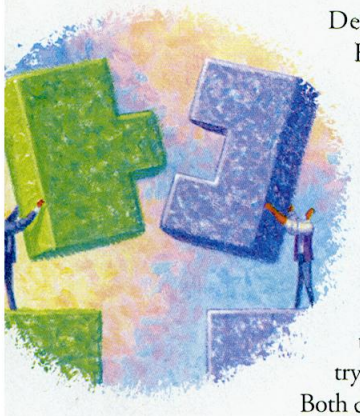
Hometown help Painting, landscaping and refurbishing, nearly 900 Rowan students plus faculty, staff, high school students and local officials gathered at Glassboro High School for Rowan's second annual day of community service, the Big Event. Others helped spruce up the Glassboro Intermediate School and the Elsmere section of town. Mike Eliason '04, Big Event chair, said, "In many ways, the success of Rowan University hinges upon our relationship with the outlying community. The Big Event is an excellent way to maintain the health of that relationship."

RU clinics go town-gown

Rowan University isn't the only place in Glassboro anticipating major changes. The borough of Glassboro itself plans to revitalize the historic downtown area and Rowan's College of Liberal Arts & Sciences opened two clinics on East High Street in a town-gown show of support.

The Child and Family Assessment Clinic, funded through a grant from the Division of Youth and Family Services, evaluates physically abused and neglected children and parent-child relationships. The Tobacco Dependency Clinic offers services to help people quit smoking and is funded by the Department of Health and Senior Services with funds from the Master Settlement Agreement between the tobacco industry and the state. Both centers are seeing clients and attracting attention from the community.



In fact, the Tobacco Dependency Clinic will travel to the Gloucester County Board of Social Services in September to discuss smoking cessation options. Bill Lang, Work First New Jersey supervisor, contacted the Center after seeing a brochure advertising its services. "We're always looking for low- or no-cost public service programs," said Lang. "By working with Rowan's Tobacco Dependency Clinic, we're helping people here quit smoking and, at the same time, getting the word out about this new community facility."

E-team wins wild ride

In a NASA research plane free-falling above the Gulf of Mexico, gravity is gone just long enough for senior David Kephart to run an experiment while a Philadelphia Inquirer *reporter holds on.*

Four engineering students got a taste of what it's like to be out of this world in March when they took part in the highly competitive NASA Reduced Gravity Student Flights Opportunities Program in Houston.

Jennifer Akers '02, Michael Burg '01, David Kephart '01 and William McCorkle '02 examined the rate of heat transfer in boiling fluid in the virtual absence of gravity on the KC-135A aircraft. The development of more effective modes of heat transfer is critical to space exploration and to computer technology.

Members of the 48 teams selected for flights conducted their experiments during two- to three-hour trips over the Gulf of Mexico. They flew about 30 parabolas, roller coaster-like steep climbs and descents during which they experienced 25 to 30 seconds of zero gravity. The maneuvers cause some passengers to "lose their lunch," which has contributed to the plane's reputation as the "Vomit Comet." "My friends just say 'wow,'" Kephart said. "They can't believe I was part of this."

The KC-135A is used to train astronauts, test hardware and experiments scheduled for space flight and evaluate potential medical protocols. This was the second year in a row Rowan earned a place in the program. The students traveled to Houston with Professor Anthony Marchese. "The students have worked on this project for more than a year. They came up with the idea, wrote the proposal and built the hardware themselves," Marchese said. "It has been a lot of hard work, but the payoff is a ride on the KC-135A."

Commencement

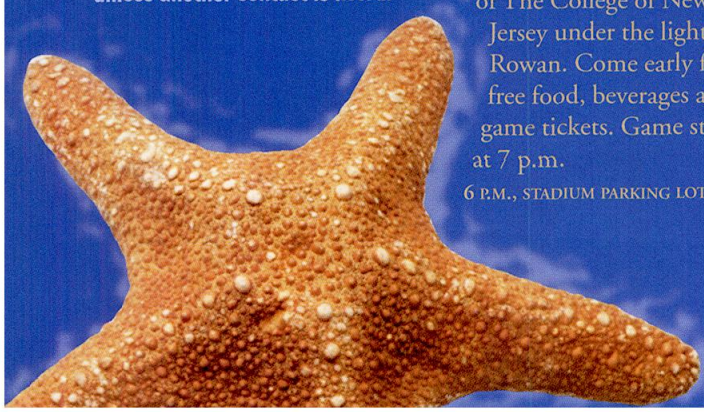
May 11 brought sunshine and smiles to Rowan's Class of 2001 grads and thousands of guests who observed the day's ceremonies and festivities. The Classes of 1931, 1941 and 1951 celebrated their 70th, 60th and 50th Commencement reunions (see photos on page 37). The University's first graduates from the doctoral program received their diplomas and three sets of mothers and daughters graduated together, drawing media attention to their accomplishments. For most graduates, though, Commencement occurred just as it has for more than 57,000 others since 1925: caps and gowns, Pomp and Circumstance, farewells bid and futures at hand—just the way freshmen dream of the day and as our most senior alumni so fondly recall.

Peter Dugan '75 (top) delivered the Commencement address, reflecting on the keen relationship between success, integrity, friendship and family. Recognized for her extraordinary career in law, Pauline Schneider '65 (right) was the recipient of this year's Distinguished Alumnus Award. Although the heat made for a somewhat uncomfortable morning on the University Green, euphoria pervaded the graduates' line-up for the processional (top, right) and the Commencement ceremony itself.

Alumni Events

www.rowan.edu/alumni

To sign up for an event, purchase tickets or for more information, please call Alumni Relations at 856-256-5400 or visit our website at www.rowan.edu/alumni unless another contact is listed.



Friday, September 7

Camden Riversharks

Sorry, sold out!

Bring your family out to see the Riversharks take on the Sunset Patriots.

Campbell's Field, Camden

Saturday, September 22

AJ Meerwald Cruise

Enjoy a sunset cruise on New Jersey's official tall ship. You'll have fun learning to raise and furl the sails or just relaxing. $25 per person includes food and beverages. Seating is limited, call today.

5 p.m., Bivalve (Port Norris)

Busch Grand National–MBNA.com 200

Be there when they wave the checkered flag. $30 per person includes skybox seating, reserved parking and refreshments (limit 4).

1 p.m., Dover Downs

Sunday, September 23

Alumni Night at the Center

"My Fair Lady"

Combine the legendary music of Lerner and Loewe with George Bernard Shaw's classic *Pygmalion* and you get one of the most adored Broadway hits of all time. "The Rain in Spain" and "Wouldn't It Be Loverly" are just a few of the enchanting songs from this musical. Alumni receive a $5 discount (limit 2).

3 p.m., Glassboro Center for the Arts, Pfleeger Concert Hall

Friday, September 28

Rowan Football Tailgating

The Profs take on the Lions of The College of New Jersey under the lights at Rowan. Come early for free food, beverages and game tickets. Game starts at 7 p.m.

6 p.m., stadium parking lot

Wednesday, October 3

GOLD Club Happy Hour

First of three networking happy hours. Check your mail for location details.

5 p.m., Hoboken

Saturday, October 6

Cirque du Soleil

This group's newest show, "Dralion," transcends the boundaries of imagination. Join us for the first area performance. $45 per person (limit 4).

4 p.m., Avenue of the Arts, Philadelphia

Wednesday, October 10

Washington, D.C. Area Alumni Reception

Enjoy an evening of cocktails and hors d'oeuvres with classmates at the residence of Ms. Pauline A. Schneider '65. Call the Alumni Office for details.

6-8 p.m., Washington, D.C.

Saturday, October 20

Class of 1961 Reunion

Student Center Owl's Nest

Saturday, October 27

Homecoming 2001

The Wonderful World of Rowan University: Where Dreams Live. See page 41 for more details.

Classes of '66 & '76 Reunions

Celebrate with classmates after the football game. More details to come.

Saturday, November 3

Rowan Football Tailgating

Join us at William Paterson University in Wayne to watch the Profs beat the Pioneers in this end-of-season showdown. Transportation is on your own. Come early for free food, beverages and game tickets. Game starts at 1:30 p.m.

noon, WPU

Thursday, November 8

NJEA Convention Alumni Reception

After a day of lectures and classes, relax with fellow alumni at our annual reception. We'll have a cash bar, hors d'oeuvres, campus updates, alumni giveaways and prize raffles. Stop by our booth at the Convention Center for more details.

5-7 p.m., Bally's Park Place

Sunday, December 2

Longwood Gardens

Hailed as "the best Christmas display in the world," Longwood Gardens will have you spellbound with its splendor. Trip includes transportation, admission to the Gardens, a guided tour and dinner at the Yuletide buffet. $50 per person (limit 4).

9:30 a.m., Rowan Campus

Saturday, December 8

Radio City Christmas Spectacular

This alumni favorite includes tickets to see the show, transportation and plenty of time to enjoy the magic of New York during the holidays. $80 per person for the first two tickets and $90 for each additional ticket (limit 6). First come, first served.

8:30 a.m., Rowan Campus

March 15–17, 2002

Vermont Ski Trip

Hit the slopes with us for our first alumni ski trip. This three-day trip features motor coach transportation, lodging, breakfast and lift tickets to Killington, the largest ski area in the East. Prices start at just $349 per person. A non-refundable $100 deposit is due by November 15, 2001. Call today for more details.

Please note: *Due to the popularity of our alumni events, refunds can only be made if the event is cancelled.*

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For Alumni & Friends of Rowan University

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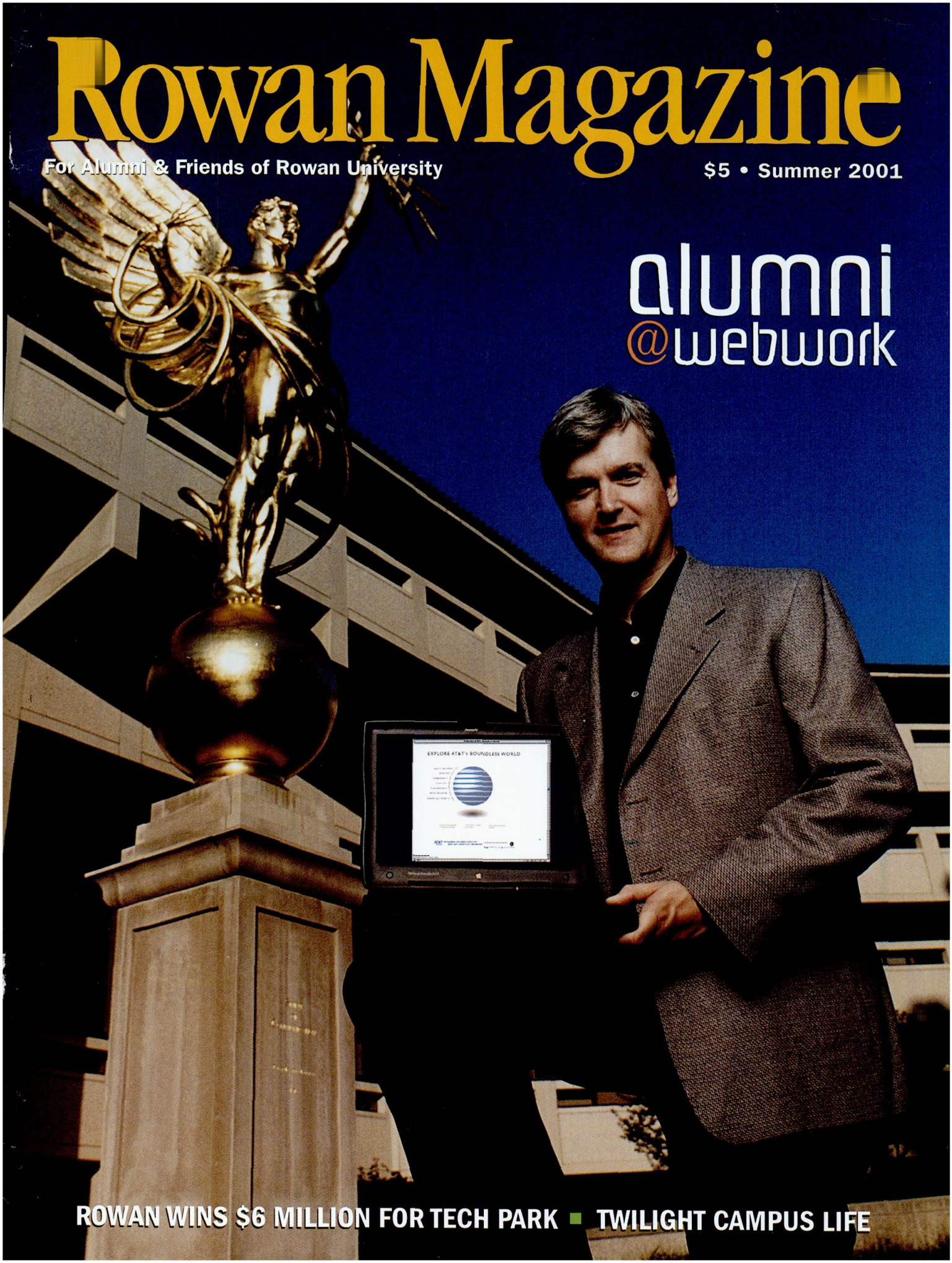

ROWAN WINS $6 MILLION FOR TECH PARK ■ TWILIGHT CAMPUS LIFE

Austin Community College Partners in progress
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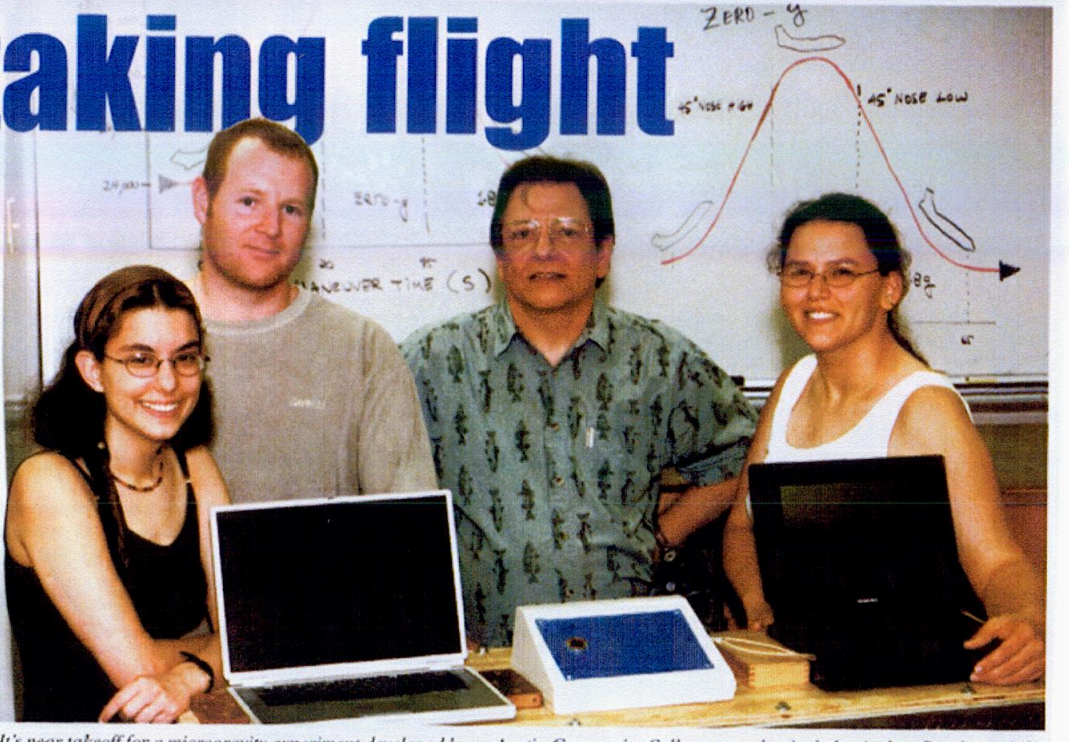
Dreams taking flight

ACC team to fly aboard NASA plane

Courtney Fritz chose her career path when she was 9 years old. Inspired by "Star Trek's" Lt. Uhura, Courtney decided that trekking through the final frontier was her dream job. In July, Courtney will have her first taste of space travel when she and several other Austin Community College students participate in NASA's Reduced Gravity Student Flight Opportunities Program.

"My mom raised me with the mindset that everything is possible," Courtney says. "She taught me that I can do whatever I want to do if I work for it."

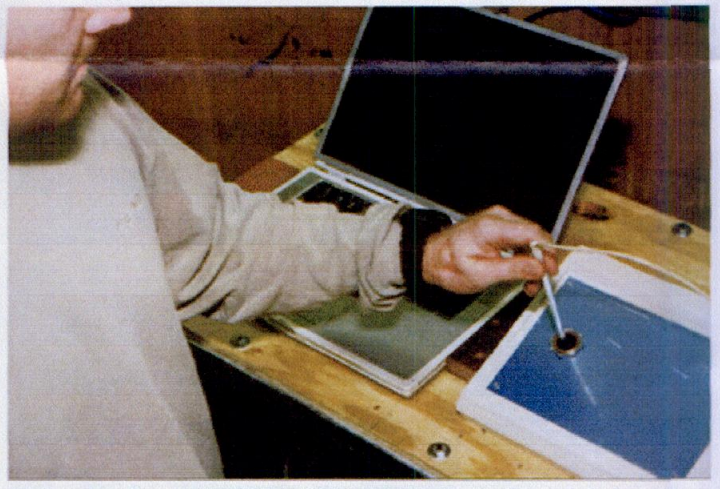
While she was still in high school, Courtney's fascination with becoming an astronaut led to an idea she thought would help astronauts: an elastic harness that would allow astronauts to passively exercise their muscles, which would reduce atrophy, a common side effect of space travel. The harness mimics the gravitational pull on the human subject by simulating the person's weight, which is derived by multiplying an object's mass by the strength of the gravitational field.



It's near takeoff for a microgravity experiment developed by an Austin Community College team that includes Andrea Pearlman (left to right), Keith Gilligan, Professor Allen Underwood, and Courtney Fritz. The team has operated on a shoestring budget of $300, raising money through bake sales, friends, and area corporations.

Appendix E

tional field.



During the microgravity flights, ACC crew members will test their dexterity and mental reasoning while strapped in the harness and unstrapped.

"The whole purpose of the harness is to exercise the muscles by resisting the pull on it," Courtney says. "If the harness is calibrated accurately enough, then it should make the person more comfortable because they'll be able to perform tasks with the dexterity of a person in a gravity situation."

Her idea is the basis for the ACC experiment selected by NASA to be performed on an airplane under reduced gravity conditions on July 23 and 24. The ACC proposal was one of 54 selected out of 80 that were submitted. ACC was only one of three community colleges chosen to participate, along with teams from California Institute of Technology, Purdue University, and the University of Texas (Austin, Dallas, and El Paso campuses).

This is the first year that ACC has submitted a proposal, which makes this project all the more exciting, says Allen Underwood, ACC physics professor. "Courtney's idea is an excellent one, and if it wasn't for her, this project wouldn't be happening."

John Ira Petty, a spokesman for the Johnson Space Center, says that the effects of low gravity limit the amount of time someone can spend in space. Currently, the longest stay in space for an American astronaut is six months. Astronauts on the International Space Station exercise twice a day for 30 minutes to an hour using a treadmill, a bicycle, and elastic straps for squats.

"It's a real problem to devise exercises to work major muscle groups that are doable in a microgravity environment, especially without disrupting other activities," Petty says. "NASA has spent a lot of research hours trying to figure out how to mitigate the effects of long-term exposure to low gravity."

Four of the nine team members will test the harness aboard the NASA KC-135 airplane. They will perform tests of the harness' effects on motor coordination, memory, reflex, math comprehension, and pulse rate. Tests will be conducted with the harness on and off in order to gauge its effects.

The KC-135 will climb to 35,000 feet, then free fall for two miles, which gives the occupants about 25 seconds of very low gravitational field, or "microgravity." The NASA flight crew will then pull out of the fall and repeat the cycle another 29 or so times. Two pairs of ACC students will perform the tests on the airplane—dubbed the "vomit comet"—over the course of two days.

"I am excited about this project because I'll become familiar with NASA, and it will help me understand what it would be like to be an engineer," ACC student Andrea Pearlman says. "I've really enjoyed taking physics and other classes at ACC. I feel better prepared to go to UT." ●

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SUNY PAPER Summer 2002

The SPECTRUM 3

UB Students and NASA Collaborate

By JAMIE LYNN PERNA
Sr. Feature Editor

An accepted proposal to conduct research on the effect of a micro-gravity environment on blood flow landed members of UB's chapter of the American Institute of Aeronautics and Astronautics at the Johnson Space Center in Houston, Texas, at NASA's mission control last summer, where the team hopes to return later this year.

"Seeing the building, seeing mission control — it was really exciting to see the people I could actually be working with," said team member Nicole Kulpit, a sophomore aerospace engineering major. "The experience was (a) once-in-a-lifetime ordeal, except for the fact that we are probably going back again next year, hopefully."

The four-member team was one of about fifty accepted into NASA's Reduced Gravity Student Flight Opportunities Program, based on a proposal submitted last October. The team conducted its research on July 18, 2002.

"It was a great experience to have, in terms of what kind of research is done in the professional field," said team member Nick Leone, a senior aerospace engineering major.

According to Project Coordinator Lindsay Volaski, a junior aerospace engineering major, the club decided to research a biomedical proposal because it had been brought up within UB's chapter of AIAA before, but never acted on.

Other members of the flight crew were Laurie Darling, who graduated from UB last year and is working full-time for mission control, and Dom DelRusso, who graduated from UB in 1989 and also works for NASA.

Originally, according to Volaski, the team submitted a proposal to test the effects of magnets on blood flow, but "NASA has a problem with promoting magnetic therapy."

Kulpit said NASA gave the team the option to either continue their research independent of NASA or submit a revised proposal.

Under the guidance of club advisor Cyrus Madnia, associate professor of mechanical and aeronautical engineering, the team researched and produced their proposal.

"It mostly relates to astronauts living in international space stations," said Volaski. "It gives us a better understanding of how the body responds to a micro-gravity environment."

The team hypothesized that blood flows differently through the body in a micro-gravity environment than on Earth because of the decreased pressure, which will decrease flow to the body's extremities and will not allow blood to pool in the lower extremities of the body, as it usually does.

"The results of this experiment are of great consequence to the space program, as well as to the field of science in general, because this type of research is new to the world of micro-gravity," the proposal states.

The team monitored blood flow and pulse rate using a Laser Doppler Flowmeter, which uses light waves to monitor capillary levels, and a portable wrist monitor to measure blood pressure. The meter was borrowed from UB's School of Medicine.

The research showed that blood flow decreased in a zero gravity environment and increased as the plane ascended because of the increased pressure.

Team members conducted the research as they traveled to an altitude of about 30,000 feet in a KC 135, or a revised Boeing 707 airplane. The plane climbs at a 45-degree angle before it freefalls for 10,000 feet, suspending gravity and causing the craft to float for about 25 seconds.

According to Volaski, it costs $7,000 per hour to operate the KC 135. Although the club was not responsible for this cost, team members were required to pay for the trip to Houston. Leone said that the total cost for the trip was about $4,500.

Volaski said that some of the money was raised through fund raising and the rest was gotten through club funding and $1,600 allottment from the Student Association Senate.

This year, the club is starting an engineering project on the effects of thermal coating on metallic objects and different properties.

"Thermal coating is a new study for NASA, especially in zero gravity," stated Kulpit in an e-mail. "With people living in zero gravity in space, they have to learn to use their environment to their advantage."

According to Leone, flight weeks for this year's projects are available from February through April. Since he is graduating in May, he said he would like to get a flight week around spring break but would return to Houston over the summer if necessary.

Courtesy of Lindsay Volaski

Junior Lindsay Volaski experienced zero gravity at the Johnson Space Center in Houston over the summer. Volaski is part of a team of UB students selected to do research work with NASA.

Figure 1 UB Spectrum Article

2.3 Web Based

A great source for information on our research, past, present and future, is our club web site http://www.eng.buffalo.edu/Students/Organizations/aiaa . This website contains our papers, pictures, and links to microgravity research pages. We also post up to date information on our current research involving aerogels. The web address was given out on club business cards at all of our events, so anybody interested could contact us about our project.

OIT students conduct weightless experiments with NASA

By JAMES THIELMAN
For the Herald and News

HOUSTON — "Over the top," says John Yaniec, lead flight test director for NASA's Weightless Wonder, a KC-135 airplane used for scientific experiments.

His remark is the cue to prepare for a dive that will give a handful of Oregon Institute of Technology students a taste of what weightlessness feels like.

Smiles, laughter, and joyful murmurs erupt from six teams of college students from around the country who are flying with their experiments.

Some of the students hope to become astronauts someday, including OIT's Heather Hava. Hava was part of a team from OIT testing bubble behavior in low to zero gravity at NASA's Ellington Field in Houston last month.

The plane gives science students the ability to test theories that can't be tested on the ground.

The NASA KC-135 airplane arches high above the Gulf of Mexico before going into a dive. For 30 seconds, passengers are weightless. The plane makes a series of climbs and dives that are called parabolas.

After an initial upward thrust that lifts students toward the ceiling, they float. If they move, it's because they push off the padded walls of the airplane.

NASA flight directors and doctors monitor the participants for safety.

This first parabola is a warm up. Getting free of earth's gravity for half a minute is such a kick no one blames the students for enjoying their first taste of weightlessness.

Not, that is, until Yaniec shouts, "Feet down, coming out."

Newcomers learn quickly how gravity returns with a vengeance during the bottom of the parabola where their weight nearly doubles.

At the next 30-second arc of weightlessness, Richard Witherspoon, OIT team leader, sets to work. He tests a game developed by high school students at a recent OIT Space Camp. Flippers must push a ball bearing to a sensor atop a Plexiglas case. He scores.

Hava helped another group of high school students develop a vending machine. Yaniec joked that the Russians could use it to sell food to proposed space tourists.

Hava hangs onto the experiment, as her feet fly up above her head. Undaunted, she turns a knob and pushes a button. A box of breath mints falls into the chamber where a space tourist could retrieve it.

Next, the two tackle the main experiment — testing bubble behavior in low-to-zero gravity.

In weightlessness, engineers must control bubbles in fuel or other fluids by attracting them with heat or pushing them away with cold. Under the direction of OIT professor Tim Brower, the students are exploring this idea.

Members of OIT's team who are making their second trip Witherspoon and Wes Beecroft, now employed by Sandia National Laboratory in Livermore, Calif. Richard and Wes's experience last year is helpful.

Newcomers to NASA include mechanical engineers Hava and Evan Pickett, who is working on a double major in engineering and design.

Also new is Kris Murray, a computer engineer. His role is to make sure the computer accepts data carried through a host of wires.

Pickett and Beecroft fly on the first flight day. The rest of the team watches a video downlink as they run the high school student experiments without at hitch.

Next, they work with the main experiment. This year, the bubble test cell and a video camera are mounted on a unit the size of a breadbox. Beecroft designed a precise manual bubble injector. Once the bubble is injected, the test unit floats freely on a tether. The goal is for the unit to reach even lower gravity levels than the airplane.

When the unit comes to the end of its tether a team member grabs it and sets it where it can free float again. They can do this about three times before Yaniec yells, "Feet down!" Then they set the unit on a foam pad.

A problem the first day is that a large bubble in the test cell dominates the action. The data isn't as clear as the students hoped. They work that night.

The next day, they are ready. They run the high school experiments successfully once again. They also have eliminated the large bubble in the main experiment. However, the temperature probes fail to track temperatures on the hot and cold side of the test cell — a setback.

Witherspoon and Hava now focus on collecting data on gravity levels. Knowing these levels could make future free-floating experiments on the KC-135 more valuable.

The plane flies 40 parabolas, 10 more than usual and everyone from OIT comes through fine.

The students use the last few parabolas to again enjoy floating. They do spins with the help of the NASA flight test directors.

Hava does a leap or two on a last parabola that mimics gravity on Mars. It has special meaning to her. She dreams of being the first woman on Mars.

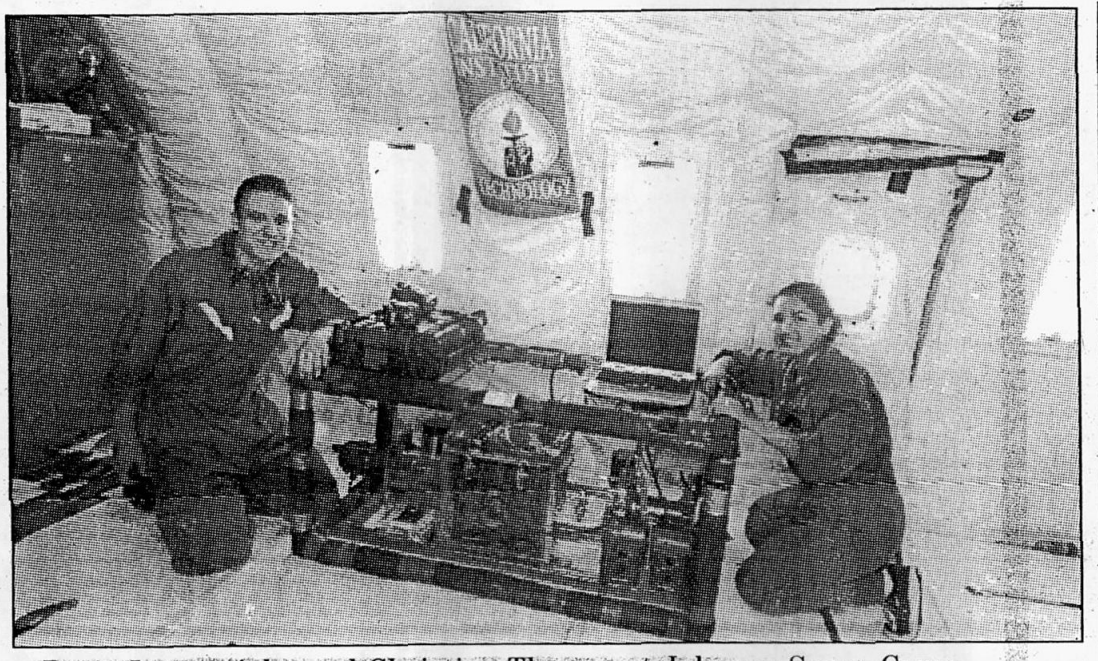
NASA

Richard Witherspoon, left, watches while OIT student Heather Hava hangs on to an experiment she is performing on NASA's "Weightless Wonder" plane. John Yaniec watches in the background.

Hava does a leap or two on a last parabola that mimics gravity on Mars. It has special meaning to her. She dreams of being the first woman on Mars.

Former Chino High students take flight at space center

By Marti Taylor



Brain Largarticha and Christina Thomas at Johnson Space Camp.

Christina Thomas and Brain Largarticha are still floating on air after an uplifting experience.

The two former Chino High classmates recently participated in the KC-135 Reduced Gravity Student Flight Opportunities Program at the Johnson Space Center (JSC) in Houston, Texas.

The nine-day program, offered through the National Aeronautics and Space Administration (NASA), culminates with participants conducting an experiment in a Boeing KC-135 plane during which they experience weightlessness at zero gravity.

"It's completely different from anything I've ever experienced," said Christina, 19, of Chino. "I immediately started kicking my legs, but you don't go anywhere. You literally have to push off of something. It's the weirdest thing, but you get used to it."

Things were a little different for her 6-foot-3, 210-pound buddy, Brian.

"I did get slight motion sickness," said the 20-year-old Chino resident. "I had to strap myself down for about the first 10 periods of zero gravity. But for the next 20 through 40 I calmed down and my body got used to it. At the end, I was doing cartwheels and flips in the air."

Brian and Christina were among more than 200 undergraduates who participate in the annual program that attracts students across the country.

This fall, Christina will be a junior at the California Institute of Technology (Caltech) in Pasadena and Brian will start his third year at the University of California at Irvine.

The two first met in the seventh-graders at Magnolia Junior High School. They were both in the school band, but soon found out they shared common interests beyond music.

"We always had aspirations of going to college," said Brian. "As far as academics, our interests were in the sciences, physics. I like science fiction and so does she..."

However, he admitted his friend has "higher" aspirations.

"I would like to be an astronaut," said Christina "I've always liked space and science."

Brian, on the other hand, feels more "grounded."

"I enjoy building things," he said. "When I graduate I'm going into a field that integrates computers and engineering components."

In order to qualify for the program, Christina had to submit a scientific proposal, which included a budget and an outreach plan.

From October to December, a group of NASA researchers reviewed the proposals. This year, 54 teams were accepted.

Christina's experiment proposal, titled "Sound Propagation in Bubbly Media," measured the speed of sound in a mixture of bubbles and water and asked the question how much slower does sound travel through bubbles as opposed to air or plain water at zero gravity.

In the end, Christina had a budget of approximately $15,000.

She received contributions from the Caltech departments of Geological and Planetary Sciences and the Engineering and Applied Sciences, which paid for all travel expenses.

Students spent a week and a half preparing for the flight. Part of their training included being placed in a decompression chamber to test the effects of Hypoxia, a condition caused by inadequate oxygen intake. Its effects range from blurred vision to giddiness.

"We all got mild symptoms," said Christina. "I had loss of concentration. They (testers) thought I fell asleep."

The program is set up to have experiments conducted in two flights. The four-member teams are split in half with two members making the trip one day and the second half flying the following day.

Using a device constructed by Brian — a 12x12x12 inch metal-framed cube made of one-inch thick plexi-glass— Christina's team conducted its experiment by filling 95% of the glass box with water. Then, two impellers stirred the water, which evenly distributed bubbles throughout the box.

The test indicated that during periods of zero gravity, the bubbles, which would rise to the top under normal conditions, remained suspended until the flight reached normal gravity.

Christina's team is in the process of gathering data for a more in-depth analysis.

Both students said they plan to participate in next year's program and conduct another experiment dealing with fluid properties.

from: Chino Valley Champion August 3, 2002

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Chino High grads fly high with NASA

By CHRISTINA CHANES NYSTROM
CORRESPONDENT

CHINO — Cristina Thomas and Brian Largarticha lived up to their vow of staying in touch this summer as the 2000 Chino High School graduates participated in a high-flying project.

Thomas and Largarticha were half of a four-member team that recently spent more than 10 days at Houston's Johnson Space Center in Houston as part of the Reduced Gravity Student Flight Opportunities Program, working on a project measuring the speed of sound through a homogenous bubbly mixture.

In simpler terms, the team was trying to test sound through a mixture of water and air.

"I was the only female on our team," the 19-year old Thomas said. "This is the most amazing thing I have ever done, so it was worth it, plus being a student at Caltech you get used to that. I really wanted to be a part of this team and I really wanted to fly, so it was definitely worth it."

The students were selected from a national pool of more than 200 proposals submitted by students to NASA at Johnson Space Center.

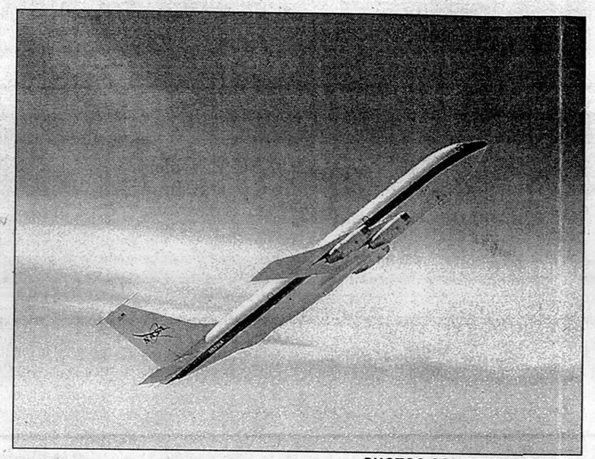
"I want to become an astronaut," said Thomas, who is studying planetary science at Caltech. "When this opportunity arose to submit a proposal, we jumped at the chance."

Part of the program included flying on NASA's KC-135A, nicknamed the "Vomit Comet."

The plane induces moments of micro gravity during flights over the Gulf of Mexico, which means that for more than 40 seconds at a time the students were weightless.

Before getting on the plane, the students had to go through rigorous physiological and emergency training classes at the space center.

"I have always wanted to be an astronaut and so this gave me a chance to see what NASA is about, what they have to offer and how it all works," said Thomas, adding that the team she worked with was dedicated to making sure their project not only made the cut but helped team members garner valuable experience.



PHOTOS COURTESY OF NASA

NASA's KC-135A, nicknamed the "Vomit Comet," is a research and training aircraft designed to create snippets of 30-seconds of microgravity. Astronauts must train in this airplane before they venture into orbit for the first time.

"You get to feel weightless and that was a very interesting experience because your normal reactions don't work. You have to be very calm and go with it. After about five periods, you kind of get the hang of it and start to really enjoy it. I've never quite experienced anything like it."

The NASA program was the single most awesome thing Largarticha said he has ever experienced.

"The trip definitely opened my eyes to what NASA is all about and it actually peaked my interest in terms of engineering," said Largarticha, a 20-year old University of California, Irvine student.

A computer information sciences major, Largarticha said he enjoyed the experience so much he may add a second major in engineering or minor in the subject.

Largarticha said he learned a lot about space, bureaucracies and how to hustle during the funding process.

"NASA did not grant the funds to complete the project. We had to come up with those on our own," Largarticha said. "Our funds came from private companies who support science and engineering programs and the students who pursue them."

Bykowski Engineering Equipment Company of Chino participated in this NASA project originally because Largarticha is the son of one of the owners.

"As we got more involved, we saw that our company could contribute and help these students with a what we believe to be a once in a life time opportunity," said Jack Wiersma, co-owner of BEECO.

"At the same time we wanted to motivate the students to contribute scientifically through the NASA program. We gave the team more than $3,000 to them to help fund their project and that in turn helped them to get materials, motors, labor and other supplies to help them with their experiment."

Persistence is the best motivator, Largarticha said.

"It doesn't matter where you come from, if you have a dream and it is what you want to do, then just go for it," Largarticha said.

The pair is hoping to complete another experiment next year, using the same model and are now working to generate the funds necessary to do so.

To donate funds or to find out how to help, call at (626) 395-4229 or (909) 821-9593.

Aboard the "Vomit Comet," Caltech student Cristina Thomas, a 2000 graduate of Chino High School, stands by her team's experiment, which sought to measure the speed of sound as an ultrasound beam passed through a mixture of water and air bubbles. Thomas says she wants to become an astronaut.

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Drexel UNIVERSITY

Honors Program News

A Publication of the Drexel University Honors Program >< Volume 11 No. 1 >< Fall 2002

Drexel Honors students ride NASA's "Vomit Comet"

-Mary Sullivan

Mary Sullivan and Mario in Zero-G

In July, the Drexel SpaceDragons Microgravity team defied gravity aboard NASA's KC-135 "Vomit Comet" airplane. The team was selected by NASA to conduct research experiments at the Johnson Space Center in Houston, Texas. Honors students Brian DiPaolo (Senior, Biomedical Engineering) and Mary Sullivan (Freshman, Chemical Engineering) studied the pollutant properties of diesel and Biodiesel fuel, while experiencing, first-hand, life without gravity.

The ride starts with a 2-g climb to about 35,000 feet. It feels like your brain is being pushed into your throat. Not too good. Then, all of the sudden, the plane pitches forward and takes a nosedive. You get that nervous, unsettling feeling, like on a roller coaster, when you're about to go over the edge. All of a sudden, you realize there's nothing holding you down. Your arms start floating and you drift right up to the ceiling.

I was belted down beside our experiment during a dive, and when zero-g hit, it felt like I was hanging upside-down from a jungle gym. Zero gravity is so disorienting that you could be standing on the ceiling, but think it was the floor. Since the entire cabin, including the floor, is bright white, you wouldn't know which way was down until the 2-g pullup - and then, SLAM!

We did about forty 30-second zero-g dives, one lunar gravity (1/6), and one Martian gravity (1/3). The flight lasted two hours, and only one of us got sick!

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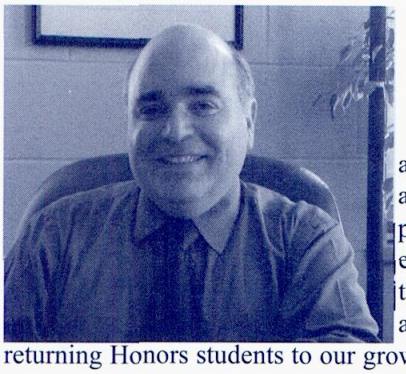
Winter 2002-2003 Honors Course List

Course #		Title	Meeting	Credits	Time	Instructor
HNRS	200-014	Introduction to Honors	TBA	1	TBA	TBA
HNRS	301-010	Writing the Self: Autobiography	TBA	3	TBA	Ibieta
HNRS	301-12H	Special Theory of Relativity	TBA	3	TBA	Vogely
HNRS	450-005	Honors Directed Study	TBA	3	TBA	TBA

From the Director

-Dean Mark



WELCOME—or WELCOME BACK!

The autumn is almost upon us as we anticipate the pleasant prospect of welcoming our eleventh freshman class to the Honors Program. We also warmly welcome back returning Honors students to our growing family. Some 300 new students will be joining us, bringing our total number of students to over 950. A fitting tribute to a decade of growth, building, and improvements to Drexel's Honors Program, our fine students are our reason for existing.

Our new members come from every major and college. They are the largest, and most academically talented incoming class to date, with average combined SAT scores of 1345 and an average GPA of 3.67. These students should find our Honors courses as challenging and enjoyable as does our current gang. Within this issue of our *Newsletter* you will find the names and majors of all incoming Honors students. I know our current members will do their best to welcome, advise, and **mentor** our new colleagues. We plan a special **welcoming pizza party**—the first event to take place in the all-Honors residence, Van Rensselaer Hall—on **Thursday, September 26th from 4-6 p.m. in the Van R. Ballroom.** ALL Honors students, commuters, off-campus residents, and residents alike, are welcome; all are automatically admitted to Van R. for all Honors events. What a great way to begin the term by getting to know our newest Honors students!

We will also sponsor a full range of co-curricular events arranged by our capable GAs, Sujatha and Aniket, and Gary Miller, the new AD/RD of Van. R. Hall. With colleagues at the Drexel University School of Medicine, we are continuing our Medicine and Culture Series and our Honors Research Forums. **On October 23rd at 4:30 PM,** Professor Yury Gogotsi, Dept. of Materials Engineering, will present his award-winning research: **"Nanotechnology - How it Will Change Your Life."** We'll attend concerts in the new Kimmel Center by the Philadelphia Orchestra and performances of the Opera Company of Philadelphia (through the generous donation of tickets by Drexel alums). And there may be some surprise visitors, as well (details forthcoming). In all, we have a pleasingly full calendar of events for you.

With our largest class of Honors students to celebrate, there will be many opportunities for each of us to learn and contribute. We will look back to past accomplishments and forward to future opportunities as we grow the Program together. Meanwhile, you will find the Honors Center a comfortable place to gather, play chess, study, and exchange ideas. Our traditional concern for maintaining a warm community here and for doing whatever we can to encourage and support your success remains the same. Welcome back!

MARK YOUR CALENDAR!

The Honors Program Fall Term Dinner Will Be Held On Thursday October 24 @ 6pm

Kudos to President Papadakis

-Sujatha Sivakumaran

In 2001,The National Collegiate Honors Council established the Presidential Leadership Award in to honor annually a university or college president of an NCHC member institution deemed to have contributed significantly to the advancement of Honors Education.

The Honors Program is proud to report that this year's winner was Dr. Constantine Papadakis. Winning this award has been a great feat for the Drexel University Honors Program and has also made the entire university very proud of the Program.

Rest assured that with the support of President Papadakis, the able leadership of Dean Greenberg and Toni McMenamin, and most of all, the talented young minds that comprise the student body, this Program is sure to scale great heights.

Co-editors/ Graduate Assistants	Aniket Hirebet Sujatha Sivakumaran
Program Director	Dean Mark Greenburg
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Hispanos en el espacio

Cada año la NASA invita a grupos de estudiantes a volar en el KC-135A, el avión de entrenamiento de cero gravedad para astronautas (también usado para experimentos en ingeniería aeroespacial). Este año la oportunidad fue para dos estudiantes del área de Houston que cursan carreras de ingeniería en la Universidad de Drexel, en Philadelphia, Pennsylvania. Junto a otros cuatro compañeros de carrera, Luly Rodríguez, nacida en Monterrey, México, y Mac Haas, de Houston, diseñaron un experimento para observar el proceso de combustión de la gasolina en gravedad cero.

Title: Hispanics In Space

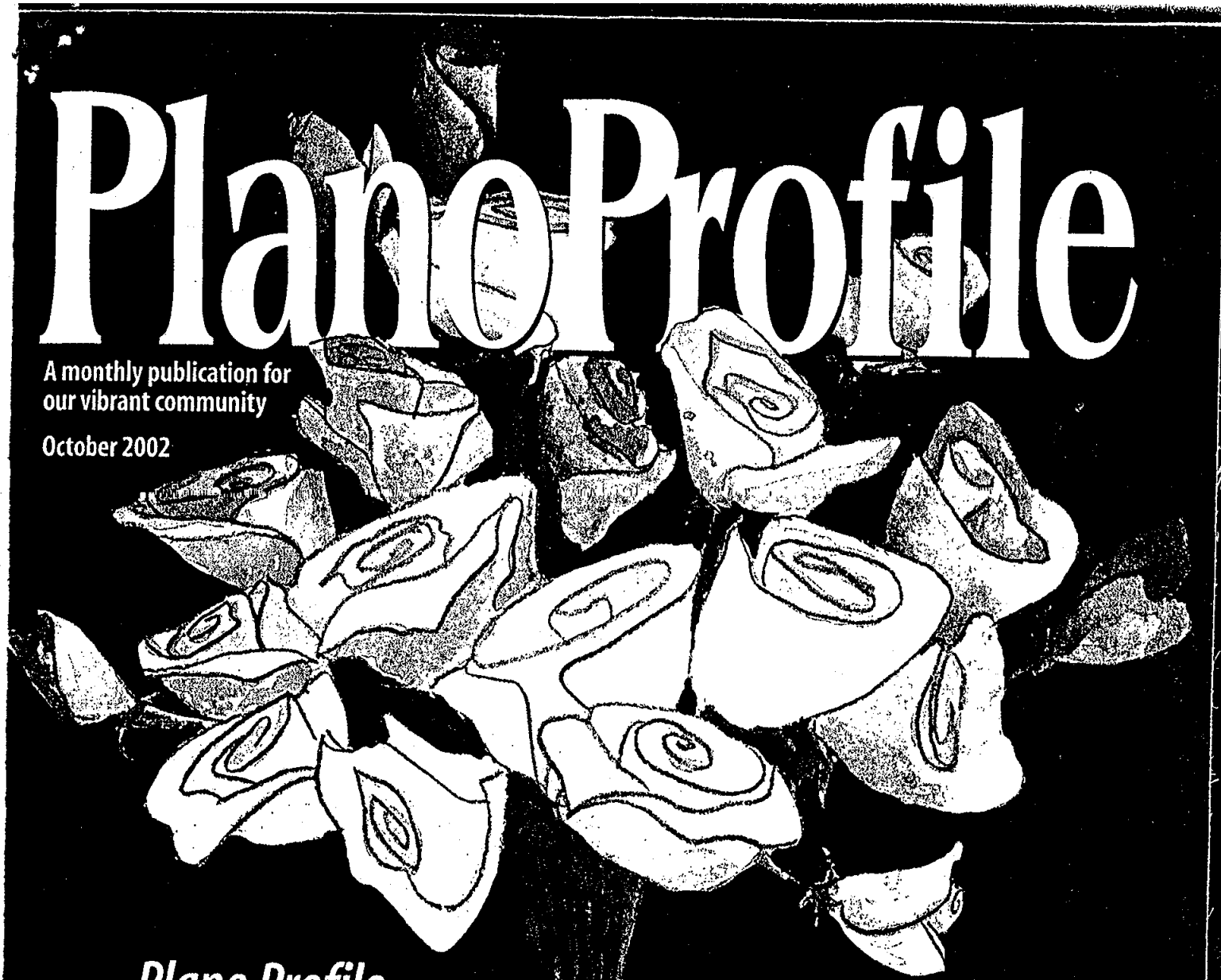
Caption: Each year NASA invites student groups to fly on the KC-135A, the zero gravity training airplane for astronauts (also used for aerospace experiments). This year the opportunity was for two Houston-area students who are pursuing engineering at Drexel University in Philadelphia, Pennsylvania. Along with four other classmates, Luly Rodriguez, born in Monterrey, Mexico, and Mac Haas, from Houston, designed an experiment to observe the process of gasoline combustion in zero gravity.

Semana News Sept. 2002

Plano Profile

A monthly publication for our vibrant community

October 2002



Plano Profile 20 years and counting

The Farmstead Museum

Plano's own little house on the Blackland Prairie

Healthcaring
Showing seniors they care

Interiors
At home on Stonebriar

Dining In
California dreamin'

In Profile
Meredith Shapiro

CELEBRATING 20 YEARS

New features this issue...

Discover delicious dining with the divas

Ready-to-Wear with Linda Kenney

By Heather Darrow

CCCCD team finds zero gravity a plus at NASA

Not many men have an opportunity to share an experience that connects them to their unborn child, but Collin County Community College District student Chris Alley can claim a bond that not many fathers have forged – a simultaneous feeling of weightlessness.

While his unborn daughter floated weightlessly in her mother's womb and his 17-year-old son was on standby to make a quick drive to the hospital, Alley experienced zero gravity in a National Aeronautics and Space Administration (NASA) plane. Alley's NASA excursion was the climax of six months of teamwork on a physics quest for a perfectly shaped metal ball.

The project originated in 2000 when Dr. Mike Broyles, CCCCD professor of physics, got an announcement about the reduced gravity program at NASA. Within days, CCCCD students Eric Wooton, 2000-2002 team leader; Jesse Bennett, 2002 team flight leader; Steven Lawless, Cindi Warnstaff and Florence Yee formed the team that developed the idea to make spherical balls in a weightless environment, one of 10 NASA higher education projects selected from around the U.S. that year. The students learned that there are two conventional ways to make a relatively round ball bearing: grind it into a round shape or drop liquid metal through a tunnel. Neither way produces perfectly round balls. The first way produces roughly hewn balls and is expensive, and the second way produces deformed balls because of the wind resistance on the cooling liquid metal.

"I was proud and amazed at the level of thought and research. They had a first-class research project, and NASA was very impressed too. They were able to do a difficult experiment under difficult conditions. It is not a typical lab setting where you can go and get a soda. Your body is going to be reacting in this kind of environment. It is not a natural kind of thing," said Broyles.

In 2001, the students traveled to NASA bringing with them a three-foot-long by six-inch-wide tube in which the metals balls could form and harden. On the plane, they discovered that the balls did not have a long enough time to harden before they hit the side of the tube so they went back to the drawing board.

A 47-year-old resident of Plano and Texas Instruments technical writer, Alley holds an engineering/physics degree from Texas Tech, but decided he wanted to go back to school to brush up on his physics. In 2001, Alley heard about the NASA physics project in one of his classes at the college and decided to join the team along with new team member Justin McGee.

"Imagine yourself on a roller coaster and when you get to the top there is that split second before you go down. The way you feel when you crest the top of a roller coaster is how you feel just before you are weightless. Once you are floating, it is fabulous. You are grabbing things, and you are moving around and your legs are dangling, and you like it. I did a 'superman'," said Alley.

Chris Alley takes a tumble and Cindi Warnstaff lends a hand aboard NASA's Weightless Wonder V aircraft.

In 2001-2002, the students developed a large Plexiglass, metal-framed box, the maximum size that NASA would allow, to give the balls ample time to travel and cool. The box was equipped with a transformer that heats an electric wire that is wrapped around a large metal syringe. The metal, inside the syringe, is heated to 165 degrees, and when the syringe screw is turned, liquid metal comes out in droplets.

In order to experience zero gravity, the students traveled to the Johnson Space Center at Ellington Field in Houston and flew in the KC-135, affection-

ately named both the "Weightless Wonder V" and the "Vomit Comet." Actor Tom Hanks flew in this same plane while he was filming zero-gravity scenes for *Apollo 13*, and this plane was also used to train all the astronauts before the existence of the space station.

To create a zero-gravity environment, the NASA plane flies in a parabola. The plane travels to 26,000 feet at 510 knots and pulls up to 45 degrees. At 34,000 feet the plane crests the parabola and hits zero gravity and weightlessness for 25-30 seconds before diving at a 15 degree angle, at double gravity, and leveling out at 26,000 feet again.

The students were told to lay down or sit at the beginning of the parabola while the plane was pulling up because it would feel like you were twice your normal weight. Then as they went over the top of the parabola they would float right off the floor of the aircraft. The weightless sensation makes most adults feel and act like young children, leaping, spinning and laughing.

According to Warnstaff, CCCCD physics team member and Texas Instruments technical writer, she is a visual learner and she is glad that all the classes she has taken at the college are hands-on. The zero-gravity project was no exception to the rule.

"In zero-gravity, if I asked you to hand me a cup of coffee, you would just let it go and it would come to me. When you use a sports top to drink water, you squirt out a little bit and it comes out in a bubble, and you can catch it. I wish it could be like that here on earth. You feel heavy when you come down. When I came back down it felt like my toe was here on earth and the rest was in zero gravity. I did not want to get back," Warnstaff said.

CCCC's Cindi Warnstaff (left) and TI's Chris Alley (right) take time for a photo with NASA astronaut Bonnie Dunbar.

At NASA, the students broke up into pairs, went up in the air and completed 40 parabolas per day for a total of two flight days. Astronaut Bonnie Dunbar, who has been on five shuttle flights, flew with the students along with a number of NASA staff and other project teams from universities and colleges around the U.S.

While the experience was exhilarating, the experiment did not go as the students had hoped. Alley and Warnstaff recall several times when they saw metallic balls that looked spherical hit the compartment walls and flatten. The metal still did not have enough time to cool before it hit the walls of the container.

For Alley the highlight of the learning process was the teamwork.

"Once we got to NASA there was an

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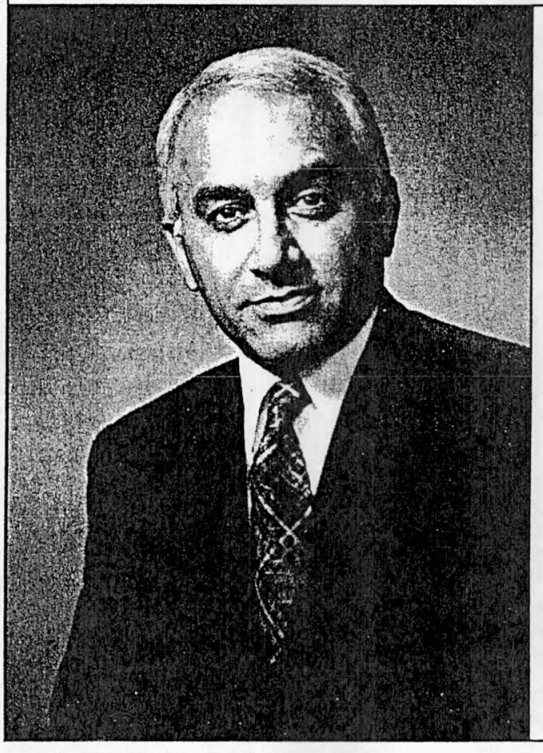

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Cindi Warnstaff has a little fun with the zero gravity aboard the Weightless Wonder V. The plane, also referred to as the Vomit Comet, was used in the filming of Apollo 13 *with Tom Hanks.*

atmosphere of teamwork. I really value this experience. NASA people want you to succeed. We did not really know how to bolt this box to the floor of the plane, and guys from NASA devised a way using runners along the side and under the box," Alley said.

Faculty advisors Broyles; Dr. Jud May, adjunct professor of geology and Paul Johnson, adjunct professor of physics joined with Kevin Starnes, former interim dean of math and natural sciences; Dr. David McCulloch, professor of biology, Dr. Cameron Neal, dean of math and natural sciences and Dr. Sheryl Kappus, vice president of academic affairs, to support the students' efforts.

May, an astronaut want-to-be since childhood said that he wished he had this opportunity as a student.

"They are going to be talking to their children and grandchildren about this. Only a small percentage of the population gets to do this. These students will walk away with a lifetime appreciation for what it means to walk out into the cutting edge of technology. NASA is about exploration. When students can personally witness these things, it makes them realize how important science is and the kinds of things science can do. It is a way of having them project what they can do in the future in science," said May.

After his experience, Alley feels his future is shining bright ahead of him, regardless of his age. He is currently contemplating a career teaching math and science.

"Now, [after taking classes at CCCCD] I think I could become a teacher, and before I was not sure that I could. The confidence is what paid off the most. We need to keep learning. If you sit around and do not learn something new, you will just dry up. Sometimes the material for kids in school is dry, and you do not get fired up about the idea of science. Things need to be fun; students are looking to get into things that are fun," he said.

Being able to tell students stories of the zero gravity he experienced first hand is sure to entice several young minds to consider the fields of math and science.

For more information about science classes at CCCCD, call 972-881-5880. ●

Heather Darrow is a public relations writer for the Collin County Community College District.

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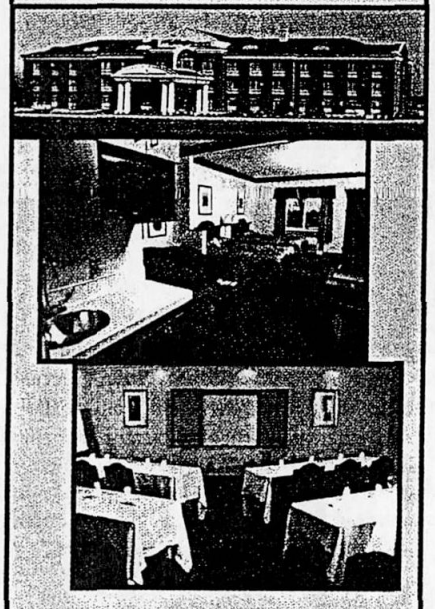

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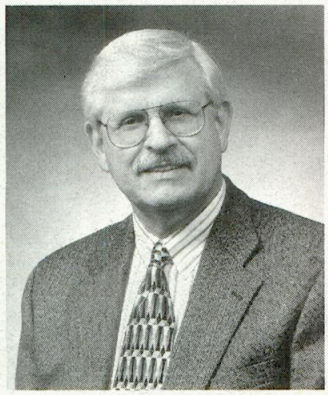
Vol. 11 No. 1
September 2002

Conference speaker to address impact of 9-11 on aviation research

The impact of September 11 on aviation research in America will be the topic of the luncheon address at the 12th Annual Iowa Space Grant Conference on Friday, December 6, at the Iowa Valley Community College District in Marshalltown.



Dr. Herman A. Rediess

This year's luncheon speaker is Dr. Herman A. Rediess, director of the Office of Aviation Research at the Federal Aviation Administration, which he joined in 1996. His current responsibilities include identifying and developing the FAA research and development program, as well as collaborating with other agencies, industry and universities to meet their national airspace system requirements.

Rediess came to FAA from SPARTA, Inc., a small aerospace company where he was vice president and operations manager of their aerospace engineering and systems operation. During his 25 years with NASA, he served as director of research at Dryden Flight Research Center in Edwards, Calif., and managed the Office of Electronics and Human Factors at NASA headquarters. There he worked in research and development programs in avionics, navigation guidance, controls, automation and aviation human factors at NASA centers.

The FAA administrator holds a B.S. degree in mechanical engineering from the University of California, Berkeley, an M.S. degree in aerospace engineering from the University of Southern California, and a Ph.D. in aeronautics and astronautics from M.I.T.

During the one-day conference, ISGC grant recipients will report on their Consortium-sponsored research during concurrent technical sessions, while students who participated in the research projects will take part in poster sessions throughout the day.

For additional information on the conference and how to register, please visit the ISGC website at cosmos.ssol.iastate.edu/isgc/HE.htm or call the ISGC Office at 1-800-854-1667.

ISGC researcher awarded NASA grant

A leading researcher with the Iowa Space Grant Consortium, with the help of a $520,000 grant from NASA, is seeking a better way for scientists to make use of robots to gather data on Mars.

Geb Thomas, assistant professor of industrial engineering in the Department of Mechanical and Industrial Engineering at the University of Iowa, was awarded the three-year renewable grant, along with Nathalie Cabrol, a planetary scientist at NASA Ames, and Robert Anderson, a geologist at the Jet Propulsion Laboratory. Thomas directs the U of I base program, which focuses on robot interface with humans, for the Iowa Space Grant Consortium.

The three principal investigators and Edmund Grin, another geologist at NASA Ames, will formulate mathematical models to connect what scientists want to know about a site—for example, the geologic history of the region—with the capabilities of the robots.

This information will help scientists use the robots more effectively and help mission planners improve the design of future robot missions. Models from the project may be used as early as NASA's 2003 Mars mission, which Cabrol and Grin have been selected to participate in.

"What we're really trying to do," said Thomas, "is provide information that will help scientists use planetary robots more effectively."

Thomas has worked extensively with virtual reality and originally thought that recreating the environment on Mars through three-dimensional graphics would be the preferred way to provide an effective interface between scientists and robots. However, helping to build and evaluate several such systems for NASA convinced him that virtual reality was too broad-brushed.

Instead, Thomas and his colleagues are making an information map connecting how field geologists work on Earth with the capabilities of a robot on Mars.

For example, geologists on Earth can analyze the shape of a dry streambed to determine how fast and how frequently water once ran through that stream. On Earth, a geologist would simply walk to the edge of the streambed and look around. On Mars, moving the robot close to an embankment is dangerous, so the scientists will need to know how far from the streambed they can be and still be able to accurately measure its shape.

Descriptions of the features would form the core of the information

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Director's corner

As hard as it is to believe, it is time to begin the renewal process for the next five-year funding increment of the NASA Space Grant Program here in Iowa. According to NASA headquarters, during the fall and winter of 2002-03, we will undergo an external review and self-assessment report process. NASA hopes to announce the award of five-year renewals in the fall of 2003. This is a serious review, since some states may have to re-compete their contracts. With all of the good work you have done since our last five-year review, we should not be in that situation. I will keep you informed.

These are good times for Space Grant. With the new NASA Administrator establishing education as a core NASA mission, and with the concern over the declining technical workforce, we are in a position to see continued stable funding or increases. However, we must keep the NASA objectives of Space Grant in mind . . . building linkages to NASA Centers and contractors. This will be a continuing, but re-emphasized theme in our strategic plans for the ISGC.

Thanks for your support and good work.

William J. Byrd

William J. Byrd, Director

National SG Foundation chosen to run Education Associates Program

The National Space Grant Foundation, now in its second year, is the prime contractor to manage the NASA Ames Research Center Education Associates Program, a contract valued at $1.5 million in the first year and up to $5 million in the third year.

The Foundation (www.spacegrant.org) is a nonprofit organization whose purpose is to expand and enhance the ability of U.S. colleges and universities to carry out education, research and public outreach activities in science, mathematics, engineering, technology and other space-related fields. Serving as the organization's first president is William Byrd, ISGC director.

To fulfill its goal, the Foundation seeks to increase the financial and governmental support available to Space Grant consortia, to publicize the objectives and activities of the Foundation, and to develop mutually beneficial relationships among private-sector organizations, government agencies, and colleges and universities.

The Education Associates Program, which began in May of 1998, links students and faculty with projects at NASA Ames Research Center (ARC), a field laboratory located in the heart of Silicon Valley. ARC specializes in scientific research, exploration, and applications aimed at creating new technology for the nation. Some of the Education Associates projects involve astrobiology, telemedicine, information technology, aerospace simulation and rotorcraft technology.

"This program offers students valuable experience and new challenges; moreover, the positions are paid and students can receive academic credit," said Byrd. "Best of all, it doesn't hurt to have 'NASA Ames' on your resume."

The program is open to most major areas of study, according to Byrd. The most relevant backgrounds are in the fields of engineering, information systems and communications, space sciences, physical sciences, life sciences, behavioral sciences, mathematics and business.

Students or faculty members at any accredited U.S. college or university may apply. Those who most closely match the required skills and educational background for a given project are selected for further consideration. Assignments may range from two months to a year and are renewable. Compensation is based on level of education and time worked.

For more information about the Education Associates Program, visit the website at http://edassoc.arc.nasa.gov/.

Mark your calendars!

12th Annual Iowa Space Grant Conference to be held in Marshalltown on December 6, 2002.

Details to come on the ISGC website:
cosmos.ssol.iastate.edu/isgc/HI_EDU/12conf/12gen.html

Who to contact

For more information on the ISGC, visit our website: cosmos.ssol.iastate.edu/isgc/, contact the Consortium Office, or your nearest Campus Coordinator:

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The Consortium Comet
is published annually by the Iowa Space Grant Consortium

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Produced by Engineering Communciations and Marketing, College of Engineering, Iowa State University 50011-2153

ISGC scholarship winner looks at ag methods in new ways

Sometimes if a new set of eyes looks at an old way of doing things, all kinds of interesting things happen. That was the case when Chris Nelson of Stuart started considering effective and economical ways to feed cattle.

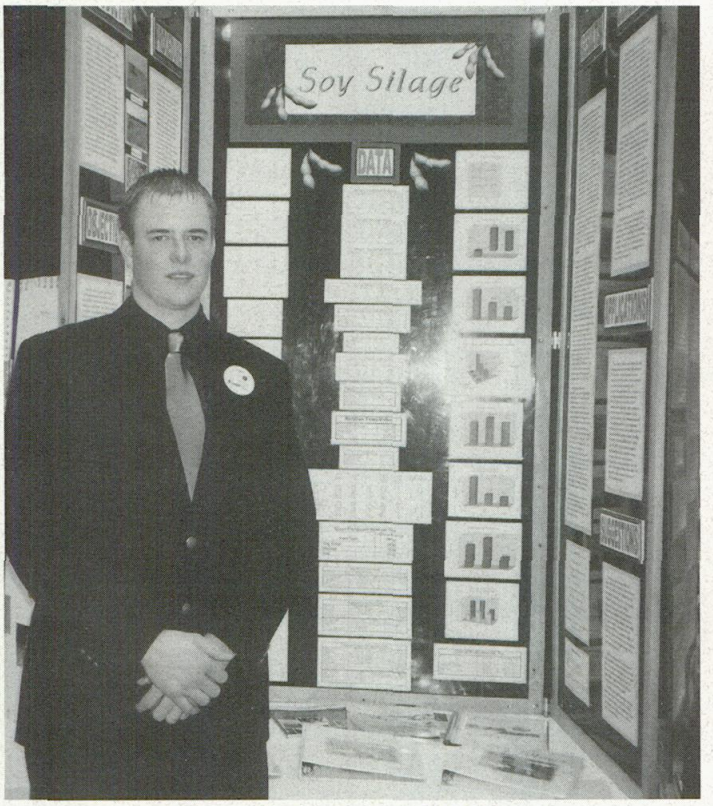
A graduate of West Central Valley High School, Nelson won a $5,000 tuition scholarship from the Iowa Space Grant Consortium for his project "Soy Silage" at the 2002 State Science and Technology Fair of Iowa in Ames this past spring.

Nelson, who has been involved in farming and agriculture his whole life, is interested in finding better ways to do things. He has been competing in local and regional science fairs since his freshman year in high school, and last spring attended the International Science Fair in Louisville, Kentucky. All of his projects have been agriculture-related.

He decided to investigate soy silage because he thought it might provide an economically viable alternative to dry hay. Typically, farmers feed their cattle hay, along with protein and other supplements. Silage is made when the plants still have a high level of moisture.

After e-mailing agriculture professors and feed specialists, Nelson found that no research had been published on soybean silage, only soybean hay. Thus, he decided to do his own research and set out to find if soybeans can be successfully and economically harvested, ensiled, and fed to cattle in silage form.

To test the worth of his idea, he compared the merits of three types of cattle feed: soybean silage, alfalfa silage and alfalfa hay. Each type of feed was given to a group of five cattle. Nelson made the soy silage by baling the immature soybean plants—beans, leaves and all—grown on one acre, wrapping them in airtight bundles and leaving them to ferment for three weeks.



ISGC scholarship recipient Chris Nelson

Over a period of 25 days, Nelson fed each group of cattle one of the three feeds. For each group he calculated such factors as average daily weight gain, consumption intake and nutrient intake, and compared consumption rates to weight gain. Nelson used a bomb calorimeter to determine how much energy would be absorbed from each type of feed.

A nutrient analysis of each type of forage showed that the soy silage was providing all the necessary nutrients. In terms of nutrient intake, or how the cattle used the feed, the soy silage ranked first among the three types of feed, somewhat better than the alfalfa silage but considerably better than the dry hay. (In fact, the cattle in the dry hay group actually lost weight.) Confirming Nelson's hunch, soy silage proved to be an excellent source of nutrition as well as a readily available, economically viable method of feeding cattle.

Nelson plans to stick with his, so far, life-long interest in agriculture this fall at Iowa State University, where he plans to major in agricultural engineering. Beyond that, his plans are open, but they are sure to involve looking at tried-and-true methods with fresh eyes.

New Science Center of Iowa moves forward

The new Science Center of Iowa took some critical steps in June toward becoming a reality. The official announcement of its downtown Des Moines location was made as well as the selection of its architect and contractor. The Science Center is an affiliate member of the Iowa Space Grant Consortium. (Mary Sellers is the Science Center's ISGC representative.)

The $60-million, 100,000-square-foot facility will be built on a roughly 4-acre site south of Market Street between Third and Fifth streets, north of the Martin Luther King Boulevard extension. The goal was to select a site that ensures long-term sustainability and service to the community.

Two architecture firms were selected: Zimmer, Gunsul, Frasca Partnership of Seattle and Brooks, Borg, Skiles Architecture Engineering LLC of Des Moines. Neumann Brothers, Inc., will build the facility.

The capital campaign is scheduled to begin in September of 2002 and construction in 2003. The opening of the facility is planned for 2005.

The new Science Center will feature five galleries that will adapt to Iowa's changing needs and at the same time reflect the latest trends and advancements in science and technology. A large-format film theater will show IMAX films and a Science Adventure Theater will feature live performances.

For early childhood learning, there will be a discovery center and preschool; for educators and students, the Iowa Learning Center.

For more information on the Science Center and its programs, visit the website at www.sciowa.org.

Educational Grants Awarded for 2002-2003

The Consortium awarded three Educational Activity Grants and four Educator Incentive Awards for 2002-2003. The activity grants (up to $1500) are for K-12 educator workshops or curriculum development, and the incentive awards (up to $750) are for individual educators for professional development.

Grant recipients will report on their projects at the Iowa Space Grant Consortium session of the Iowa Science Teachers Conference on October 17 at the Polk County Convention Complex in Des Moines. For conference details, visit http://ists.pls.uni.edu/.

Educational materials produced as a result of the grants will be available to Iowa educators through the NASA Regional Educator Resource Center at Western Hills Area Education Agency 12 in Sioux City (1520 Morningside Ave., Sioux City, IA 51106, 712-274-6000, ext. 6211, chri2000@aea12.k12.ia.us).

The winning proposals are described briefly below. Information on how to apply for the grants is given at the end of this article.

EDUCATIONAL ACTIVITY GRANTS

Elementary School

- Space exploration curriculum development and teacher inservice – *Joy Tweedt, Sixth Grade Teacher, Sawyer Elementary School, Ames*
- Workshop development to provide experiences for teachers using technology to enhance student learning of science concepts – *Stacey Newbrough, Science Consultant, and Patty Achey Cutts, Technology Consultant, AEA 7, Cedar Falls*
- Curriculum development and training in physical science for elementary teachers based on the National Science Education Standards – *Shirley Johnson, Science Consultant, Lakeland AEA 3, Lake Park*

EDUCATOR INCENTIVE GRANTS

- *Ganesh Ganpat, executive director of the Science Station in Cedar Rapids,* selected an educator to attend the Association of Science and Technology Centers annual conference on October 12-15 in Charlotte, N.C., and to share the information via a presentation at the Iowa Science Teachers Conference in Des Moines on October 17, newsletter distribution, and the website of the Science Station.
- *Gail Lynch, fourth grade teacher at Maharishi School, Fairfield,* attended the National Science Teachers Association Conference in San Diego on March 27. In addition to Maharishi School faculty meetings, she will share information at the Iowa Science Teachers Conference on October 17 and at the annual inservice of the Southern Prairie Area Education Agency in Ottumwa in October.
- *Birgitta Meade, science teacher at North Winneshiek Community School in Decorah,* attended the National Science Teachers Association annual conference in San Diego on March 27 and is sharing the information through inservices and ICN meetings with the TEAMS (Teachers Engaged in the Advancement of Math and Science) committee, a group organized by the Science Education Faculty at UNI.
- *Ernest Schiller, science teacher at Central Lee High School in Donnellson,* attended meetings of the American Junior Academy of Science, the American Association for the Advancement of Science, and the National Academy of Science in Boston in February. He is sharing information through discussions with and presentations to fellow educators of the Iowa Science Teachers Section and AEA groups.

HOW TO APPLY

Educational Activity Grants are for proposed activities involving K-12 educators in inservice or curriculum development that correlate with national mathematics or science standards. The activity should be consistent with the objectives of the Space Grant program to enhance science, mathematics and technology education at all levels and to encourage the pursuit of technical careers. Proof of matching funds is required.

Educator Incentive Grants are for educators to attend conferences, courses, Space Camp, etc. Proof of matching funds from the teacher, school system or other organization is required.

Employees of ISGC member institutions or affiliates or any Iowa educators are eligible to apply. Proposals are due in the Consortium Office by December 13, 2002. For complete details on proposal format, visit our website at cosmos.ssol.iastate.edu/isgc/K12.htm for "how to apply for a grant" or contact Jay Staker at 1-800-854-1667, or jstaker@iastate.edu.

E-SET

Who to contact

For more information on the Extension-Science, Engineering and Technology Youth Initiative (E-SET), contact your Iowa State University County Extension Office or:

E-SET Office
Iowa State University
33 Curtiss Hall
Ames, IA 50011-1050
Telephone: 515-294-5738
Fax: 515-294-4443

Jay Staker
E-SET Program Director and
ISGC Associate Director
Telephone: 515-294-8417
E-mail: jstaker@iastate.edu

Steve Truby
E-SET Youth Initiative Specialist
Telephone: 515-294-2078
E-mail: struby@iastate.edu

E-SET is Iowa State University Extension's and the Iowa Space Grant Consortium's Science, Engineering and Technology Youth Initiative. Its mission is to prepare youth for the careers of tomorrow by providing formal and informal educators with professional development inservice and support in research-based experiential learning resources in science and technology.

E-SET staff members are available to come to your school, district, county or area education agency to provide professional development workshops. Staff members are also available to consult on designing science curriculum frameworks and implementing national science standards.

www.extension.iastate.edu/e-set/

IMSTI sends teachers, students to space

More than 200 Iowa teachers took part in a pilot project during the 2001-02 school year to learn how to implement new classroom strategies for math, science and technology. Called the Iowa Math, Science and Technology Initiative (IMSTI), the project was funded by a grant from Space Education Initiatives as part of a larger U.S. Department of Education grant.

IMSTI's centerpiece is an innovative and quality program of Web-based learning developed and maintained by Space Education Initiatives in Green Bay, Wis., according to Jay Staker, ISGC associate director, who coordinated the program. "Using NASA mission data, students conduct space mission simulations and then work with the real data from the missions," he explained.

Students across Iowa were able to take missions to the moon, Mars or the Eros asteroid. The missions are structured so that the students man the stations of mission control and direct their rockets to their destinations. "The students found the simulations realistic and exciting," Staker said.

Instruction was delivered to teachers through workshops. In addition to the 200 participants at these workshops, 33 teachers joined the IMSTI project as pilot teachers who agreed to two days of further training and to evaluate the program's success with their students.

The Space Education Initiatives website also features a portfolio of lessons that can be searched by age, topic or standards. In the pilot-project workshops these lessons, as well as E-SET and Solar System Educators kits and curricula, were demonstrated, and the teachers had a chance to work with the materials.

"The strength of the workshops was the discussion and reflection time teachers had to process how best to use the program materials," Staker pointed out. "Working as an IMSTI team, the teachers were able to develop a strategy to move their classrooms toward inquiry-based learning." The teachers' evaluations indicated that the Web-based lessons and hands-on activities of the IMSTI project did have a positive impact on them and their students.

Staker credits Iowa Lieutenant Governor Sally Pederson, Department of Education science consultant Tony Heiting, Space Education Initiatives, the ISGC and E-SET with making IMSTI a reality. He is seeking funding to continue the program.

What's new? Educator's shopping page

This recurring feature describes what's new in science, engineering and technology curriculum materials and resources and how you can obtain these items/services.

The two programs described below are being added to the E-SET curriculum this year.

Wonderwise: Women in Learning series. Grades 4-6. Kits include videotape and CD-ROM media as well as a printed project book. Each video features a scientist doing and discussing her work, and the activities relate directly to what the scientists do in their work. Nine different scientific fields are included. The kits allow learners to explore science as a discipline as well as learn the excitement of science by doing science. Developed at the University of Nebraska, the curriculum is intended for the classroom but was also written in a 4-H project book format. Iowa was a pilot state, and E-SET Youth Initiative Specialist Steve Truby worked with the UN team to improve the curriculum and delivery. For more information on the kits, visit www.wonderwise.unl.edu. **Wonderwise** materials are available free through your local ISU county extension office.

Global Positioning System. Grades 4-12. Each kit includes ten Brunton compasses, ten Garmin e-Trex GPS receivers, GPS curriculum, compass curriculum, and topographic map software for Iowa. The GPS kits and curriculum, which introduce users to GPS and its applications, were developed and piloted by teachers; Pioneer Hybrid has provided funds for piloting the kits statewide for the coming year. In addition to its value from the scientific perspective, the kit is important for agriculture education. Precision farming has come to rely increasingly on GPS data to make decisions and control applications. The kits are being assembled this summer and showcased through teacher workshops and extension training. They will be available early in the school year. For information on the kits, contact the E-SET office.

Science Station director steps down

Ganesh Ganpat, for five years the executive director of the Science Station in Cedar Rapids, an ISGC affiliate member, resigned his position in June of this year to pursue a career in fundraising consulting. At press time a search for a new director was under way.

"We will miss working with Ganesh but wish him success in his new endeavors," said William Byrd, ISGC director. "The results of his energy and enthusiasm are apparent in all of the dramatic changes that occurred at the Science Station during his time there."

The organization's budget grew from $250,000 to $1.5 million during Ganpat's tenure, and the changes at the Science Station were equally impressive: a capital campaign that raised over $8 million, an addition with a 176-seat IMAX® Dome Theatre, the expansion of the permanent exhibit collection, and an increase in annual visitors from 40,000 in 1996 to 240,000 in 2001.

Ganpat credits the Iowa Space Grant Consortium with awarding a series of grants that helped to sponsor programs and exhibits and with encouraging the Science Station to collaborate with other Iowa museums to improve their collective effectiveness.

The importance of partnership and collaboration was one of the most valuable lessons that Ganpat took away from the Science Station—whether it was working with staff, board members or volunteers or with other not-for-profit organizations.

Ganpat sees a bright future for the Science Station. "The excellent staff and board of directors ensure that the organization will continue to grow and mature," he said. "The strength of the Science Station is the diversity of products it offers."

Space Explorers becomes ISGC affiliate

Space Explorers, Inc., became the Iowa Space Grant Consortium's newest industry affiliate in February of 2002. The company, headquartered in Green Bay, Wis., provides innovative K-12 Standards-based education programs that motivate children to learn through methods of discovery, inquiry and analysis. The programs are delivered through the Internet.

Through Space Explorers education programs, students take an active role in an ongoing space mission, thus preparing them for future study and employment.

"We welcome Space Explorers to the ISGC," said William J. Byrd, Consortium director. "Because of the overlap of our interests and theirs, this is bound to be a mutually beneficial relationship."

To learn more about Space Explorers, Inc., their programs and products, visit their website at http://www.space-explorers.com.

UNI Chemistry students ride NASA's Vomit Comet

The UNI team, Kate Leibold, Kelly Boss, Jon Jansen and Adam Brustkern (left to right), after they passed the Test Readiness Review, a necessary step for flying on the KC-135A

"Awesome!" That was how four chemistry students from the University of Northern Iowa described their ride on NASA's "vomit comet," the KC-135A jet used to simulate microgravity. The students found out about the program through an article in *Chemical and Engineering News*, and the Iowa Space Grant Consortium was one of the sponsors of their trip.

Kelly Boss, Adam Brustkern and Jon Jansen, who graduated in May 2002, and Kate Leibold, a senior, took part in the Reduced Gravity Student Flight Opportunities Program in Houston in April of 2002. They were accompanied to Houston by their adviser Shoshanna Coon, UNI associate professor of chemistry.

The students submitted a proposal for an experiment on the effects of microgravity on the electroplating of copper metal, and their proposal was accepted. Their team was one of 54 nationwide who participated in the program this year.

Before their awesome ride, the four had to undergo two separate days of training in Houston, which included time spent in the classroom and in a hyperbaric chamber. Most of the training focused on an awareness of what happens when the plane maneuvers and lands and safety issues such as what would happen if the plane lost pressurization. Besides viewing a video of other teams in flight, there was no preview of what zero gravity would feel like.

Each team was allowed two flight days so that changes could be made in its experiment, if necessary, after the first flight. Flights last two hours, during which the plane performs 30 parabolas, simulating zero gravity, and then two additional parabolas simulating Martian gravity and lunar gravity. Experiencing weightlessness was "pretty interesting," according to Brustkern. "You're told to lay down and your feet kind of float off the ground during the dive." During the flight, some students were able to perform somersaults with the assistance of crew members.

The students were offered medication to prevent motion sickness, which they gratefully accepted. Boss and Jansen's flight was the seventh "no-kill" flight (when no one got sick) since the student program began 10 years ago.

As far as the outcome of their experiment, the copper did electroplate, but the team plans to do additional analysis on the differences in the surface morphology of the crystals in the samples. Leibold hopes to ride again on the vomit comet, or the "weightless wonder," as it is also known, and plans to submit another proposal in the fall. The other members of the team could return too, but as graduate students, they would be restricted to the ground crew.

Looking back on their experience, the students were impressed that they were in the middle of all the activity rather than being shunted to the side. "The scope of everything going on was huge," said Brustkern. "They tried to get us to see as much as possible."

Other sponsors of the team's trip included Allen Hospital, JB's Pools, the Leighty Foundation, the Intercollegiate Academic Fund, the UNI College of Natural Sciences and Chemistry Department.

ISGC researcher ***continued from page 1***

engine. The team is now at the mapping stage, deciding which of the hundreds of potential observation conditions will be analyzed in detail. The next step will be deciding how to present the analysis during a mission in a way that is useful and not overwhelming. Thomas envisions that the data will be used as a tool for decision making. For example, if during a mission there are competing theories about a geological feature, the information provided by the system will be able to help identify exactly what robot actions will best resolve the scientific debate.

"We hope to demonstrate that this approach is feasible," said Thomas. "Ultimately the work should lead to better science for the same cost." Thomas sees other applications for the approach, which he thinks of as an "intelligence enhancer," a new way to use the computer to focus on specific targets to produce a finite and manageable data set.

And the 2002 winners are . . .

This year's winners of seed grants and cooperative grants and their project titles are listed below. For more information on the projects, as well as how to apply for a seed grant or cooperative grant, visit the Consortium's website at cosmos.ssol.iastate.edu/isgc/.

SEED GRANTS

"Development of a Novel Technique for the Automatic Generation of Dynamic Atmospheric Models"
David Courard-Hauri, Project Manager
Ryan Heule, Student Research Assistant
Environmental Science & Policy
DRAKE UNIVERSITY

"Cellular Mediators of MODS: Neutrophil Priming, Activation and Apoptosis"
LaRhee L. Henderson, Project Manager
Rebecca Bolin, Holly-Marie Duda, Molly Fiedler, Student Research Assistants
Biochemistry, Cell & Molecular Biology
Rebecca Roper, Student Research Assistant
Biology
DRAKE UNIVERSITY
Eric Weatherford, Student Research Assistant
Zoology & Genetics
IOWA STATE UNIVERSITY

"Investigating Bulges, Black Holes and Active Galactic Nuclei with Hubble Space Telescope"
Charles H. Nelson, III, Project Manager
Derek Lamb, Aaron Plasek, Andrew Thompson, Student Research Assistants
Physics & Astronomy
DRAKE UNIVERSITY

"Testing of Satellite Remote Sensing for Analysis of Semi-Aquatic Habitat for Salvage of a Threatened Species"
Fredric J. Janzen, II, Project Manager
Heidi Harms and Ryan Paitz, Student Research Assistants
Zoology & Genetics
IOWA STATE UNIVERSITY
James L. Christiansen, Co-Project Manager
Biology
DRAKE UNIVERSITY

"Development of Robust Control Strategies for Aerospace Systems"
Atul G. Kelkar, Project Manager
Kevin Kruck, Feng Liu and Phil Soash, Student Research Assistants
Mechanical Engineering
IOWA STATE UNIVERSITY

"Application of Hyperspectral Imaging for Remote Sensing of Maize Pollen Shed"
Mark E. Westgate, Project Manager
Amanda McInerney and Alec Otteman, Student Research Assistants
Agronomy
IOWA STATE UNIVERSITY

"Mechanical Responses of Discontinuously Reinforced Aluminum Composites under Multi-Axial Loads for Aerospace Applications"
Lizhi Sun, Project Manager
Derek Skolnik, Student Research Assistant
Civil & Environmental Engineering
UNIVERSITY OF IOWA

"Leaf Orientation in Space: Phototropic Leaf Movements"
Virginia Berg, Project Manager
Jeffrey Church and Thomas Rinehart, Student Research Assistants
Biology
UNIVERSITY OF NORTHERN IOWA

"Geographic Information System Technology Used for Mosquito Surveillance in Northeastern Iowa"
David R. Mercer, Project Manager
Jonathan Eastman and Sara Sheeley, Student Research Assistants
Biology
UNIVERSITY OF NORTHERN IOWA

COOPERATIVE GRANTS

An asterisk(*) following a name indicates the individual is the principal investigator of the project.

"Terrain Sampling Density and Texture Requirements for Synthetic Vision Systems (SVS)"
Thomas Schnell,* Industrial Engineering
Shawn Driscol, Jillian Glow, Marni Seieroe, and Jason Wenger, Student Research Assistants
UNIVERSITY OF IOWA
Tim Etherington
ROCKWELL COLLINS

"A Molecular, Biochemical and Biophysical Study on Piezophilic Bacterial Adaptation to the Deep-Sea High Pressure Environment: Astrobiological Implications"
Jiasong Fang,* Geological & Atmospheric Sciences
Olivia Chan and Eric Muggenberg, Student Research Assistants
IOWA STATE UNIVERSITY
Tonya L. Peeples, Chemical & Biochemical Engineering
Karl Niggemeyer, Student Research Assistant
UNIVERSITY OF IOWA

2003 Grant Announcements

Watch our website: cosmos.ssol.iastate.edu/isgc/ for impending release of application materials for...

- Precollege Educational Activity Grants
- Seed Grants - $10,000 each
- Cooperative Grants - $30,000 each

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Science Station
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The purpose of the ISGC is to coordinate and improve Iowa's future in aerospace science, design and technology and to stimulate aerospace research, education and outreach activities throughout the state. These goals are carried out through the Consortium's program categories of higher education, research infrastructure, fellowships, general public and K-12 education. Through its programs, the Consortium emphasizes training of professionals, especially women and underrepresented minorities, for careers in mathematics, science, engineering and technology. In addition, the ISGC encourages cooperative programs among universities, aerospace industry, and government.

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Support from senior Louisville administrators—including Martin and graduate dean Ronald Atlas, a nationally known bioterrorism expert who helped shape the new law as president of the American Society for Microbiology—has helped the process go "pretty smoothly" on her campus, Watts says. Louisville biochemist Russell Prough says it took him "just a few minutes" to confirm that he didn't deal with any of the agents in his four-person lab. But some scientists chose to avoid greater paperwork by disposing of potentially problematic research materials. "They decided they didn't want to have to fill out the forms," she says.

Overall, Watts estimates that fewer than two dozen Louisville researchers currently work with the regulated agents. Still, the university might develop new policies and rules that govern their conduct in the lab and go beyond current federal rules. There is already talk of a policy that would require a witness to certify that a researcher has properly destroyed regulated materials, for instance. More thorough and frequent laboratory inventories could also become routine, and some labs might have to be remodeled to meet security requirements. "We're not done; this will be a moving target," Watts predicts.

Other universities report similar discussions. Although a half-dozen institutions contacted by *Science* say that the notification process is going relatively smoothly, others report some bumps in the road. At Stanford University in Palo Alto, California, for instance, biophysicist Steven Block thinks that ESH officials have gone way too far in asking researchers to inventory "any and all biological agents and biological toxins that are used or stored" on campus. The request exceeds legal requirements, doesn't inform researchers about potential legal ramifications, and is maddeningly vague, he complains. "Does this mean [I have to report] even house plants or home-brewed beer? How about grad students?" he asks, only partly in jest.

Lawrence Gibbs, Stanford's associate provost for ESH, says the inventory is a "prudent measure" to create a baseline for future biosafety planning. "We don't want to have to poll the faculty every 2 months because of inconsistencies," he explains. Other faculty members applaud his strategy. "The [broader] survey was absolutely the right thing to do," says John Boothroyd, chair of Stanford's microbiology department. "The fewer requests, the better."

Universities are also pondering how to collect and store the information securely. Some have established supposedly hacker-proof Web sites and e-mail accounts. But other schools, including Louisville, are insisting that researchers deliver their signed notification forms in person. "We are not allowing anything to go through mail or e-mail," notes ESH director Karen VanDusen of the University of Washington, Seattle.

Virtually every university official *Science* contacted also voiced concern about unrealistic deadlines. "It is putting the squeeze on everyone," says L. Todd Leasia, director of the office of research safety at Northwestern University in Evanston, Illinois. And Gibbs worries about the uncertainties over how to handle certain classes of agents such as genetically engineered proteins. "The CDC needs to clarify its guidelines," he says.

That's expected to happen in the next few months as government agencies issue policies on a variety of research-related security issues. In the meantime, Watts and her colleagues are preparing to ride out the continuing aftershocks from last year's attacks. "It's certainly given us a lot to think about and a lot to do," she says.

It's also changed the nature of her professional interactions. "I get invited to some pretty high-level meetings now," she says. "Health and safety issues have always been important to universities, but now they are really in the limelight."

–DAVID MALAKOFF

With reporting by Erica Goldman.

UNDERGRADUATE EDUCATION

New Lure for Young Talent: Extreme Research

Science funding agencies are letting students experience weightlessness in hopes of keeping them grounded in science

HOUSTON, TEXAS—Eleven thousand meters over the Gulf of Mexico, Graylan Vincent and Karen Kennell are floating—or diving to Earth in a 3-kilometer free fall, depending on how you look at it. The University of Washington (UW), Seattle, undergraduates are inside a KC-135 microgravity research airplane, running a self-designed experiment in a lab that flies in a sinusoidal wave pattern to mimic the weightlessness of space. The plane belongs to NASA, which doles out a fraction of its flying time to undergraduates looking to experience science on the edge.

Trying to hold himself steady, Vincent, a senior in aeronautical engineering and geology, hits a button on a laptop that's wired to a motor-controlled milling machine inside a Plexiglas cage. A half-inch (1.27-centimeter) drill bit whirs to life and slices through a slab of aluminum. For a few seconds, thousands of silvery shards hover aloft. They move as if in slow motion until Vincent flips another switch that turns on a converted Toro leaf blower, which blows the flecks into a mesh screen and out of the way.

At 8000 meters, NASA pilot Stephanie Wells gently pulls back on the yoke. The

CREDIT: JSC/NASA

On the fly. UW undergraduates Graylan Vincent (left) and Karen Kennell (front right) spend 25 seconds in free fall while running an engineering experiment aboard NASA's "Vomit Comet."

lights dim, and Vincent and Kennell settle onto the floor of the white, padded interior of the Boeing 707. A couple of seconds later their bodies weigh twice normal as the plane pulls up to reverse its fall and climb to the top of its arc. A bell chimes softly, the lights come back on, and Vincent and Kennell get another chance to experience the sensation of weightlessness that only astronauts normally encounter. After a couple dozen of these parabolas, Vincent looks up with a big grin on his face. "This is awesome," he says, bobbing over his equipment. "I can't wait to be on the space station."

It's just the reaction NASA officials were hoping for. NASA, the U.S. National Science Foundation (NSF), and other science funding agencies are expanding adventurous undergraduate research opportunities in the United States and other countries in an effort to encourage students to choose careers in science and engineering. According to NSF's *Science and Engineering Indicators*, the number of U.S.-born students pursuing Ph.D.s in the natural sciences and engineering declined more than 20% in the 1990s, despite the nation's increasingly technology-based economy. Offering undergraduates an inside look at cutting-edge research has long been considered a promising way to stem that tide. And today, research experiences like this trip on the "Vomit Comet" are taking more and more students out of darkened basement labs and into extreme environments.

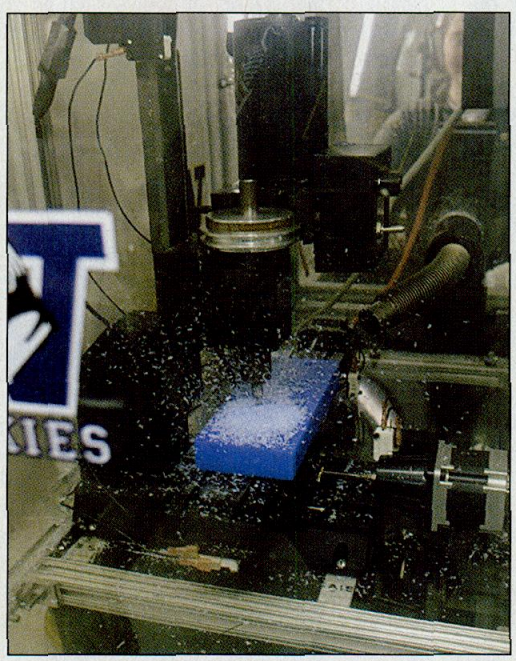
Astronomy students, for example, have an opportunity through NSF to pursue galactic questions at the Cerro Tololo Inter-American Observatory in La Serena, Chile. The agency also sends students aboard oceangoing research vessels and on projects everywhere from Iceland to the South Pole. The Department of Energy offers several research stints, including one at its magnetic fusion facility at Lawrence Livermore National Laboratory in California. And the European Space Agency gives undergraduates access to a weightlessness-research aircraft like NASA's.

According to Karolyn Eisenstein, who directs NSF's Research Experiences for Undergraduates program, there's more to these exotic research projects than adventure: "It's the opportunity to put students in the venue where the science is being done. That gives them an introduction to what the field is really like."

Career boost

Do such programs work? It's hard to know for sure, says NSF's acting director of undergraduate research Norman Fortenberry, because so many factors influence career choices. Nevertheless, he says, many people are convinced that "these experiences elicit interest in science and technology and reinforce students' decisions to pursue careers in these fields."

Donn Sickorez, who heads NASA's student research program, doesn't track the career paths of student fliers. But he does know that none of the 1230 students who have gone through the program since its inception in 1995 has gone on to apply for astronaut training. That's not surprising, because the program is young and so are the alumni. Still, Sickorez says that he has anecdotal evidence that student fliers have stuck with careers in science. "That's our goal," he says.



A cut above. In a high-altitude test of drilling in zero gravity, flecks of blue wax hover around a robot-controlled milling machine until a blower whisks them away.

Joel Lohrmeyer, a member of the UW team who just completed his bachelor's degree, is convinced that his research adventure will lend cachet to his résumé: "It was great for me as someone who is going into the job market." He imagines someone noticing and saying, " 'Wow, he took the initiative to be involved in this competition and has experience with NASA.' " Lohrmeyer sees "a definite benefit."

Not just a joy ride

Setting your heart on joining exotic research projects is problematic, though: They can be hard to come by. Vincent, Kennell, Lohrmeyer, and their fourth teammate, Holly Devlin, spent over a year preparing their experiment. They had to come up with an idea, submit a proposal, pass a competitive peer review at NASA, raise money, design the equipment, put it together, make sure it passed NASA's rigorous safety precautions, and, of course, collect data on the flight—all work for which they received no course credit. "I was determined to get on that aircraft," says Vincent, who first heard about the program in high school. His flight, he says, "was the culmination of 6 years of thinking about it, 2 years of planning, and 14 months of actually working on it. It has been a lot of work. But it was every bit as exciting as I had hoped."

The UW team's experiment, Lohrmeyer explains, was designed to test the feasibility of making precision machine parts in microgravity. A machine shop could come in handy aboard the international space station, where astronauts could use it to make replacement parts long before a spare could be sent from Earth. But weightlessness could raise havoc with the machining process. Whereas shards are pushed to the side of the cutting blade in a normal environment, in weightlessness they might float in the way, reducing performance. The UW team wanted to see if this happened aboard the KC-135. And although the cuts look fine, the UW team is now using a variety of precision metrology techniques to see whether there was any difference between those made at zero gravity (0*g*), 1*g*, and 2*g*.

Not all experiments aboard the KC-135 work out so well. Desiree D'Orazio, a mechanical engineering student at Rowan University in Glassboro, New Jersey, for example, was a member of a team whose experiment didn't go as planned. It was designed to determine whether weightlessness slows the diffusion of heat, a condition that could affect countless pieces of equipment in space. The apparatus consisted of a water-filled tank with a wire inside and a speaker nearby. When heated, the wire generates air bubbles on its surface, which were supposed to be dislodged by the speaker's sound waves. But during the students' flight an electrical connection to the speaker failed, limiting the amount of useful data they could collect. "It was somewhat disappointing," D'Orazio says. "But I learned that complex research experiments rarely work the first time."

All is not lost. D'Orazio says she and her team will likely propose a modified experiment in the fall. "I definitely want to try this experiment again next year," she says—not just for the data, but for another shot at being weightless. "It was better than anything I could have imagined." Vincent, too, says his team might consider submitting a revised proposal on its experiment. Then again, he says, he might look for another adventure altogether: "I might have to see if I can get on one of those oceanography research programs."

–ROBERT F. SERVICE

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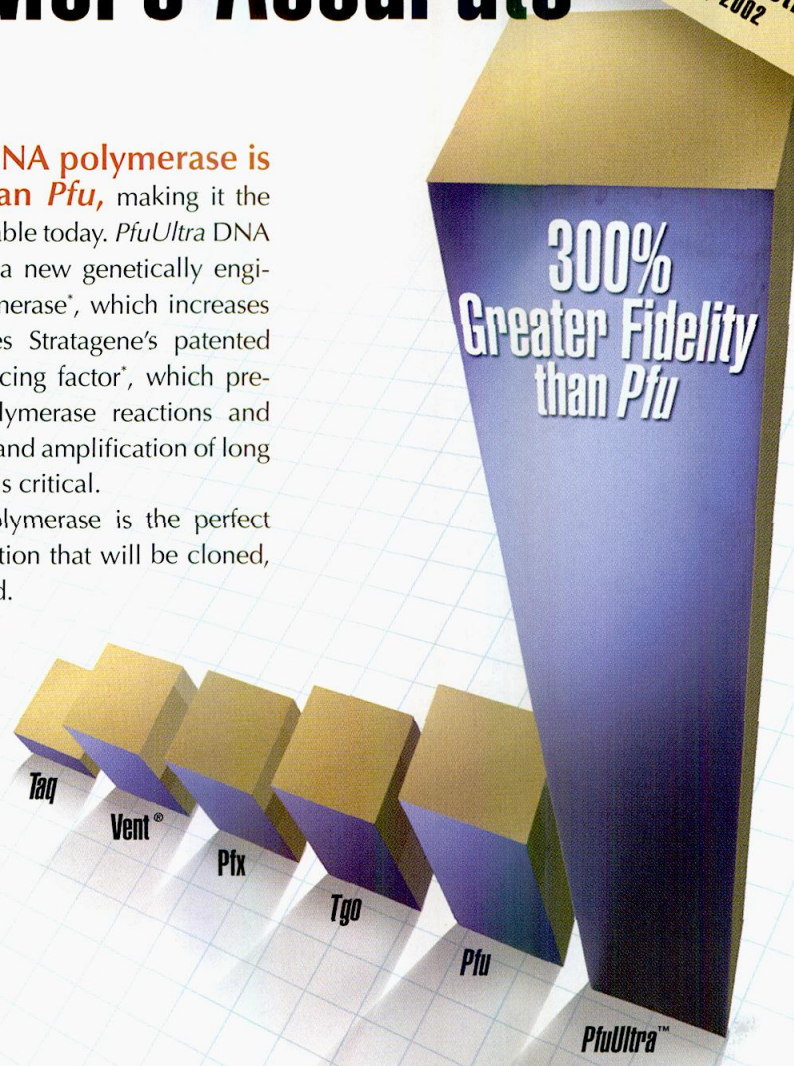

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AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Weightless Wonder

David Murphy's team of engineers was selected by NASA to fly their experiment aboard the Weightless Wonder.

by David Murphy
University of Alabama, Birmingham

Most children dream of experiencing weightlessness.

They imagine the thrill of being astronauts, floating through space and being released from gravity's chains. As they grow up, most kids give up these daydreams as they pursue more "practical" interests.

Words cannot adequately describe the feeling of being completely free from gravity, but as I floated off the floor and up the padded airplane wall for the first time, I will say that a pure euphoria overcame me. I was soon engrossed by our experiment. It was amazing to be the first human to see this type of flame burn in microgravity.

Imagine my delight when I found out about NASA's Reduced Gravity Student Flight Opportunities Program (RGSFOP).

This program allows teams of undergraduate college students to propose, design and build a reduced-gravity experiment over a six-month period. These projects are then flown aboard the KC-135 aircraft, also known as the "Weightless Wonder."

This airplane permits the student researchers to experience 20-25 second periods of microgravity (weightlessness) by flying up and down in a series of parabolic maneuvers. This occurrence is similar to the floating sensation you feel for just a second when you crest a hill on a roller coaster. On the KC-135, however, the "hill" is 8,000 feet high.

The KC-135 has been used for everything from training astronauts to making movies. In fact, all of the "zero g" scenes in the movie "Apollo 13" were filmed aboard this aircraft.

During my sophomore year, I joined a team of three other mechanical engineering students from the University of Alabama at Birmingham to submit a proposal to the RGSFOP. We wanted to study the effects of microgravity on a special type of flame called a laminar slot diffusion flame. As no one had ever seen how this type of flame behaved in zero g, it was extremely exciting to be involved in this cutting-edge research. This type of research is important because it can yield a deeper understanding of combustion.

Such understanding is important because combustion, especially that which occurs in fossil fuel power plants, provides the electricity that powers our nation.

Research in flame properties could eventually lead to new and more efficient combustion-related technologies.

As a student engineer in the research and environmental affairs department at Southern Company, one of the world's largest power-generating companies, I am constantly aware of the importance of developing new technologies that will squeeze every last watt from a fuel source. A more efficient combustion method would conserve natural resources, save money and minimize the harmful emissions released into the atmosphere.

With such ambitious goals, the project itself was a mammoth undertaking. Our team worked for many months to design, build and test the experiment. Many obstacles, including budget constraints, design changes, equipment failures and multiple flight date delays, were faced and overcome.

One major concern was safety. NASA officials, quite understandably, were worried about letting our team burn an open flame aboard the aircraft. Eventually, the multiple safety features we designed were deemed sufficient protection against any hazard.

In March of 2001, our team joined 11 other teams from across the country at Ellington Field in Houston, TX, to finally fly our experiment aboard the Weightless Wonder. Before we could fly, though, we had two more obstacles to overcome: physiological training and Test Readiness Review.

The physiological training was done to give us a condensed course in what happens to the human body at high altitudes and to teach us about motion sickness (after all, another nickname for the KC-135 is the "Vomit Comet"). I'm glad to say that my team passed with flying colors.

Test Readiness Review was the final inspection of our experiment by a group of NASA engineers to ensure its safety. Our multiple safety features paid off, as the reviewers came away impressed by our design and foresight.

Flight day dawned at last. Our project was ready to go, but was I? Imagine my nervousness as I buckled into my seat on the legendary Weightless Wonder. After all, this was only my second time to fly on an airplane!

Minutes after takeoff, we were allowed to leave our seats to attend to our experiments. We soon began the parabolas.

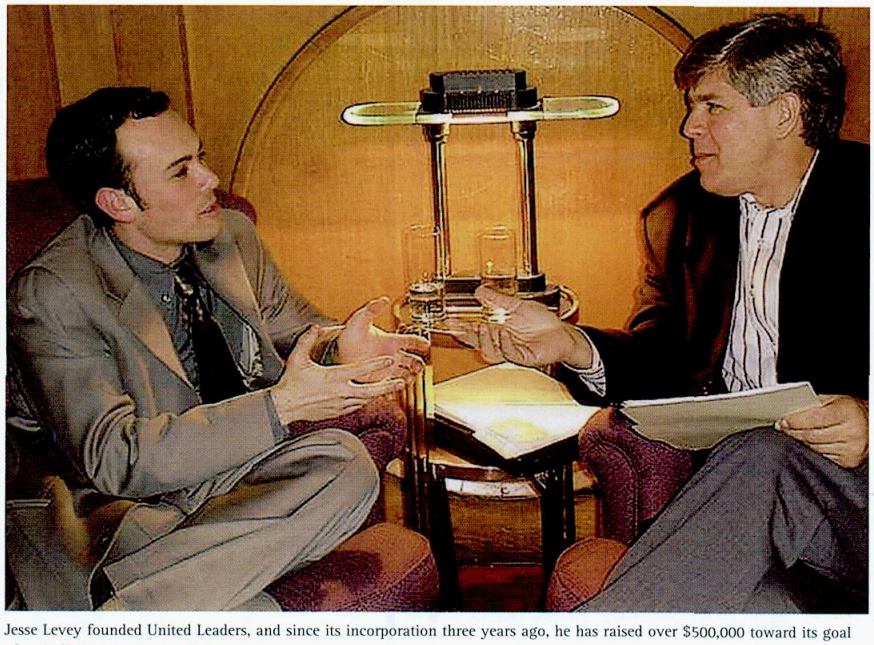
Words cannot adequately describe the feeling of being completely free from gravity, but as I floated off the floor and up the padded airplane wall for the first time, I will say that a pure euphoria overcame me. I was soon engrossed by our experiment. It was amazing to be the first human to see this type of flame burn in microgravity.

In all, the simple delight of briefly being free from the bonds of gravity and the tremendous success of our experiment were more than ample return for the many hard hours and late nights spent working on the project. I can truly say that NASA's Reduced Gravity Student Flight Opportunities Program is one of the most unique and exciting opportunities available to college undergraduates.

It has certainly been my most valued experience thus far in my college career and has taught me the value of leadership, teamwork and, especially, determination.

Why Not?

by Jesse Levey
Tufts University



Jesse Levey founded United Leaders, and since its incorporation three years ago, he has raised over $500,000 toward its goal of revitalizing American politics.

During this period, I founded United Leaders, a growing and successful social-action tank, to re-engage my generation and connect traditional forms of service and political service.

"Some people look at how things are and ask, 'Why?' I dream of things that never were and ask, 'Why Not?'"
— Robert Kennedy

My career as a social entrepreneur started at the age of 4 at Echo Park Day Care, where I organized my class to protest the unfair nap policy.

Although I had already stopped taking naps, a dictatorial preschool environment forced me to waste time lying on my cot for one hour each day. Surprisingly, my teachers did not understand that, in a pluralistic preschool, students progress at different stages.

I knew the risks were great. I could be punished for my disobedience, or even worse, they could call my mother.

As the nap bell rang, the children at Echo Park Day Care Center, some of them still in diapers, stood atop cots and chanted, "No naps at school. No naps at school." That day, I learned that one person can envision change, work for it and see it through.

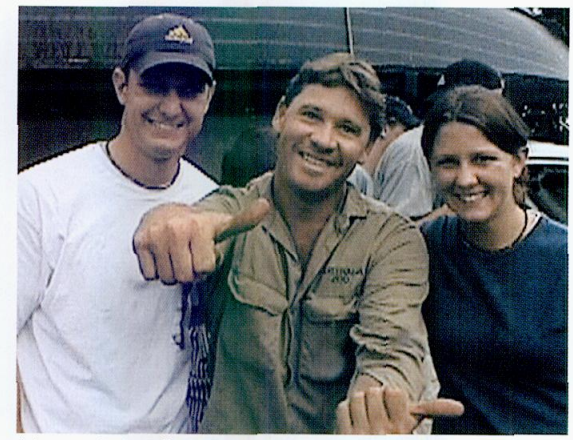
To me, an entrepreneur is someone who assumes personal risk to build a venture and creates a new way of thinking in a sector. I make a distinction between two types of innovators: entrepreneurs and social entrepreneurs.

A social entrepreneur is someone who attempts to solve societal problems through the public sector and introduces a new way of thinking. A social entrepreneur further seeks to address problems at the root and often identifies a problem before it exists.

The spring of 1999 was an ugly, gut-wrenching time in American politics. The close of the Clinton

OUTSTANDING MEMBERS

Traffic in Nepal



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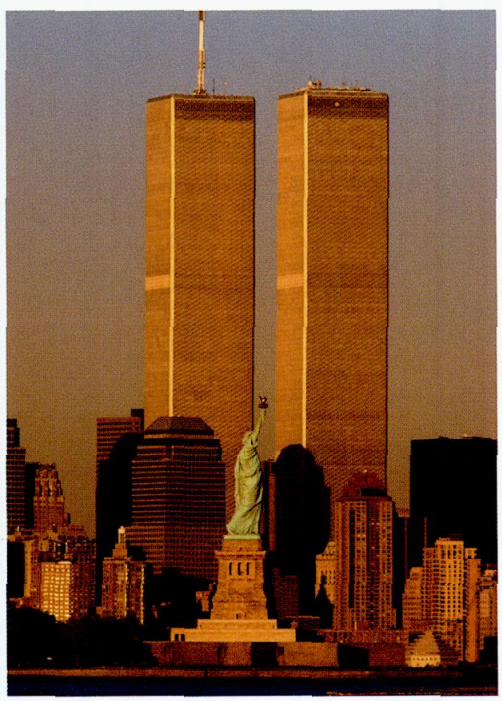
The Society recognizes excellence in works of fiction, non-fiction, poetry and feature writing through this academic program. The four entries in this section showcase the literary talents of Golden Key members.



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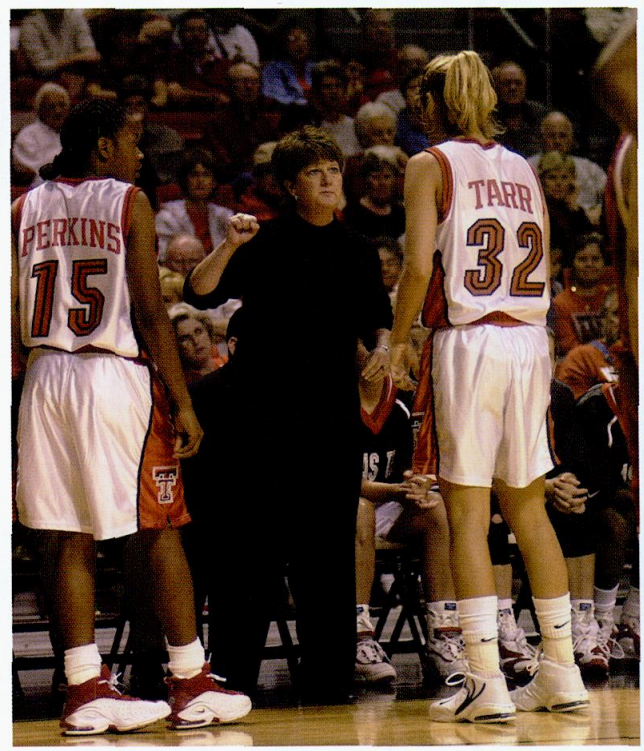

Sharp Shooting

About the Magazine

CONCEPTS is one of the Society's most popular benefits of membership. This award-winning magazine offers tremendous opportunities for Golden Key members to be published. Members are encouraged to submit high-quality articles in any of the following categories: outstanding members, features, chapter activities or honorary members. All articles MUST be between 500-1,000 words in length and MUST be accompanied by quality, color, action-oriented photographs to be considered for publication. Deadlines for submission for North American chapters are November 15 and March 15. Deadlines for Asia-Pacific and South African chapters are May 15 and October 15.

To receive your free copy of CONCEPTS, be sure to update your records with the Golden Key International Headquarters. You can do this by visiting the Society's web site at http://goldenkey.gsu.edu and e-mailing our web master or by calling the international headquarters at 1-800-377-2401 or the Asia Pacific headquarters at (61) 2 9519 1696. When you update your records, please be sure to mention that you would like to receive the current issue of CONCEPTS.

CONCEPTS

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This section provides a forum for the Society's most progressive thinkers. Topics range from terrorism to travel. Although the authors' views do not necessarily represent those of Golden Key, they do offer insight into the minds of its members.

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Golden Key members serve their universities and their communities in a variety of ways. This section highlights successful activities which are performed around the world and which range from youth mentoring and protecting the environment to academic programs and global consciousness. The Society commends the chapters as well as the individual members who participate in these worthwhile projects.

CONCEPTS

About Golden Key International Honour Society

Golden Key International Honour Society is a world-class academic honors organization with chapters at more than 300 colleges and universities in Australia, Canada, Malaysia, New Zealand, South Africa, the United Kingdom and the United States. In 25 years, the Society has recognized more than one million juniors and seniors in the top 15% of their class, in all fields of study.

As an academic honors organization, the Society focuses on recognizing and encouraging scholastic achievement and excellence in all undergraduate fields of study, however, its mission is much broader than that of traditional honor societies. Golden Key also unites with college faculty and administrators in developing and maintaining high standards of education; it provides economic assistance to outstanding members by means of both undergraduate and graduate scholarships; it promotes altruistic conduct through voluntary service; and it is the first honor's organization in the world dedicated to providing career assistance to its members.

CONCEPTS

Published annually by
Golden Key International Honour Society

Editor: Kali Kirkham Boatright
Printer: *Seiz Printing*

Special Thanks:

Fatimah Bashir
Pam Davis
Mary de Villiers
Marci Farmer
Lynette Kirkham
Forrest Knowles
Jessica Miller
Sandi Owens
Bob Sheppard
Sara Schwittek
Tom Treglown

2002-2003

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Membership in Golden Key rewards excellence for a lifetime, and benefits include the following:

- Academic Recognition
- Scholarships and Awards
- Career Assistance
- Publications
- Leadership Training and Opportunities
- Community Service Activities
- Alumni Chapters

Golden Key was founded at Georgia State University in Atlanta, Georgia, USA, on November 29, 1977 by a group of highly motivated undergraduate students. In the last 25 years, the Society has established itself as a positive force in higher education. More than 13,000 honorary members, including world leaders, public servants and Nobel Prize winners, are proud of their association with this dynamic organization.

The Society is governed by a board of directors, a council and delegates to the international convention. Most recently, Alexander D. Perwich II was named by the board to lead a trained, professional staff which is dedicated to serving the chapters and the members throughout the year.

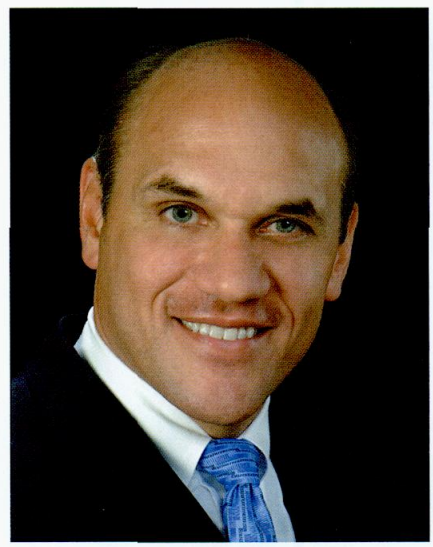
The naming of Perwich as executive director demonstrates Golden Key's commitment to future growth as the organization celebrates its 25th year.

"We are most impressed with Mr. Perwich's unique blend of experiences in the public, academic and private sectors," said Di Yerbury, chair of the Golden Key board and president of Macquarie University in Australia. "He has a 23-year track record as a high-impact leader and change agent with an outstanding record of building world-class, strategy-focused teams and organizations."

Perwich served as an active member of the United States Army for 20 years, mentoring and developing several generations of U.S. military leaders, and retired with the rank of lieutenant colonel.

His academic career includes a three-year assignment at the United States Military Academy at West Point, where he served as an assistant professor of economics. He holds an MBA with distinction from Harvard University and a bachelor's degree with honors from West Point.

Most recently, Perwich served as chief operating officer of a Houston-based chemical company where he was responsible for management of the company's affairs including manufacturing, sales and marketing, business development and corporate financial oversight. Perwich also served as president of a "dotcom," global, business-to-business marketplace for the water industry in the United States, Canada and the United Kingdom.



Alexander D. Perwich II, Executive Director

"I am honored to serve Golden Key as the Society begins its second quarter century," said Perwich. "I am committed to providing Golden Key the purpose, motivation and direction necessary to accomplish its mission and to improve the organization, and I look forward to hearing from our members and advisors whose input will be the impetus for change."

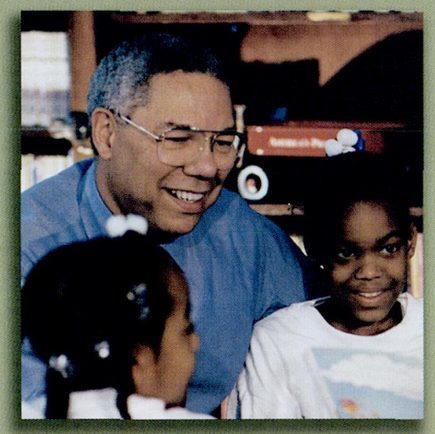
U.S. Non-profit Status:
Golden Key International Honour Society is a non-profit organization *under Section 501(C)(3) of the Internal Revenue Code. The Society is* exempt from federal income tax and is not subject to any excise taxes under Chapter 42 of the Code. Donors may deduct contributions to Golden Key as provided in Section 170 of the Code. Bequests, legacies, transfers or gifts can be accepted by the Society and are deductible for federal estate and gift purposes if they meet the applicable provisions of Section 2055 and 2522 of the Code. The international headquarters has developed two scholarship funds: one for undergraduate students and one for graduate students. We encourage any contributions that can be made to further the education of our outstanding members. The board of directors is responsible for ensuring that Golden Key is operating as a non-profit organization, for the well-being of each of our members and for the continued development of the Society. Golden Key values the richly diverse heritage of its members and the constitution strictly prohibits discrimination on the basis of race, color, sex, religion, national origin, physical disability, age, sexual orientation or social status.

Golden Key International Honour Society

TWENTY-FIVE YEARS OF REWARDING EXCELLENCE

Since its founding 25 years ago, Golden Key has communicated with its members through its publications. CONCEPTS, the Society's annual magazine, was first published and sent to all members in 1978. The Society has always relied on its outstanding members to submit articles for CONCEPTS. Today, each chapter is required to submit two articles per year to ensure the magazine's award-winning quality.

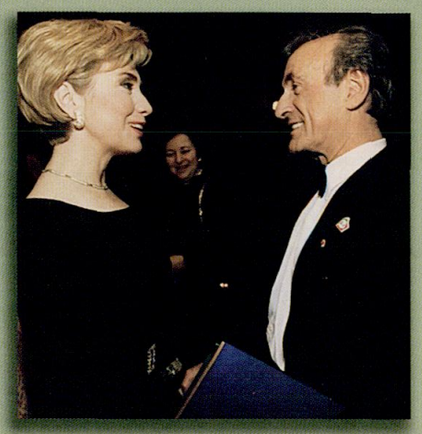
The first issue of CONCEPTS was the size of a newsletter and included information on upcoming receptions, scholarships and chapter information as well as essays on personal development and current events. As the organization has grown so has the publication; yet, it continues to reflect the excellence of Golden Key's activities, student members, alumni and honorary members. Beginning in 1981, the cover of CONCEPTS has highlighted some of its many distinguished honorary members.



2000-2001: Colin Powell

"The speaking circuit really introduced the whole country to me. In all that success, I saw kids who were still very much in need. You think the country's great, but then a teacher tells you that her children weigh less on Monday morning than they do on Friday afternoon; and I say, 'We can do better than that in this country.'"

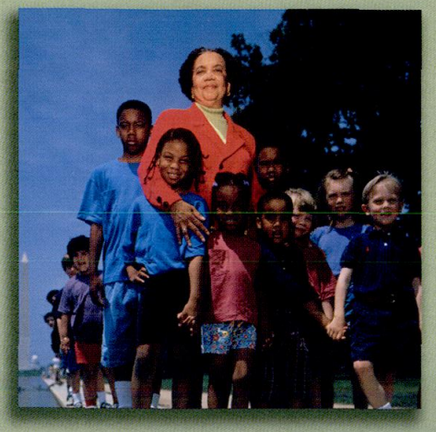
After the 1997 President's Summit, Powell was appointed the first chairman of America's Promise, a non-profit organization dedicated to the five basic elements children need to be successful: an ongoing relationship with a caring adult, safe places and structured activities, a healthy start, a marketable skill through effective education and the opportunity to give back through community service."



1996-1997: Elie Wiesel

"Young people today are more interested in the subject (of the Holocaust) than their parents when they were young. So, they will continue. Furthermore, there is a vast amount of documentation. This is the most documented tragedy in the world — in history. There are millions and millions of pieces of evidence. In general, I don't believe that memory can be erased. It comes back. It can vanish for a generation ... but it comes back."

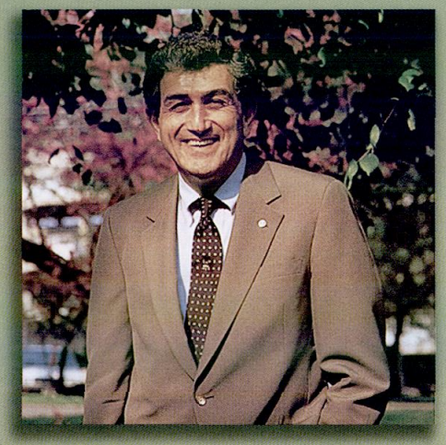
Holocaust survivor and Nobel Peace Prize recipient Elie Wiesel is one of the best-known authors in history, writing fiction, non-fiction, plays, short stories, essays, lectures and a cantata. His first book *Night* recounted his experiences during the Holocaust, and is still required reading in many high schools.



1998-1999: Marian Wright Edelman

"I am absolutely convinced that children are the moral and economic Achilles heal of this nation, and that is the seed of our destruction .... Our goal is to educate the nation about the needs of children and to encourage preventative investment in children before they get sick, drop out of school, suffer family breakdown or get into trouble."

Marian Wright Edelman, founder and executive director of the Children's Defense Fund for more than 25 years, works tirelessly to meet the needs of all children, particularly the needs of poor, minority and disabled children.



1987-1988: Dr. John DiBiaggio

"I view Golden Key as vitally important to our university (Michigan State University), for it promotes participation and quality performance. As important as the intellectual pursuits is that Golden Key gives back to the community. Every major leader I meet, regardless of what forum, has inevitably been involved in activities in college."

Dr. John DiBiaggio was the son of immigrants from Italy and was the first in his family to attend college. DiBiaggio's academic career includes time as assistant dean at the University of Kentucky, as dean of the School of *Dentistry at Virginia Commonwealth University and as the* executive director of the medical center at the University of Connecticut where he eventually became president. Dr. DiBiaggio assumed the presidency at Michigan State University in 1985. He completed his career by retiring from the presidency at Tufts University.

1993-1994: Dr. Johnetta Cole

"If you ask me what I think is the greatest stumbling block to moving ahead in our country, I would say that we seem to be disinterested or incapable of understanding each other's reality. You don't have to go to the same movies all the time. You don't have to read books that come out of a strictly anglo-saxon stream of experience all of the time. We can get up under each other's skin by how we move, read, think, etc. If we have to wait until every man turns into a woman to understand women's issues, then I guess we aren't going to make much more progress."

Dr. Johnetta Cole is known as one of the most influential women in America. She served as the president of Spelman College from 1987-1997 and became well known for fund raising after securing two of the largest gifts ever given to a historically black institution. Dr. Cole or "Sister Pres" as she was affectionately known to Spelman students also served as the head of one of President Clinton's "cluster" teams charged with scrutinizing federal agencies for problems and effectiveness.

1991-1992: Elizabeth Dole

"I don't know if I can pinpoint one person or one moment that influenced my decision to seek a career in public service. As an undergraduate at Duke University, studying political science and serving as student body president sparked my interest in a public service career. But, it really was a decision that evolved over time. As I searched for my place in life, I knew that whatever I did, I wanted to make a difference ... a positive difference ... in the lives of others. Public service offered that opportunity, as well as the challenge of tackling some of the challenging issues of our time."

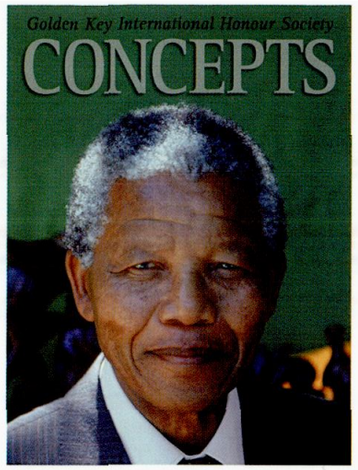
Elizabeth Dole has always been determined to succeed. She served under every president from Lyndon Johnson to George Bush and made her name known in the areas of education, trade regulation and consumer interests. From 1991-1999, Dole was president of the American Red Cross and has dedicated her life to at-risk youth championing causes such as gangs, teenage pregnancy and underage alcoholism.

1989-1990: Alex Haley

"My concern, or apprehension — even alarm — about the direction we're heading is far broader than black and white. It's that the ozone may be irreparably damaged. It's that ... in global terms, our ecology is being mutilated. The results of these things are not going to be directed toward black or white, or purple or polka-dotted peoples. It will be directed at human beings. The racial thing is something we perpetuate upon each other. It means utterly very little in the scheme of things."

It took years before Alex Haley was finally published, but he is now remembered as one of the best authors who ever lived. Alex Haley's first book, *The Autobiography of Malcolm X,* is still required reading in high schools and colleges, and his Pulitzer-Prize winning *Roots* has been translated into 37 languages and is well known as an award-winning TV miniseries.

CONCEPTS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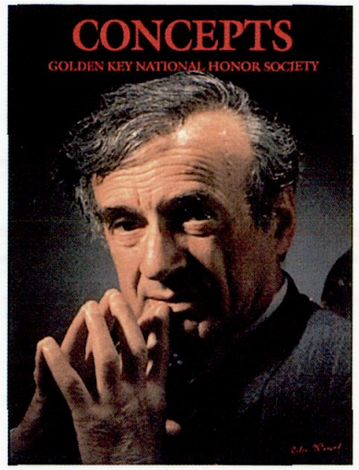
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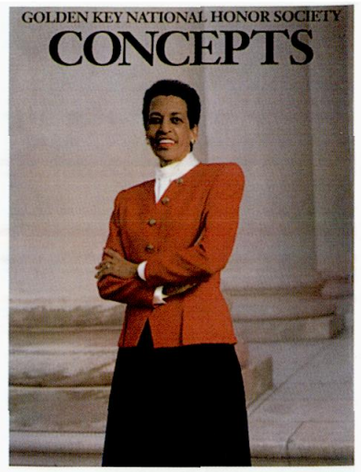
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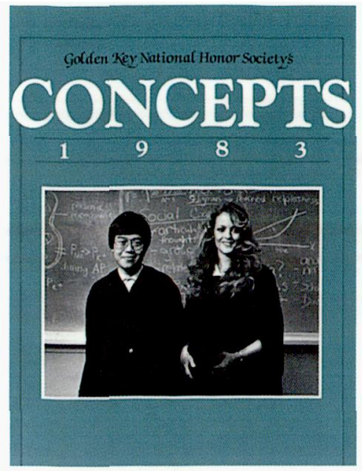
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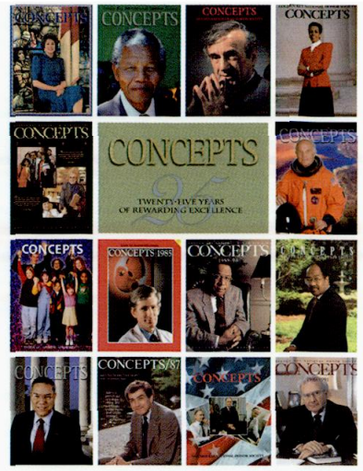
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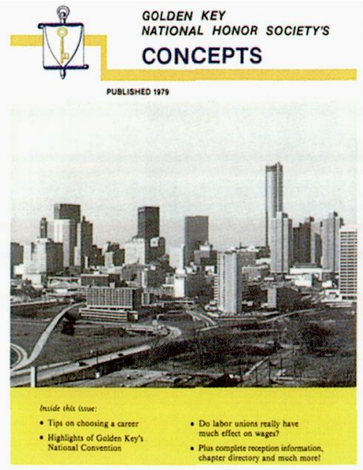
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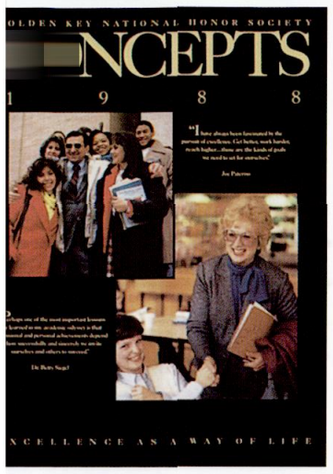
PUBLISHED 1979
Inside this issue:
• Tips on choosing a career
• Highlights of Golden Key's National Convention
• Do labor unions really have much effect on wages?
• Plus complete reception information, chapter directory and much more!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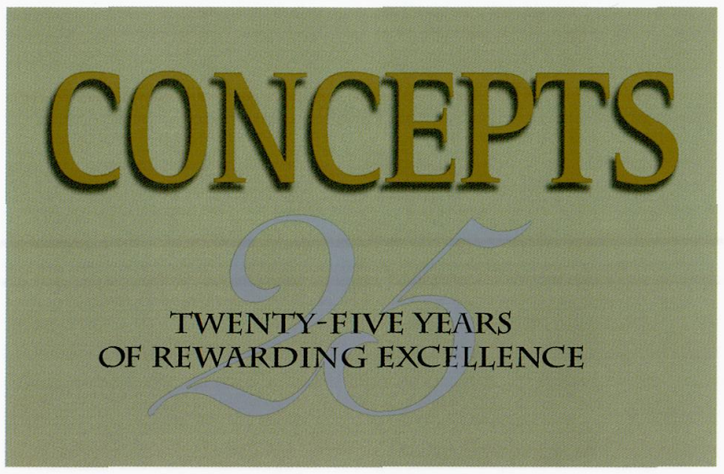
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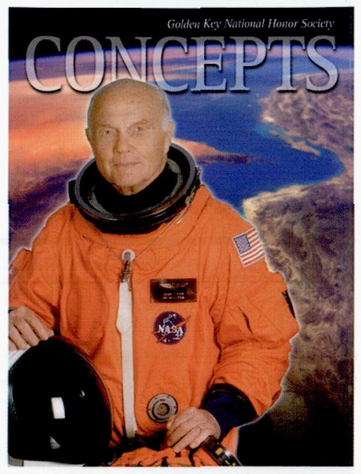
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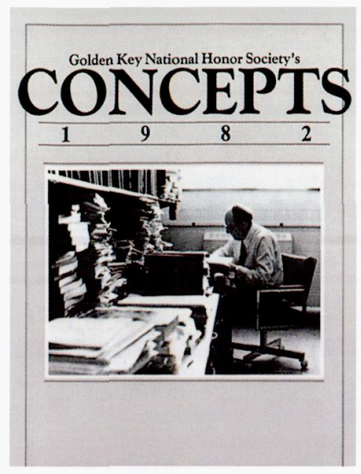
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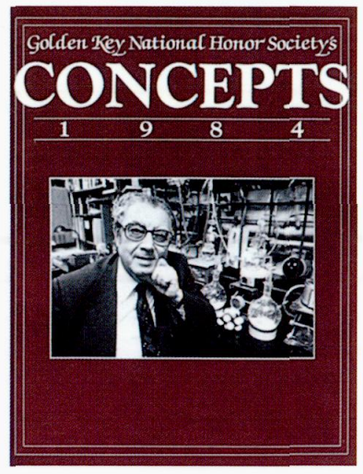
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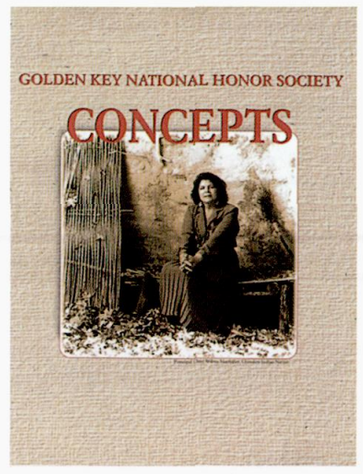
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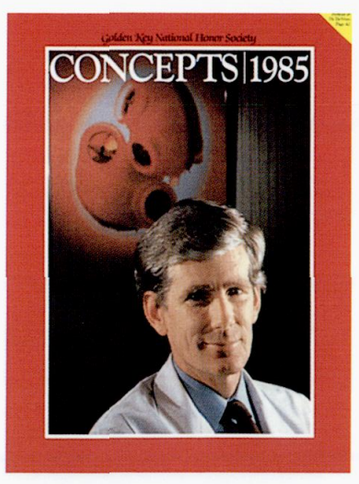
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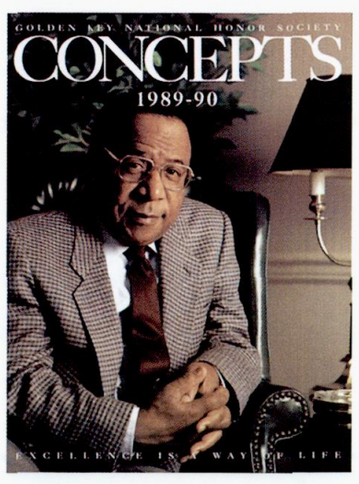
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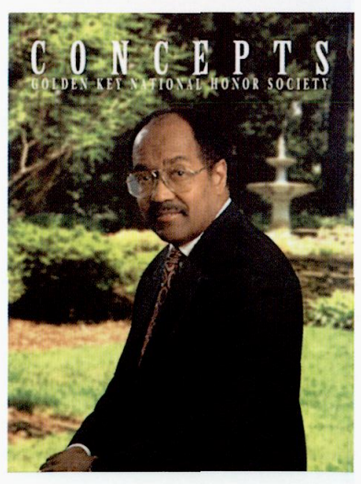
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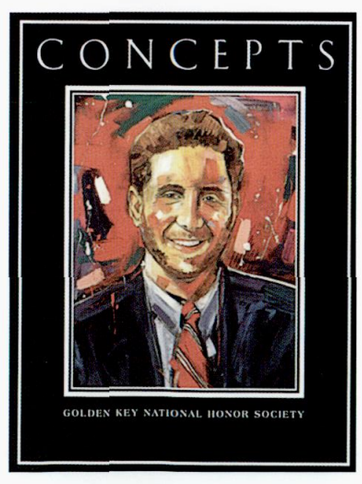
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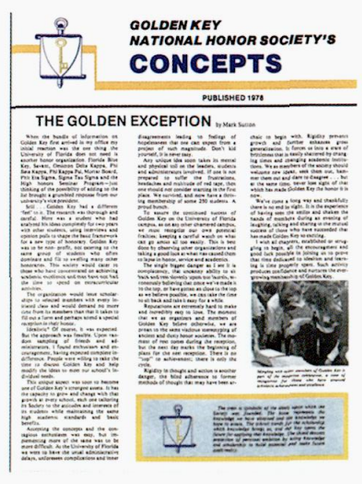
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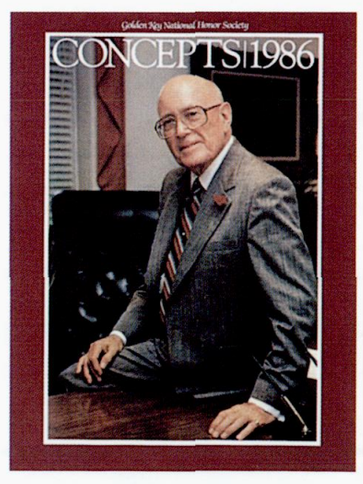
THE GOLDEN EXCEPTION by Mark Sutton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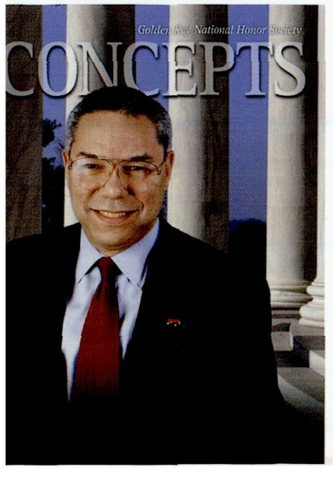
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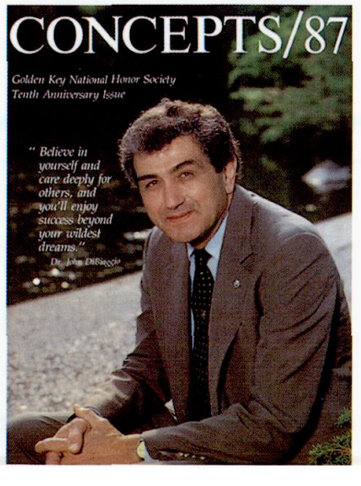
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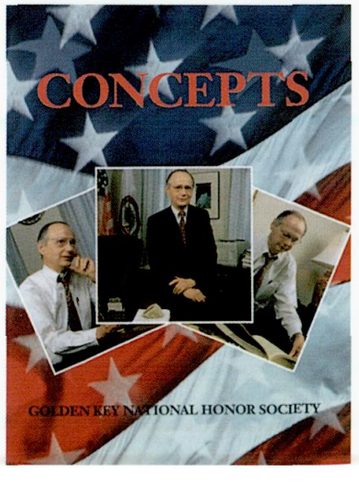
Golden Key National Honor Society
Tenth Anniversary Issue
" Believe in yourself and care deeply for others, and you'll enjoy success beyond your wildest dreams."
Dr. John DiBiaggio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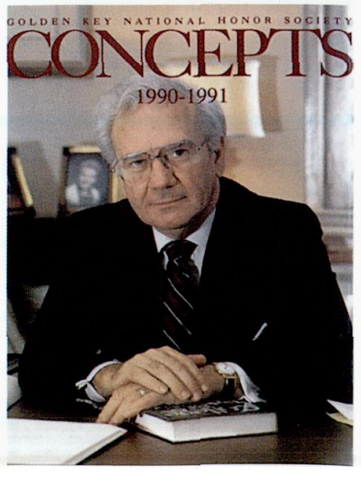
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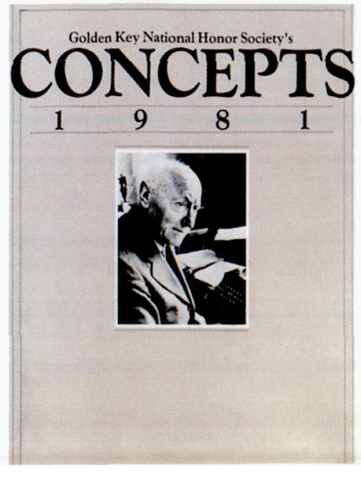
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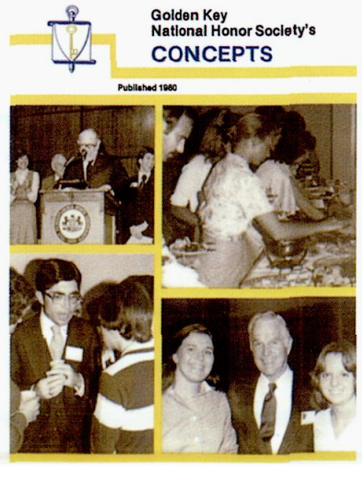
Golden Key
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GOLDEN KEY
INTERNATIONAL HONOUR SOCIETY
25
Anniversary

FEATURES

The Machine grinds into Sloss Furnace, **page 5**

House blends at Highland Coffee House, **page 6**

The University of Alabama at Birmingham student newspaper

Kaleidoscope

Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
T-Storms Hi: 89° Lo: 69°	T-Storms Hi: 91° Lo: 70°	T-Storms Hi: 91° Lo: 69°	T-storms Hi: 93° Lo: 68°	Partly Cloudy Hi: 93° Lo: 68°	Partly Cloudy Hi: 89° Lo: 68°

SPORTS

Watson Brown named interim AD, **page 10**

Graeme McDowell wins golf's top honor, **page 10**

Tuesday, July 2, 2002 http://www.uab.edu/kscope Vol. 36, Issue 24 10 pages

UAB engineering students in Reduced Gravity Competition

Photo Courtesy of David Murphy

UAB Engineering students study the effects of reduced gravity on various industries.

Chris Mahan
Staff Writer

Six UAB students recently took part in NASA's renowned Reduced Gravity Student Flight Opportunities Program in Houston, Texas.

This program selects 54 teams from around the country to participate in experimental research aboard NASA's KC-135 reduced gravity aircraft.

UAB sent a team of six students (James Irvin, Marlin Stoltz, Harrell Wiggins, Daniel Lee, David Murphy, Jonathan Lemsky and John Skates) accompanied by Dr. Heng Bang to conduct an experiment designed to prove the existence of non-uniform charge distribution on a particle surface as the result of one or multiple contacts.

The team hopes to show how electrically charged particles affect motion and rotation in reduced gravity climates.

"This research is important because electrostatic processes affect industrial-scale systems in emission control technologies, mining, powder and grain processing, and pharmaceuticals," said UAB team member David Murphy.

The team hopes that this research may lead to better designs in these areas, increasing the efficiency and productivity of the various industries.

"This research could lead to better designs for the processing and safe handling of granular materials in fluidization systems, grain transport systems, and in material sorting/separation systems where processing is strongly influenced by grain electrostatic charge," says Murphy.

"This research is important because electrostatic processes affect affect(s) industrial-scale systems in emission control technologies, mining, powder and grain processing, and pharmaceuticals."

David Murphy
UAB team member

While conducting their experiment at the Houston program, the students gained valuable experience in various fields ranging from scientific research to educational outreach.

They also took part in an extreme training program designed to prepare them for the effects of micro-gravity on the human body.

The training consisted of both classroom lectures and high altitude simulation training conducted in a pressure chamber.

This is the third time UAB has been selected by NASA to conduct student research through this program.

BIOMEDICAL CIVIL COMPUTER ELECTRICAL ENVIRONMENTAL MATERIALS MECHANICAL

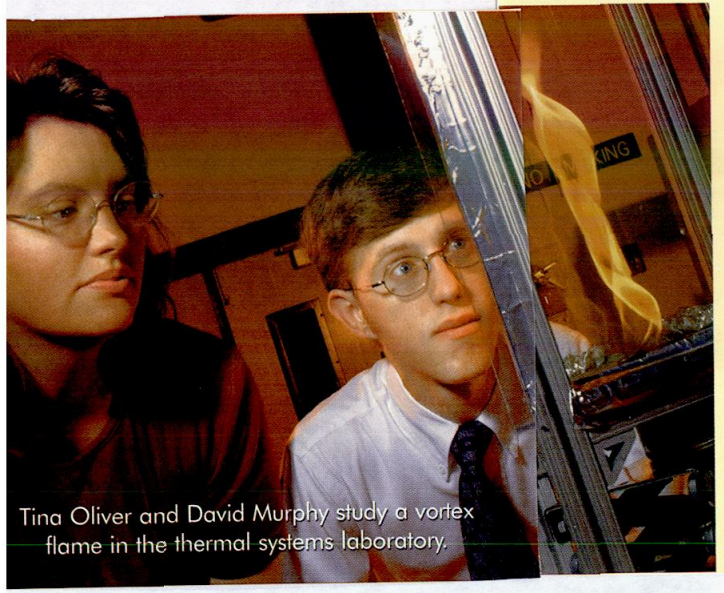
INGENUITY

THE NEWSLETTER OF THE UAB SCHOOL OF ENGINEERING VOL. 5 NO. 1 SPRING 2002

Gravity Optional:

DAVID MURPHY

Undergraduate mechanical engineering major David Murphy always knew he had a knack for science and math—but he probably never expected his aptitude in those areas to land him in a zero gravity scenario. But that's just where Murphy found himself in the spring of 2001 as a participant in NASA's Reduced Gravity Student Flight Opportunities Program.



Tina Oliver and David Murphy study a vortex flame in the thermal systems laboratory.

"The NASA program allows teams of undergraduate students to design an experiment to fly aboard the KC-135 aircraft," Murphy explains. "The KC-135 provides about 20 seconds of weightlessness at a time by flying up and down in parabolas. The UAB team I worked with researched laminar slot diffusion flames in microgravity." Murphy returned to Houston in April, this time to participate in the program as an alternate flyer on a team researching charge distribution on particles.

In between zero-gravity experiences, the undergraduate student of the year maintains a hectic schedule split between his duties as a student engineer at Southern Company and classes in the School of Engineering and UAB's Honors Program. Whenever he finds a spare moment, Murphy relaxes by playing ultimate frisbee and piano. His spare time gets more limited as he nears graduation, however—and as he is selected for more honors such as the *USA Today* Academic Team, which he was asked to join this year.

Murphy traces his academic successes back to high school, where his first encounter with engineering showed him the niche that best suited his abilities. "I think my fate as an engineer was sealed when I went to the International Science and Engineering Fair as a junior in high school," he explains. "That trip encouraged my interest in engineering by showing me what science and engineering really consisted of and by letting me meet other students who were as interested in science as I was."

Murphy notes that his best experiences at UAB have involved keeping that level of intellectual interest high—whether through research projects with professors like Dr. John Baker and Dr. Heng Ban or honors topics with Honors Program Director Ada Long, Ph.D.

"I came to UAB to develop my ability to learn," Murphy says, "and I think that this ability, in the long run, is more important than a specific set of knowledge." Murphy will have ample opportunity to put that theory to the test. After graduation, he plans to attend graduate school and pursue a Ph.D. in engineering.

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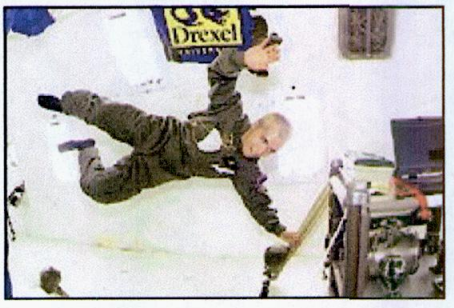
from the September 19, 2002 edition



WEIGHTLESS WONDER: Brian di Paolo, an engineering student at Drexel University, experiences the 25 seconds of microgravity that NASA's KC-135A creates by flying in a precipitous wave pattern. Researchers use that brief period to test experiments. NASA

They float through the air with the greatest of ease

By Angela Swafford | *Special to The Christian Science Monitor*

HOUSTON – I am strapped to a chair in the cockpit of NASA's KC-135A, the agency's fabled microgravity research and training aircraft, whose nicknames range from Weightless Wonder to Vomit Comet.

As the plane takes a dive at 34,000 feet over the Gulf of Mexico, the ocean comes rushing toward my face. Seconds later, the aircraft climbs steeply and then arches over the top of its parabolic flight path, creating the desired 25-second snippet of reduced gravity.

Held by our restraints, neither the pilots nor I float freely. But the main cabin has a confusion of body parts tossing about in every direction, screams of surprise reaching us in full force.

No matter how many times you fly the KC-135A, those first seconds of microgravity hit the senses. But when it is your first time and you are an excited student seated by your experiment box, these precious moments also mean the culmination of years of preparations, proposals, exams,

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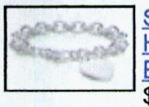

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tests, and mixed emotions.

Though it is widely known for its role in NASA's personnel training – every astronaut gets a first taste of weightlessness here – 80 percent of KC-135A flights are devoted to research. This is the only way scientists can observe the behavior of materials, objects, phenomena, and even plants, animals and people, destined for space. Free from gravity, the aircraft becomes a laboratory to look at things with new eyes.

An equally important role of the "K-bird," based at Houston's Ellington Field, is to serve as a testbed for groups of college and university students, who design and build their own science experiments and compete to bring them on board. Swept off their feet by science, these students aspire to become NASA's future engineers and astronauts.

"I can't believe I am floating here!" yells Drexel University's Mary Sullivan as she hovers above a box containing a diesel flame inside a steel cylinder. "I always knew I wanted to be an astronaut. But now I am determined to become one."

Ms. Sullivan is a chemical engineering major, and her team wants to collect soot particles to study the combustion in microgravity of bio-diesel – a mixture of soy fuel and diesel. "Learning how the soot forms, its size and shape, can give us valuable information to be applied in designing safer engines in the future," she says excitedly.

In spite of the enthusiasm of students like her – 110 colleges in 44 states have flown since the program began in 1995 – budget restraints last year made the future of the Reduced Gravity Flight Opportunities Program for Students uncertain. The cost of each flight hour is about $11,000 for crew, maintenance, and fuel.

Yet NASA officials made clear they think it is important enough to be kept alive.

"NASA is proud to support microgravity research opportunities for students," says Scott Pace, NASA's deputy chief of staff, who flew in from Washington D.C., to evaluate the program. "We will continue to fund it one way or another because it promotes good work and dedication. Students learn leadership, science and engineering skills, and also, professionalism."

For Caltech's Cristina Thomas, whose team and project came close to falling apart, the experience was a valuable course in managerial skills. "It taught me not to give up," she says.

Caltech's project had to do with measuring the speed of sound as it traveled through a mixture of water and air bubbles. The experiment needed to be done in microgravity to prevent the air bubbles from migrating toward the top of the box.

"Though this is basic science, it does have interesting applications in sonar technologies, because boat and submarine engines create

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Jim Thune on the campaign trail.
Jim Thune, backed by his wife Kimberly, parades for votes in Wagner, SD.

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bubbles as they move through the water," says Ms. Thomas.

Throughout the years, the KC-135A team has seen student experiments of virtually all sciences. "We have had life sciences, chemistry, engineering, astronautics, you name it," says Donn Sickorez, university affairs officer. There was even a study on body painting, as a proposed way for astronauts to play during their spare time in orbit.

The complexities of parabolic flight and NASA's concern for safety mean every person on board must first pass a physical and be trained in a decompression chamber to experience what it's like at the oxygen-starved equivalent of 25,000 feet. And of course, there is "the vomit thing."

"One hour prior to boarding, they gave us a very powerful anti-nausea medication," says Drexel's Brian di Paolo. "I did not get sick at all, in part because I did not move my head too suddenly during the high-G pullout periods, when the aircraft is climbing onto the next parabola, and the inner ear is at its most sensitive."

Paying attention to what the crew says can also mean the difference between having a blast and having a tough time on a flight that performs 30 to 40 parabolas nonstop.

For students, the rewards of the trip are worth the unusual challenges it presents.

"This is one of the greatest student programs I've ever encountered," Thomas says. "I've learned so much about so many things, not just science. Microgravity changes a variable that on the ground is always constant. If we have the opportunity to lift it, even if for just a few seconds, there is no end to what we can discover."

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NASA's Zero-G Flights Of Fancy

by Scott Chase

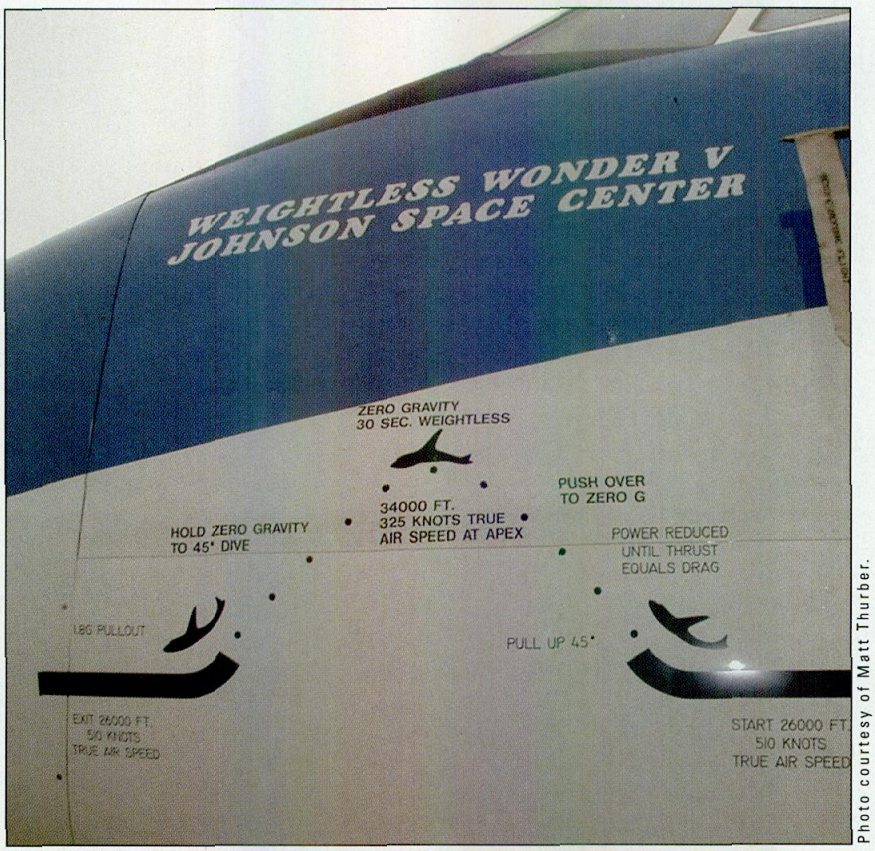

Photo courtesy of Matt Thurber.

Photo courtesy of Matt Thurber.

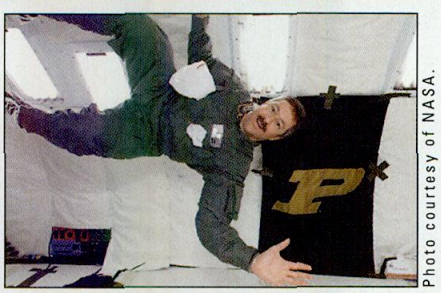

Photo courtesy of NASA.

(Top and left)The Weightless Wonder V is the fifth zero-G flight demonstrator operated by NASA over the last several decades. (Above) The author takes a few seconds to enjoy the zero-G experience.

What goes up, must come down.

In most cases, that old saying rings true. For a dozen aeronautical engineering students from Purdue University working on new ways to increase operational efficiencies and useful lifetimes of commercial communications satellites and other spacecraft, however, it may not hold. The students recently got the dream "up" of a lifetime when they and their experiments were selected for testing on NASA's KC-135 Reduced Gravity Student Flight Opportunities Program (RGSFOP), and the zero-G experience lifted them high enough that most won't come down for years.

In the heyday of the "Space Race," dedicated and enthusiastic satellite builders and spacecraft design big thinkers were virtually a dime a dozen. The real task was in choosing the brightest and the best from a limitless pool of self-selecting top talent. More recently, recruiters and human resources pros will tell you, it's been a scramble just to keep the pipeline filled.

But this threatened dearth of future space age worker bees was not in evidence during a recent 10-day stretch at the Johnson Space Center near Houston, TX. Joining the Purdue University contingent was a new generation of potential satellite and space professionals from a dozen colleges including Alfred, California Polytechnic, North Carolina State, Penn State, and oth-

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Photo courtesy of Steven Collicott.

Students, pilots and team journalists pose at the conclusion of another successful flight on the Weightless Wonder V.

ers. The student teams were selected after a rigorous series of tests and evaluations of experiments that were months if not years in the making. Proposals ranged from gauging the effects of weightlessness on human organs to using virtual reality set-ups as zero-G training tools.

College teams have the option of inviting a "flight-team journalist" to help document the most exciting part of their experiment. Everyone unanimously agreed that that part is the zero-G flight itself, with NASA's special KC-135, dubbed "Weightless Wonder V," making 30 zero-G parabolas on a standard test mission, one lunar-G and one Martian-G arc. Total time of weightlessness for a typical RGSFOP flight is about 13-15 minutes, with each parabola providing 25-30 seconds of glorious freedom from Earth's insistent pull.

PURDUE TEAMS FOCUS ON SATELLITE TECHNOLOGY

Three of four Purdue teams participating in the spring 2001 semester offered a spectrum of different approaches to serious problems encountered by commercial spacecraft in orbit.

One team experiment focused on weight reduction in propellant management vanes. These vanes, situated in the hydrazine fuel tanks typically used to position and move geostationary communications satellites and other spacecraft, keep the liquid propellant in a relatively stable state and help wick the fuel toward the tank outlet valves. Students proposed, built and then tested modified vanes that were designed to reduce overall weight. Another Purdue student test also targeted satellite fuel tanks, with a second team seeking ways to improve mass center control. The goal of this experiment attempted "to identify new technologies that will enable exact positioning of the fuel mass center by better controlling the ullage bubble." The ullage bubble, is, according to Webster's, "the amount that a container lacks being full." Permutations in the weight of a satellite, the students postulated, can cause difficulties with wobbling in orbit and other stationkeeping management concerns.

A third Purdue team tackled the "experimental development of hydrazine fuel line gas arrestors." In this experiment, students devised four mechanical schemes to trap gas bubbles that sometimes form while in orbit in the fuel lines of hydrazine arc-jet thrusters. These bubbles can increase electrode erosion and may disrupt the anticipated force of a thruster burst, thus complicating in-orbit maneuvers and stationkeeping.

In fact, according to team member Melanie Silosky, "the data gained from the proposed research could have a tremendous impact on future satellite design. Better dynamic modeling of satellites has positive impacts on guidance and controls, reaction wheel sizing, satellite failure rates, and fuel consumption." With a typical direct broadcast satellite carrying somewhere in the neighborhood of 200 gallons of fuel, and a burn rate of about a gallon a month, any fuel management scheme that can either prolong the life of the spacecraft or improve its operational efficiency is money in the bank.

Along with support from Purdue, and from university Professor Steven Collicott, students participating in the 2001 RGSFOP also teamed with researchers and scientists from Lockheed Martin Missiles and Space Co.

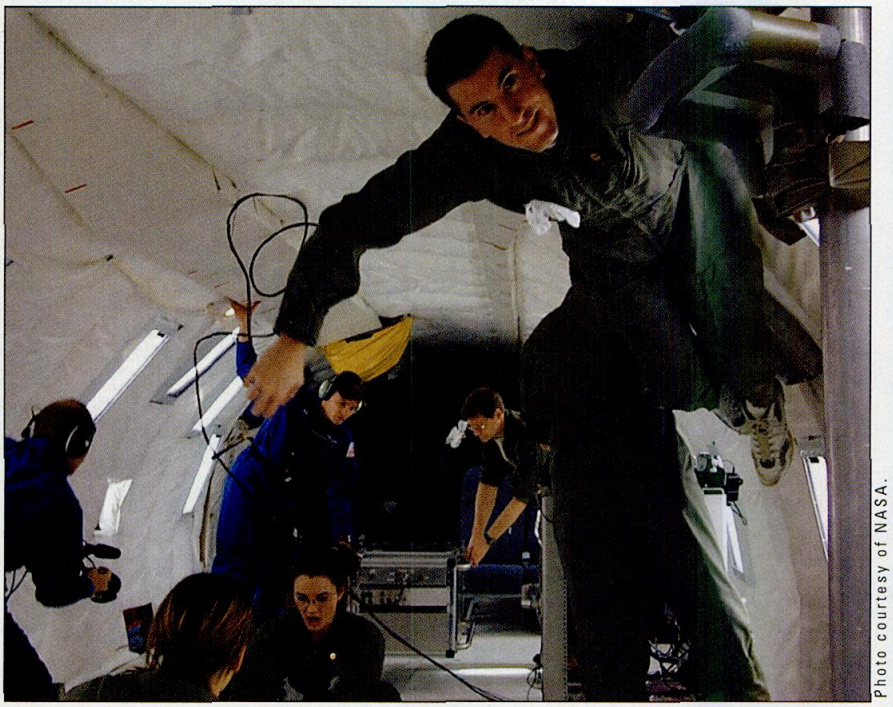

Photo courtesy of NASA.

Purdue University student Paul Brower hovers weightlessly over experiments in progress.

UP OVER THE GULF OF MEXICO

The fun begins when the work is done.

On a gray, cloudy day at JSC, students, faculty advisors, and flight-team journalists assembled at dawn to test the fruits of a semester's labors. Individual experiments had been loaded onto Weightless Wonder V the day before. Pre-flight checkout consisted of various tweaks to ensure that video cameras were in place and working, that needed tools and other equipment had been stowed, and that everything was locked down to the floor of the aircraft.

Rollout and takeoff were uneventful and, above the clouds, the sun shone brilliantly. Reaching cruising altitude, the lead test director, NASA's John Yaniec, gave the word that student teams could make their final preparations for weightlessness. And then, suddenly, the KC-135 rolled up at 26,000 feet into a 45-degree angle climb, bleeding airspeed as it approached 34,000 feet. At the apex of the climb, seconds before the nose keeled over, Yaniec screamed out, "Over the top! Here we go!" The next few moments were pandemonium as students felt the floor fall away and they started drifting for the first time in a flying zero-G rubber room the size of a four-car garage.

Never has 30 seconds passed so quickly. Almost as soon as it began, Yaniec was shouting, "Feet down! Two seconds!" And, as abruptly as weightless had uplifted us and set us free, the crushing force of double gravity 2Gs pressed everyone to the floor as Weightless Wonder V came out of

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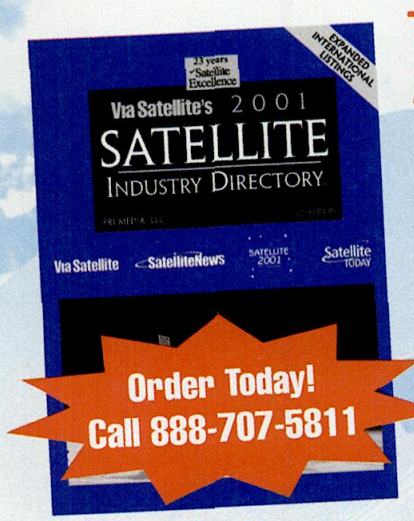

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the dive and headed back up on the ascent. Within just a few minutes, the sequence was repeated. It took just two or three parabolas for most of the students to settle down to their experiments, gauges, and camcorders. And that's all it took for a few unfortunates to find out definitively that weightlessness doesn't agree with everybody. Out came the barf bags, and the most severe cases were seated, buckled down and covered with blankets to weather the next 25 or 30 loops as best they could.

Meanwhile, student teams put their experiments through their paces, the entire proceedings documented for all time by two NASA videographers and an agency still photographer. As a final *finesse*, the NASA pilots treated all passengers to two special parabolas. One simulated the gravity of the moon (about one-sixth of Earth's) and another that of Mars (about one-half). People danced and leapt, with the more imaginative dreaming of the potential for a visit to long-abandoned lunar outposts.

We were back on the ground just two-and-a-half hours after liftoff.

WHAT THE FUTURE HOLDS

Purdue University is the self-proclaimed "cradle of astronauts," with good reason. Nearly two dozen graduates have participated in missions from the Mercury program (Virgil "Gus" Grissom) to the moon shots (the first on the moon, Neil Armstrong, and the last, Eugene Cernan), to the shuttle program. Today Purdue's School of Aeronautical and Astronautical Engineering gets far more applicants to its RGSFOP class than it can handle. For the lucky few that make the cut, the payoffs go far beyond a letter grade.

"Our experiment on weight reduction performed according to our expectations, but it will take some time to fully understand and analyze the data that we captured," says team member Adam Butt. Adds team member Paul Brower, "Every pound of material launched into orbit costs the satellite owner at least $10,000, and every month of extended lifetime is worth thousands in added revenues. The Purdue tests could end up being worth millions to satellite operators."

The final outcome of student experiments created for and demonstrated during the 2001 RGSFOP won't be known for months, perhaps years. But one thing is certain: The months of study, of building and testing on-ground prototypes, of managing and then passing the arduous NASA experiment selection process and pre-flight training regimen pays off each year for dozens of lucky college attendees and a handful of honor high schoolers.

"Zero-G was awesome. There's nothing like it anywhere else," says Butt. "You simply can't get experience like this in the classroom." And that's the point of NASA's Reduced Gravity Student Flight Opportunities Program at Johnson Space Center. Inspire a student today, and tomorrow the satellite and space industry worldwide will continue to grow, innovate, prosper and succeed. ❖

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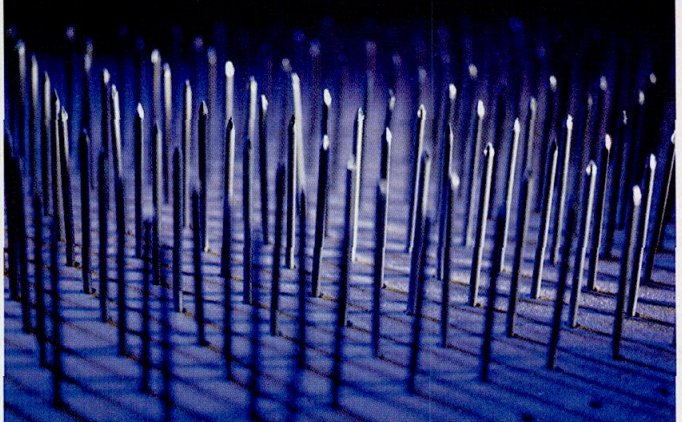

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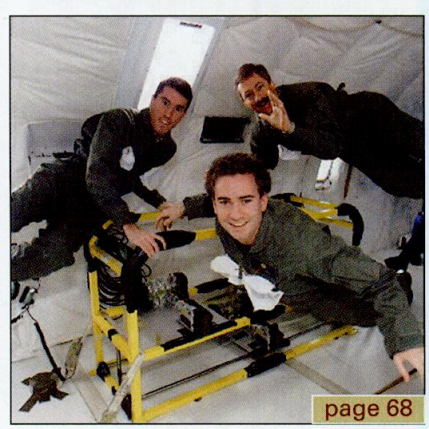

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About the cover: This month *Via Satellite* focuses on broadband in Europe.

Cover design by Rhonda Scharlat Hughes

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Student Tells Congress Her NASA Educational Experience Was 'Awe Inspiring'

by Gregg Kleiner

Marcia Whittaker, a senior studying nuclear engineering at Oregon State University, had the rare experience of testifying before the U.S. Senate Subcommittee on Science about how her involvement with a NASA research project through OSU has been "life changing" and "awe-inspiring."

Whittaker, who grew up in a small town in eastern Oregon where education "was not the top priority," told the committee that "in a small farming and lumber community, it is difficult to interest parents and children in the pursuit of knowledge when mills are closing and crops are failing."

She urged Congress to continue to fund NASA's educational outreach programs because these programs are "inspirational education," and have the potential to "inspire" an entire generation of young people to study science and engineering.

As a freshman at OSU, Whittaker discovered that a group of undergraduates were involved with NASA's Reduced Gravity Student Flight Opportunities Program (RGSFO), and immediately signed on.

Since then, she has traveled three times to Ellington Field in Houston, where she has flown on NASA's KC-135, affectionately called the "Vomit Comet" because of the aircraft's sudden plunges that imitate a zero gravity environment. Experiments that Whittaker and other OSU students helped design and build have been tested in the zero gravity environment of these flights.

Oregon Space Grant, based at OSU and directed by Dr. Andrew Klein, provided scholarship support and leadership for Whittaker and other OSU students involved with the NASA program.

Whittaker said the "true genius" of the NASA program is how it inspires high school and elementary students to study science and engineering. The program requires college participants to speak to groups about their NASA experiences.

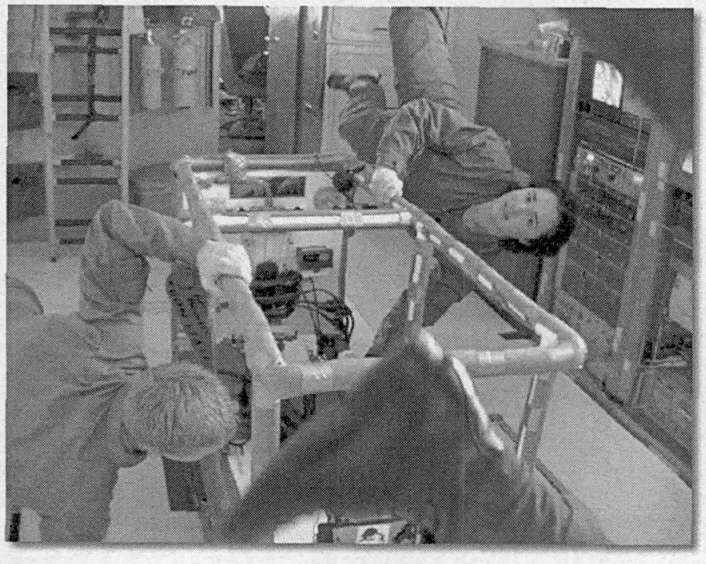
"I am now able to return to my very small high school and give the students the inspiration that I was lacking," Whittaker said. "The students who spoke of NASA in whispers now send me emails about how they are going to college so they can participate in this program, too."

Ron Adams, dean of the OSU College of Engineering said that attracting more students to engineering is key to building a top-ranked engineering program at OSU. "We welcome committed students like Marcia Whittaker to OSU Engineering," Adams said. "These students are the living wells out of which flow the creative ideas that will ultimately help build a better future for all of us."

OSU Engineering alumni William Oefelein and Donald Pettit have both received flight assignments on upcoming NASA Space Shuttle flights, and meet with the OSU students when they are in Houston.

Senator Ron Wyden, who chaired the hearing, called for tripling the number of science and engineering graduates by 2012 and dramatically increasing the number of women working in these fields. Sean O'Keefe, Administrator for NASA and former Secretary of the Navy, requested $61.6 million for NASA's educational programs for next year and said education is an official core mission of NASA.

Whittaker said she hopes her fourth year of college at OSU will be "no less amazing" than her first three.



Left: Marcia Whittaker, an engineering student at Oregon State University, recently testified to a Congressional subcommittee about her experiences working with NASA, including this experience of simulated weightlessness aboard the NASA aircraft known as the "vomit comet."

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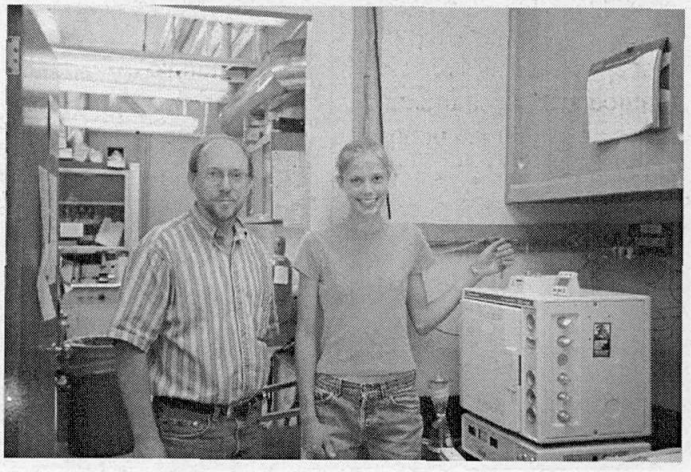

Dr. Dan Arp and Betsy Verhoeven in the Botany and Plant Pathology lab at Oregon State University. Picture taken by Betsy Rollins; Courtesy of the ASE program.

While most students this summer are at the pool, on vacation, or hanging out at the local mall, a select few students are busy at work in research labs across the state. These high school students are part of a prestigious apprenticeship program that pays them for their work with local research scientists. "Students get real exposure to the research experiences very early in their careers," says Dan Arp about the ASE program. Dr. Arp has been involved with the Apprenticeships in Science and Engineering Program (ASE) for eight years now. ASE, a program of Saturday Academy, is an eight-week, full-time summer internship program for 9th-11th graders. The program includes a Mid-Summer Conference and Presentation Symposium.

This year, Dr. Dan Arp, Professor of Botany and Plant Pathology at OSU, is hosting Betsy Verhoeven, a student from West Albany High School. Betsy is working on a bioremediation project. She is looking at the use of bacteria to remediate contaminated environments. More specifically, she is working on a bacterium that would be useful in cleaning up chlorinated aliphatic compounds. An example is trichloro ethylene (TCE), a solvent previously used in the dry cleaning industry and currently used as a degreasing solvent. TCE is an effective degreaser because it is flame resistant and does not break down easily. However, these positive attributes that make it an effective solvent, also make it difficult to discard and clean up. The bacterium Betsy is studying can help to break TCE down through a process called co-metabolism. "We use the Pac Man analogy," says Dr. Arp. "Pac Man goes around eating points but sometimes he gets points that are poisonous." It is similar for the bacterium Betsy is studying. The enzyme that the bacteria produces to harvest substrates, will also act on these pollutants but it does not help the bacteria. In fact, it often harms the bacteria. Professor Arp believes that if we are to harness these bacterium for clean-up we need to understand the toxicity to the bacterium.

(Story continued on page 3)

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www.tulsaworld.com

Local

Former Mayo Hotel basement renovated for public parking

▶ The local landmark has been the focus of several failed renovation projects.

BY TOM DROEGE
World Staff Writer

A downtown Tulsa landmark is in the first phase of an attempted comeback from years of standing empty, its owners say.

Construction workers are renovating the basement of the Mayo Hotel for use as a public parking garage, said Charles Snyder of Minnesota, a principal of Mayo LLC.

The company purchased the 80-year-old building last year for $250,000. The valuation of the renovation work in the basement is estimated at $300,000, according to the City of Tulsa building permits division.

"We think there is demand for more downtown parking," Snyder said. "That's the only thing that's firm right now."

The Mayo Hotel, 115 W. Fifth St., is the city's first skyscraper and has been the focus of several failed renovation projects since it closed more than 20 years ago.

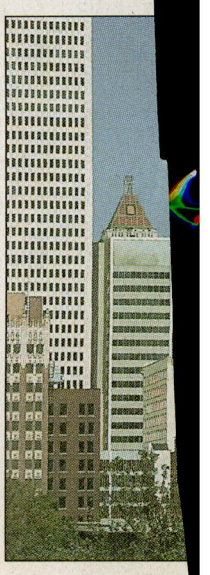
"It is such a big building that we decided to divide it up into manageable components," Snyder said.

The parking garage is the first of these components and is projected to be complete by Sept. 1, he said.

American Parking will manage the parking, which will be a mix of about 50 reserved and daily public parking slots, Snyder said.

Snyder said the company is looking for "more creative uses" for the building's first floor.

SEE **MAYO** A-21



About 50 parki
basement of Tuls

Students gravitate at zero

TU experiment explores particle motion for NASA

BY SHAUN SCHAFER
World Staff Writer

HOUSTON — Matt Olson and Rebecca Ragar stepped out of the starboard door aft of the wing on NASA's KC-135, a highly modified jet, and walked down the stairs.

The two University of Tulsa students had just spent a good part of the previous two hours flying between 38,000 feet and 19,000 feet, either floating in the cabin weightless for short periods or flattened to the floor at nearly two times their normal weight.

They may not have looked it, but they were emerging triumphant.

The flight left them tired and retching, but had allowed them to operate an experiment on granular activity that could help expand science's understanding of how parts of the solar system were formed.

It was 11:30 a.m. Wednesday as the last two fliers from TU's team stood in front of the four-engined Boeing jet for a quick photo.

There were no shouts of triumph.

Three cheers and hurrahs at the end of a mission are the sort of things that happen in fiction, and this was science.

Instead of victory shouts, it was business as usual.

Even before landing, the other members of the TU team participating in NASA's reduced gravity flight program, July 18 through Saturday, were trying to figure out ways to improve the experiment for another shot next year. TU also has room on the Space Shuttle, meaning the experiment operated this past week in Houston could be on its way to space sometime in 2004.

After two flights in two days, the discussions focused on moving fans, adjusting circuits, adding components, subtracting components — anything to make TU's custom-designed shaker shake a little bit better and to guarantee even more data the next time it goes aloft.

"We learned a lot," team leader Justin Mitchell said after the second flight. "We learned some things to do differently next time."

Ups and downs: First on that list might be additional sleep.

The group as a whole operated on a sleep deficiency right up until that last flight.

A few hours after it was over, all but one team member was asleep back at the Quality Inn Motel, south of the KC-135's home at Ellington Field.

The strained schedule of Tuesday and Wednesday's flights provides a pretty good sample of how science is neither antiseptic nor for the sedentary.

While flying the experiment for the first time on Tuesday, the team ran

SEE **ZERO** A-22

NASA photo

TU students Matt Olson (center) and Rebecca Ragar float in near-zero gravity aboard NASA's "Weightless Wonder" flight over the Gulf of Mexico last week. NASA's Troy Whitney watches as the KC-135 jet nears the top of one of its 42 parabolas during the flight.

ZERO:

The way the brass spheres move in the absence of gravity may explain how rings around planets form.

FROM **A-13**

into a number of problems. A circuit overheated, shutting down the shaker motor and eventually the lights.

The experiment operated for about 12 of the plane's 42 zero-gravity-producing parabolas.

An infrared signal to the experiments' cameras also failed after only a few minutes of operation.

The moments of weightlessness are coveted by the team because they allow their experiment to work.

During the weightless portion of the flight, the TU Gr.A.I.N.S. project — short for granular agglomeration in non-gravitating systems — shook a sapphire box with multiple chambers. Each chamber contained from a few hundred to thousands of tiny, brass spheres.

Arcane? Not entirely.

The way those balls moved in the absence of gravity might explain how dust settles to form asteroids and how the rings around planets form.

Try it again: Weightlessness can be good for experiments and bad for experimenters, the most pressing problems being motion sickness.

Through medication and training, NASA has been able to reduce the incidents of motion sickness from more than one-third to about 10 percent of each flier group, according to test director Dominic Del Rosso.

"It's when the body is getting different signals from the environment," Del Rosso told the group in a preflight briefing. "It doesn't know what to do, so your body decides, 'I'll barf.' "

Three of the five people sent aloft with the TU experiment suffered from motion sickness.

Both team members flying on Wednesday got sick.

"We got more data, but fewer survivors," Wilson said as Wednesday's flight was landing.

Back on the ground at 11:20 a.m. the previous day, the group had unloaded the experiment and started working on it in the hangar at noon.

They had planned only to remove the cameras and take a look at the data collected, but when fliers Mitchell and Whitney Marshall reported that the experiment stopped operating in mid-flight, the group was forced to dismantle the operation and reassemble it in less than 18 hours.

With a few teammates making a run for takeout sandwiches, the group continued working in the open, hot hangar until 5 p.m.

NASA photo

Justin Mitchell (left) and Whitney Marshall, members of TU's Gr.A.I.N.S. project, float in near-zero gravity aboard a NASA "Weightless Wonder" flight last week. Between them is the students' experiment on granular movement in microgravity.

Then they loaded it back into their van and returned to their motel. By 2 a.m. Wednesday they had repaired the circuit board, and, for good measure, replaced the entire power system, added a remote control to the cameras and put in a 3-inch box fan to cool the components on the board.

Here we go again: By 6:30 a.m. Wednesday they were once more at the hangar.

The day's fliers, Olson and Ragar, arrived a little later, while the rest of the team waited for an OK on their modifications.

Wednesday, Del Rosso walked into the hangar at 7:27 a.m. He looked over the modifications and the support papers that team member Aaron Coyner had amended the night before.

Again, the experiment passed without a hitch. When weighed before loading, it had even dropped 21 pounds from two days earlier. It was 113 pounds of aluminum, carbon fiber, circuits and wires wrapped in a clear lexane shell.

By 8 a.m, it was bolted to the plane's floor.

Olson and Ragar were in NASA Room 993, getting their morning briefing.

The New Deal: In flight, there was constant activity.

As soon as the plane took off, passengers unstrapped from their seats in the back of the plane and moved up to their experiments.

Flights typically carry five groups, and each has some items to check off, install or adjust, preparing for zero-G.

About 20 minutes after departure from Ellington, the cycle of parabolas started.

Once they went weightless, fliers were hanging on, trying to operate experiments and contain their breakfasts.

Some experiments worked like a charm and most people didn't get sick.

Still, things can go wrong.

On the first day for the TU group, the experiment malfunctioned, and team leader Mitchell became ill. On the second day, the experiment appeared to work well, but both crewmembers were incapacitated for a while with motion sickness.

The combination of limited sleep and maximum work appeared to catch them.

"I think that's what ruined us — no sleep, especially today," Mitchell said.

Fate, however, decided to shuffle the cards and deal the group a new hand on the last set of parabolas.

Problems with other experiments caused the flight to level off and pause.

This gave Olson enough time to get back up and restart the experiment. From the hangar, the ground crew watching the entire flight on a downlink — caught the return.

"Way to go, Matt," Marshall said. "He's quite the trouper to get back out there."

The ground crew, just minutes earlier, had been conducting the postmortem on the day's experiments.

Suddenly, their data gathering had restarted.

Their interest returned.

"He's a hoss, though, going out like that," Mitchell said, as the group watched a fixed camera downlink that provided only a few details of what was happening on the plane. "I can just see him by the experiment, saying 'Oh, I'll just stay here operating the equipment while vomiting into a plastic barf bag.' "

Periods of weightlessness would blot Olson and most of the experiment from view.

A flight surgeon, wearing the blue gloves of a man handling barf bags, passed by the area of Olson and the TU experiment. It wasn't a good sign, but someone spotted Olson's legs next to the experiment box.

"Matt's still there. He's still there," Wilson said.

"He's a beast," Mitchell added.

Down to Earth: Olson and Ragar were undergoing debriefing in Room 993 when the rest of the team clambered onto the plane.

Mitchell, Marshall, Wilson, Coyner, Adrienne McVey and flight alternate Jeremy Cain quickly removed the bolts holding the 28-inch tall experiment, reattached handles to it and brought it back to the hangar.

There they gathered their tools and then headed back to their motel home.

Now they have cameras loaded with images of the tiny, brass balls moving as the plane reached the top of its arcs.

They also have a microprocessor loaded with data on the shaker motor speed at the time.

"We've got a lot of film on the movement as a gas," Wilson said. "It seems that the plane moving in zero-G was still enough to cause some of the ones that should have clustered to gather in a corner."

Analyzing the data, writing for additional grants to fund research and measuring just how each one of those balls moved will come in the following months.

The team, which is losing Olson, its hardware engineer, and Marshall, its software engineer, to graduation, will also have to come up with new members and a new plan of attack.

Ultimately, their data may provide a better understanding of particle movement in the universe and how stellar odds and ends come together to form asteroids and planetary rings.

This week, it brought triumph, frustration, jubilation and exasperation, sometimes in series and sometimes all at once.

Shaun Schafer, World staff writer, can be reached at 581-8320 or via e-mail at shaun.schafer@tulsaworld.com.

It's more than a G-thing

BY SHAUN SCHAFER
World Staff Writer

HOUSTON — Leaving gravity behind even for brief periods this past week offered a group of University of Tulsa students an experience unlike any other, and provided the agency that runs the flight program to put a little more luster on its image.

Five members of a TU team rode with their experiment as part of NASA's Reduced Gravity Student Flight Opportunities Program. The program allows participants to engage in a flight mission similar to a trip into orbit, while riding aloft in a KC-135, a modified version of the Boeing 707, four-engine jet.

The program allows them to conduct experiments in a nearly zero-G or microgravity environment. It also poses the challenges of weightlessness and then returning to two times the amount of gravity in a short span.

"There's nothing in the world quite like it," said Whitney Marshall, who designed the programming for TU's experiment on granular action in zero-G. "There's nothing quite like having no sense of up or down."

To produce almost no gravity without leaving the atmosphere, the KC-135 flies in a series of parabolas. Once over the Gulf of Mexico, which takes about 20 minutes from Houston's Ellington Field, the pilot will take the plane from about 18,000 to about 39,000 feet in a matter of seconds. With the plane in a 45-degree arc, it repeats these in cycles of 10.

Each parabola takes about 85 seconds, and in the top half of the parabola fliers get about 25 seconds of weightlessness.

"We move in an arc like a thrown rock," Marshall said.

To avoid motion sickness, fliers try to float up as gravity lets go.

It helps to move their heads and torsos together, refrain from looking out of either of the two windows in the back and to relax, test director Dominic Del Rosso said.

"If you like roller coasters, you are going to be disappointed," Del Rosso said. "If we do it right, you won't even know."

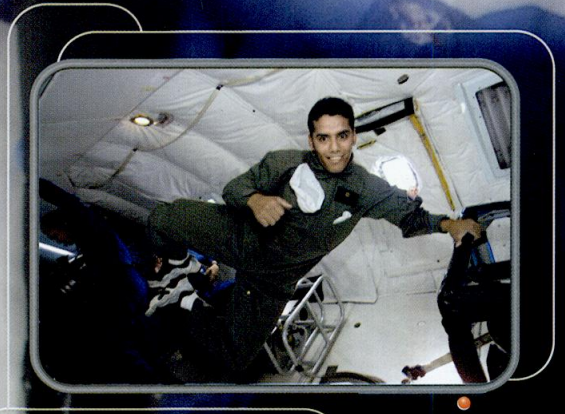
Those periods made three of the TU fliers ill.

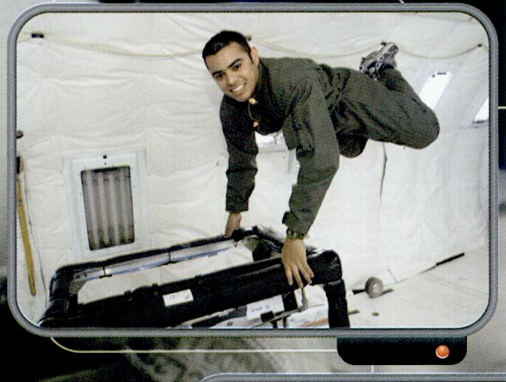
"It feels like you are falling because you are," said Marshall, who weathered 42 parabolas without incident on the group's first flight.

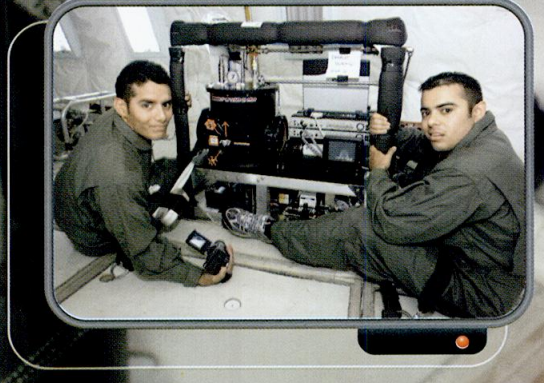
SUMMER 2002

NOVA

QUARTERLY
THE UNIVERSITY OF TEXAS AT EL PASO

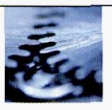






Zero-G Labs in Space

UTEP and the Changing Face of Engineering



As all our alumni will recall, UTEP was founded in 1914 as the Texas State School of Mines and Metallurgy, the third component to join the University of Texas System, after UT Austin and the UT Medical Branch in Galveston. The location of a mining engineering school in the far western part of Texas responded to the growing mining operations in southern New Mexico, Arizona and northern Mexico, and the smelting and refining industries that were associated with them.

Our first graduates completed their mining engineering degrees in 1917. They, and a majority of our graduates for many years thereafter, assumed leadership roles in mining and refining operations throughout the southwestern United States and Mexico. The university's mascot, Paydirt Pete, and our "Miners" name are enduring legacies of those early mining school days.

Another enduring legacy of those early days of the College of Mines is the strength of our academic programs in engineering and science. UTEP's engineering programs continue to be among the best known and most highly regarded on this campus today. Our traditional strengths in engineering and geological sciences continue to be recognized in national publications and awards, and faculty and students continue to compete successfully—and to collaborate—with their counterparts at universities throughout the world.

UTEP's engineering programs continue to be among the best known and most highly regarded on this campus today.

Inserted in this issue of *NOVA Quarterly* is a brief publication that welcomes readers into the labs of today's College of Engineering. It was prepared for presentation to industrial partners of the college who regularly recruit our engineering graduates, and whose investment in our programs will ensure that we continue to prepare outstanding graduates in the future. We thought that all of our alumni, and especially our many engineering alumni, would be interested in the College of Engineering's story. And, of course, we are interested in your feedback and reactions.

Engineering programs at UTEP have changed dramatically since 1914, keeping pace with the enormous technological and economic changes. In fact, UTEP is a different university today than it was just a few short years ago. What hasn't changed, however, is our institutional commitment to serve our students well, with the highest quality and most up-to-date academic programs that we can offer.

The success of these efforts to prepare UTEP students is best measured by the success of our graduates…all of you.

Congratulations on your many accomplishments, and thank you for making us proud of you and the UTEP programs that prepared you for your success.

— Diana Natalicio
UTEP President

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Contents © 2002 by
The University of Texas at El Paso
NOVA Quarterly (ISSN # 1041-6900)
is published quarterly by:
The University of Texas at El Paso
University Communications
500 West University Avenue
El Paso, TX 79968-0522
Periodicals Postage Paid at El Paso, Texas
Volume 38, No. 4; No. 150

POSTMASTER:
Send changes of address to:
NOVA Quarterly
The University of Texas at El Paso
1100 N. Stanton Street, Suite 201
El Paso, TX 79902

NOVA Quarterly is sent without obligation to alumni and friends of the university.

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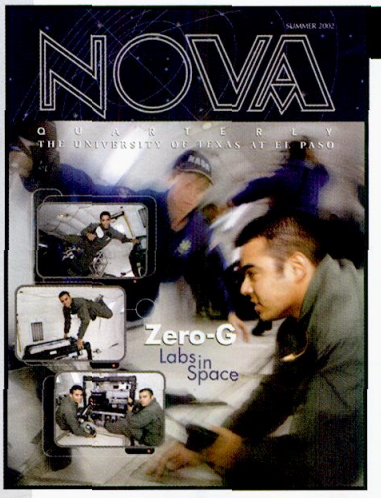
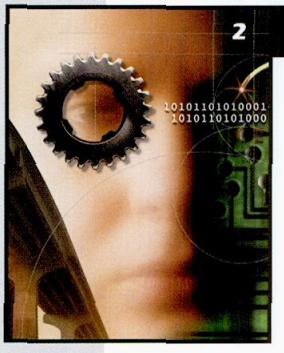
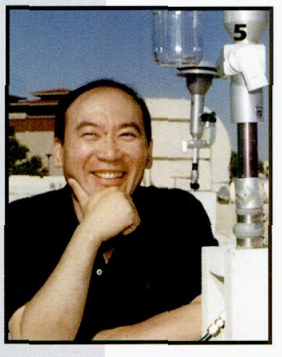


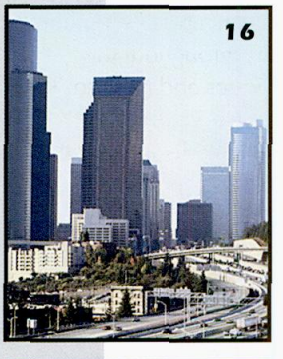
ON THE COVER

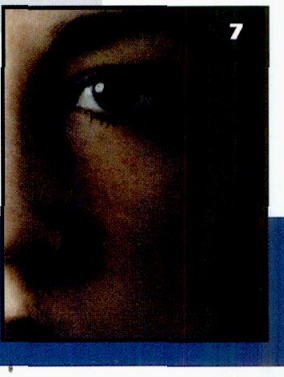
UTEP students go weightless during a 20,000-foot free fall aboard a flight at NASA's Johnson Space Center. Five UTEP engineering undergraduates tested a novel, low-pollution burner developed at the university's Combustion and Propulsion Research Laboratory.

Cover design by Bobby Daniels.









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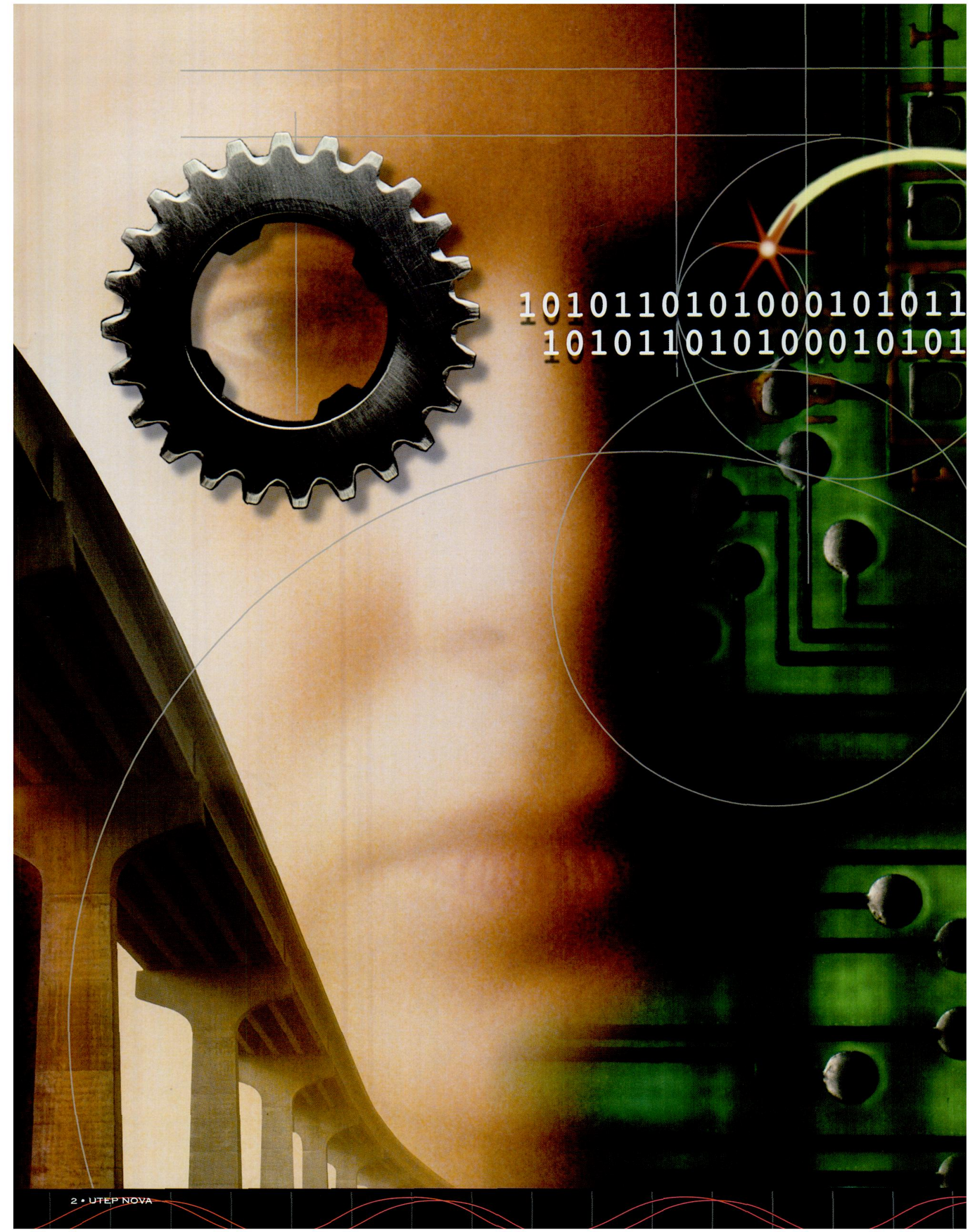
Since its inception as the Texas State School of Mines and Metallurgy, UTEP has developed deep roots in engineering. Today, the university's researchers and students are changing the face of the field, using their educational preparation to engineer solutions throughout the world.

See *NOVA Quarterly* on the World Wide Web at *http://www.utep.edu/nova*.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UTEP AND THE CHANGING FACE OF ENGINEERING

For Jesus Moncada, a simple road trip turns into a lesson about engineering and society. As the civil engineer drives along the Interstate, he comments on the expansion gaps along the freeway, bridges and road structures.

"Most people don't notice the structural marvels that surround us, but engineers notice each of the intricate details," Moncada says. "Engineering is about creating solutions for society — from the way we travel to the way we live."

The two-time UTEP graduate knows the community and its engineering needs rather well. As a researcher, Moncada focused on the desalinization of water for the underserved residents of the *colonias*. As part of his doctoral work, he researches the feasibility of using electrokinetic salt barriers to reduce the contamination of soil, therefore eliminating the need for synthetic or clay liners.

Today, Moncada is an environmental investigator who enforces compliance with state and federal laws. As a doctoral student in the university's environmental science and engineering program, he's gained professional insight into air pollution, water reclamation, geochemistry, and hazardous and industrial waste.

"By encouraging me to become involved in research that directly impacts the community at an early stage in my education, UTEP has prepared me to use the tools of my trade to tackle some of the region's most pressing issues," Moncada says. "The more I travel across the country, the more I discover that UTEP is unique among universities."

Graduates aren't alone in their recognition of the university's engineering programs. Each year, Fortune 500 companies turn to UTEP for talented engineers whose educational preparation and work ethic meet the ever-changing demands of the modern field. During a recent recruiting cycle, more than 300 companies competed for 150 bachelor of science in engineering graduates.

The recruiters' confidence in the university's alumni has opened the door to additional support. This year, when UTEP embarked upon a multi-million campaign to expand and upgrade the research facilities of the engineering building, corporations and foundations throughout the country generously responded.

The W.M. Keck Foundation of Los Angeles awarded $1 million to the university's Border Biomedical Manufacturing and Engineering Laboratory where bio-engineers develop anatomically accurate artificial models ranging from human spines to entire cardiovascular systems. The human-centered engineering of the Keck lab is expected to dramatically alter the way doctors approach surgical procedures and how medical researchers analyze blood flow and internal structures.

The cutting-edge laboratory is one example of why national attention — on both sides of the U.S.-Mexico border — is turning to the El Paso's university where excellence in engineering is changing the face of the field.

Fire in Free Fall

By Jessica Powers

What's it like to be weightless? Ask five UTEP undergraduate engineering students who had the experience during a 20,000-foot-free-fall aboard a flight at NASA's Johnson Space Center.

During the flight, Ivan A. Anchondo, Ricardo Gallarzo, Roman Villa and Isaac Estrada tested the effects of low to zero gravity on a new burner designed by UTEP's Combustion and Propulsion Research Laboratory. Enrique Quinones, also a UTEP undergraduate, accompanied the crew as an alternate flyer.

Were there any difficulties?

"During one of the seconds when I was weightless, I floated up above the rig," crewmember Villa explains. "I was afraid I would break a $42,000 piece of equipment if I fell when the plane started flying up again. When the plane starts going back up, you weigh twice as much as normal."

While being weightless provided temptation for play, the experiment was priority. After all, for three months the students worked 15-hour days, preparing to conduct the experiment with fire onboard NASA's KC-135 microgravity research aircraft in April, for the NASA's Reduced Gravity Undergraduate Student Research Program. Only two teams were granted permission to experiment with combustible materials.

The "elliptic burner," named for its shape, can reduce the emission of pollutions by 30 percent and increase fuel efficiency by 12 percent, Ahsan Choudhuri, director of the Combustion and Propulsion Research Laboratory, says.

The students built a faultless and highly reliable "rig" or experimental set-up that allowed them to safely conduct the experiment. "We had to be familiar with a 300-page document explaining the safety procedures," says Choudhuri. "It's a very complicated experiment."

The KC-135 aircraft, aka "Weightless Wonder," flies in a parabolic pattern, climbing to 40,000 feet and then dropping 20,000 feet, simulating microgravity for 29 seconds.

For two days, UTEP students, in teams of two, experienced 40, 29-second periods of microgravity each flight. The data derived from the once-in-a-lifetime experience will be invaluable to their future studies. They learned that fire in microgravity is circular, rather than elliptical as on earth. They also learned about combustion and how to conduct experiments in microgravity, as astronauts do.

Choudhuri would eventually like to experiment on the International Space Station, where there is continual microgravity.

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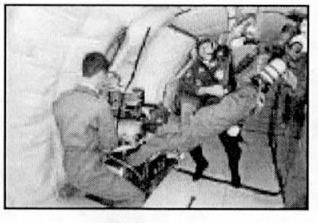
OIT students conduct weightless experiments with NASA

08/08/02
By JAMES THIELMAN



Richard Witherspoon, left, watches while OIT student Heather Hava hangs on to an experiment she is performing on NASA's "Weightless Wonder" plane. John Yaniec watches in the background.

HOUSTON — "Over the top," says John Yaniec, lead flight test director for Weightless Wonder, a KC-135 airplane used for scientific experiments.

His remark is the cue to prepare for a dive that will give a handful of Oregon Institute of Technology students a taste of what weightlessness feels like.

Smiles, laughter, and joyful murmurs erupt from six teams of college students from around the country who are flying with their experiments.

Some of the students hope to become astronauts someday, including OIT's Heather Hava. Hava was part of a team from OIT testing bubble behavior in low to zero gravity at NASA's Ellington Field in Houston last month.

The plane gives science students the ability to test theories that can't be tested on the ground.

The NASA KC-135 airplane arches high above the Gulf of Mexico before going into a dive. For 30 seconds, passengers are weightless. The plane makes a series of climbs and dives that are called parabolas.

After an initial upward thrust that lifts students toward the ceiling, they float. If they move, it's because they push off the padded walls of the airplane.

NASA flight directors and doctors monitor the participants for safety.

This first parabola is a warm up. Getting free of earth's gravity for half a minute is such a kick no one blames the students for enjoying their first taste of weightlessness.

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Not, that is, until Yaniec shouts, "Feet down, coming out."

Newcomers learn quickly how gravity returns with a vengeance during the bottom of the parabola where their weight nearly doubles.

At the next 30-second arc of weightlessness, Richard Witherspoon, OIT team leader, sets to work. He tests a game developed by high school students at a recent OIT Space Camp. Flippers must push a ball bearing to a sensor atop a Plexiglas case. He scores.

Hava helped another group of high school students develop a vending machine. Yaniec joked that the Russians could use it to sell food to proposed space tourists.

Hava hangs onto the experiment, as her feet fly up above her head. Undaunted, she turns a knob and pushes a button. A box of breath mints falls into the chamber where a space tourist could retrieve it.

Next, the two tackle the main experiment — testing bubble behavior in low-to-zero gravity.

In weightlessness, engineers must control bubbles in fuel or other fluids by attracting them with heat or pushing them away with cold. Under the direction of OIT professor Tim Brower, the students are exploring this idea.

Members of OIT's team who are making their second trip Witherspoon and Wes Beecroft, now employed by Sandia National Laboratory in Livermore, Calif. Richard and Wes's experience last year is helpful.

Newcomers to NASA include mechanical engineers Hava and Evan Pickett, who is working on a double major in engineering and design.

Also new is Kris Murray, a computer engineer. His role is to make sure the computer accepts data carried through a host of wires.

Pickett and Beecroft fly on the first flight day. The rest of the team watches a video downlink as they run the high school student experiments without at hitch.

Next, they work with the main experiment. This year, the bubble test cell and a video camera are mounted on a unit the size of a breadbox. Beecroft designed a precise manual bubble injector. Once the bubble is injected, the test unit floats freely on a tether. The goal is for the unit to reach even lower gravity levels than the airplane.

When the unit comes to the end of its tether a team member grabs it and sets it where it can free float again. They can do this about three times before Yaniec yells, "Feet down!" Then they set the unit on a foam pad.

A problem the first day is that a large bubble in the test cell dominates the action. The data isn't as clear as the students hoped. They work that night.

The next day, they are ready. They run the high school experiments successfully once again. They also have eliminated the large bubble in the main experiment. However, the temperature probes fail to track temperatures on the hot and cold side of the test cell — a setback.

Witherspoon and Hava now focus on collecting data on gravity levels. Knowing these levels could make future free-floating experiments on the KC-135 more valuable.

The plane flies 40 parabolas, 10 more than usual and everyone from OIT comes through fine.

The students use the last few parabolas to again enjoy floating. They do spins with the help of the NASA flight test directors.

Hava does a leap or two on a last parabola that mimics gravity on Mars. It has special meaning to her. She dreams of being the first woman on Mars.

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College of Engineering Student Newsletter
Student Engineering Council
University of Texas at Austin

The VECTOR

April 2002 | We're on Volume 50 after 33 years... nice counting. | Volume 50 Issue 2

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Note: The title of this month's issue is a corny riddle, not a typo. If you figure it out, come by our office and we'll give you a cookie.

Graduate school's timeless question: now or later?

Julia Wagner & Vibha Athre
Vector Staff

Decisiveness in college students is about as common as a good pun by your calculus professor. For seniors graduating this semester, the indecisiveness that has marked the past four years will need to be resolved this month. The *next step* is so daunting that some seniors have even chosen to start studying for acronymed exams as a way both to get out of engineering and postpone their entrance into the real world. This method of procrastination earns one creativity point and twenty for masochism. However, a few students actually know that they want to submerge themselves in musty rooms with antique equipment to do research under an eccentric professor for 2-5 years. The dilemma they face is whether to dive into it now or later.

There is debate as to whether engineering graduate work is best done before or after working in industry. Based on the experiences of some mechanical engineering professors, it is a very personal decision that depends heavily on what your end goal is. Learning what others, specifically professors, have done is a helpful way to shed light on the different paths ahead.

First, going straight through from undergraduate to graduate studies (whether it be a Master's or Ph.D. program) with no break offers the continued familiarity of student life, characterized by poverty and nightly hunts for dinner at organization meetings. Some have even been brainwashed into thinking the "And Stand" is tasty, and that a well-balanced meal consists of Animal Crackers and Dr. Pepper—an interesting adaptive survival mechanism. Free food is supplemented by inexpensive housing and convenient transportation options. No matter what the university, these circumstances will be similar.

Just biting the bullet and doing it all together also allows you to complete studies at the beginning of your life, which frees the rest of your life to work… and/or live. Additionally, if the job market is tight around graduation, continuing education will keep your mind actively engaged in your field while gaining invaluable experience. Also, by waiting a few years, the market may improve before the next graduation ceremony.

If you choose to attend school for 6 years straight, some of the difficulties that you may encounter also relate to student life style. Debts and student loans may worsen because even though most grad schools will pay for your education, stipends hardly cover living expenses. Also, grad school is not exactly a stable or consistent environment. We have all noticed that grad students live "unique" lives. It may be necessary to work at various times of night all through the week—your schedule is not your own.

Keep in mind that much of the success of your graduate work involves fostering a good relationship with your advising professor. In some cases, the professor's ability to acquire grant money determines how fast you are able to finish your research.

On the other hand, if you opt to go first into the workforce and later return to do graduate work, be prepared to resist the many lures of life away from school. The primary temptation is money; it is a difficult transition from an industry salary back to graduate school. The other temptation of working is realizing that you can have a life and interests outside of the engineering quadrant. It is revolutionary to go out and enjoy yourself every weeknight without the burden of homework or the limiting schedule of group work.

Additionally, if you take a break from school to work, you will gain invaluable experience. Work may allow you to see how the engineering theories learned in school are applied. Once and for all, you can decide for yourself whether the 15 assumptions made on each homework problem accurately model the real system.

Taking time to work also may postpone burnout. It is inevitable that at some point in grad school you will be fed up with it. Perhaps taking some time away from student life will keep you from growing cynical about the academic realm. In fact, many returning students speak about their ability to focus and perform better academically than when they were undergraduates. Attitudes change with different experiences. The frightening "real world" may allow you to gain some perspective on where you want to be in life, and it might be the perfect remedy to collegiate indecision.

Finally, if you spend any time in the workforce, the potential exists to advance in the company through promotions. It will be difficult to make connections only to return a few years later facing new people and circumstances. However, you may also be offered the opportunity to return to school with the financial backing of a company. If you are interested in first working and then returning to school, be sure to ask potential employers whether they offer to pay for employees to return for graduate work.

Now that you are equipped with a laundry list of reasons for and against going straight through your engineering education, it is your turn to sort it out. See which of the above reasons strike your fancy and go full force into the uncharted waters of Decisiveness. Your thesis is waiting out there! ✓

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The *Vector* is published monthly by the *Vector* committee of the Student Engineering Council. Opinions expressed in the *Vector* represent those of the author and do not necessarily reflect the opinions of the committee, the Council, or the College of Engineering. Contributions and comments are welcomed and will be accepted by delivery to our office, ETC 2.140, or by e-mail to vector@marconi.me.utexas.edu. The *Vector* C2200, The University of Texas at Austin, Austin, Texas 78712. ©2002 *Vector*. All rights reserved.

Faulkner addresses engineers

Big Tex News Service

Pulling a palm pilot and electronic pen from his inside jacket pocket, UT President Larry R. Faulkner looked up to a student in the audience and said, "I'm going to write that down…What's your name?" The student, an engineering senior, had suggested a change in the way registration is handled, so that seniors close to graduation get priority over "seniors" who have simply accumulated hours by placement exam.

That gesture was typical of President Faulkner's cordial, informative appearance at the Student Engineering Council's second Town Hall meeting of the semester. After sharing a brief biography of his life as a student, researcher, professor, and administrator at the University of Illinois, Harvard, and Texas, Faulkner addressed some issues he thought would be of particular importance to technical-minded people in the near future. He then fielded a variety of questions from an audience that had arrived sleepy on a Tuesday evening but perked up throughout the meeting, thanks in part to the Pappasitos fajitas served courtesy of the SEC.

Engineers might be glad to know that our President was once an engineering student. But courses at that time lacked AutoCAD and required manual drafting. For a left-handed student using equipment designed for the right-handed majority, "[drafting] was absolutely excruciating." So Faulkner changed courses and entered the chemistry field, where he completed undergraduate studies at SMU and later received a Ph.D. at the University of Texas. After completing his post-graduate studies, Faulkner taught at Harvard University and the University of Illinois, where he became Dean of the school of Arts and Sciences and later Provost. In 1998, he returned to Austin to succeed Robert Berdahl as President of UT.

Among the issues addressed by Faulkner was discussion of the future of nanotechnology. "In my judgment, there aren't any more important programs for this campus than what we're doing in [nanosciences, nanotechnology, and biomedical engineering]," he said. "What's happening in nanosciences and nanotechnology is going to transform the way we think about 'major' subjects in science and engineering." Using biology as a parallel, Faulkner explained what he thinks will happen to the way we think about the organization of our academic units in the future. Zoology, botany, and microbiology no longer exist

Continued on page 16

Incoming, outgoing SEC Presidents share friendly rants

Zack Warren
SEC President

As I finish up my third term as a co-op, I find myself increasingly confronted with the unpleasant aspects of being an engineer: the EE's get to drive the project objectives (I'm an ME), office politics are a constant struggle, and design parameters continually change to incorporate new ideas, leaving us to backtrack and retrofit all the time. Then, I think to myself, "Gee, I'm glad I'm not a business major! At least I get to deal in concrete ideas and practical applications. At least my whole occupation isn't based on silly things like 'goals' and 'teamwork' and 'synergy.' Thank goodness."

Yet I realize that when I leave work at the end of the day to start working with student organizations, that's what we do. We have to work together if we want to build something bigger than any of us alone can accomplish, and we must set goals to be able to remember what we were trying to do in the first place. With that in mind, I have divided my goals into three categories: Student Engineering Council, engineering societies, and the College of Engineering as a whole.

SEC

The Student Engineering Council at the University of Texas at Austin is a remarkable group. As we enter our 50th anniversary celebration, we continually work to improve our standing within the College and the University. We have been named one of this campus's best student organizations by the UT Leadership Board for the last two years, thanks in large part to serious continued involvement in a variety of programs and activities.

While all these signs point to our success, we have a lot of work to do. Attendance at our meetings is frequently very non-representative of the engineering societies. We are in the process of unveiling an entirely new website, as our current site is showing its age - Oh, the humanity, the old site uses frames! I also hope to continue to support the programs we already have in place, particularly Town Hall Meetings, EXPO, and E-Week.

Engineering Societies

Study after study has shown that students who get involved in their campus activities stick around to get their degrees. The engineering societies are the most important way that we can get students involved, which makes getting an engineering degree on this campus easier and more fun. The SEC needs to continue in its role as an umbrella organization for these groups, and support them in every way possible.

Through our new website, we hope to generate an archive of resources that can help new organizations get their feet wet, as well as ease the transitions between groups of officers in established societies. I also hope that the SEC can assist organizations in their recruitment of new members by reaching out more to freshmen and transfer students. We will also continue to support the societies through the society fund. These efforts cannot succeed without the input of societies, which means we need better attendance and participation on the part of the society representatives.

College of Engineering

The SEC, as an organization, wears a lot of hats. We put on our own events, we help other organizations put on events, and we attempt to act as a sounding board and liaison for students, faculty, and administrators within the College of Engineering. In that context, I have several goals for the College as a whole.

Engineering degree programs have a bad reputation as a quick way to demolish your GPA and send you to the dreaded Land of the Undeclared. Retention is an issue throughout the university, but it is particularly acute among freshmen and transfer engineers. By bringing more first year students into the engineering societies, we can help them find a home in this college, which will help them to succeed. At the same time, we can increase the likelihood that the societies will stay active and relevant in the future. I hope that the College of Engineering community can come together to welcome new students in an intentional, inviting way.

Probably the most frequent complaint of current students involves the handling, cost, and policies of student advising. I would like to help the College educate students on how to handle such complaints and help students get somewhere with their complaints when they experience frustration with the administration. In the days of self-advising and internet-based registration, most students seem content to idly complain, without making any effort to explore the heart of their issues. Communication between the advising offices and the students needs to improve in both directions.

Finally, I hope to improve the quality of life for engineering students. We need more food service options than the roach coach and the RLM coffee stand. We need more space to study and more computer labs to work on projects and lab reports. The SEC was founded on the idea that engineers needed a place to study and congregate. As the College grows and evolves, the "Ant Farm" feel of our surroundings will hold us back. It's up to students to initiate and support real efforts to improve the spaces that we all use.

I encourage you all to participate in your societies and come to SEC meetings. It's a lot more than just free pizza. We have many opportunities for you to develop your own leadership style, and it will be a step toward improvement of this campus. ✓

Chris Johnson
SEC XPrez

I have been lucky to have had deep involvement with organizations such as the Student Engineering Council during my term as an undergraduate at UT. Although that term will end in May when I graduate with a B.S. in Electrical Engineering, the experiences and friendships will stay with me and help me in my future.

I came from a family of UT grads. My father graduated with a civil engineering degree and my mom with a degree in nutrition. Why is this relevant? Mostly because these influences helped to shape my own journey. I have always had a respect for technical disciplines, and I grew to desire training in engineering for my own college career. Being curious about how the world works and how to fix and improve things, engineering was a natural choice for me. Most importantly, I think being an engineer is about contributing tangible things to others in society.

I studied hard in high school, a little too hard, and came to the University thirsty for social and political involvement. I know many of you are curious why it is important to be involved with student organizations. Part of the engineering discipline is to understand both the social and political environment surrounding technical decisions. We engineers do not live in a vacuum, and neither do scientists. Therefore, a great way to learn about how society functions is through involvement with organizations. While in college the most natural course of involvement is through student organizations. Throughout my terms serving as Student Government rep for engineering, organizer and participant in many SEC projects, and finally as President of the SEC, I have had a taste of how people work together to achieve a common good.

We all appreciate things such as the EXPO career fair, E-Week, and other fun and enriching events put on by all student organizations. We also benefit from the work of the Student Senate (formerly the Cabinet of College Councils) in promoting our academic interests. Recently, for example, Senate has worked toward implementing the first steps of an academic honor code. This will bring more prestige to UT degree holders in the national market, believe it or not. Student Government has served to reopen the Tower for tours, one of which I went on recently with my younger sister and her friend as they prepare to apply to UT. SG has also implemented important surveys and changes in things such as more lenient hours for parking (on the signs) and a better shuttle bus system.

Then we have the engineering student organizations, which undeniably bring life and vibrance to UT's social scene with picnics and barbecues, talks with faculty, career connections, corporate speakers, class preparation, tutoring and many other events.

In short, it pays to be involved with student organizations because you get to learn about how people work and how to work with people. We as professional engineers and as citizens in general must continually hone our social skills and our ability to function in many different environments. I have learned about dealing with personality conflicts, managing projects and deadlines, representing the views of others fairly (even when mine might disagree) and acting upon them, and cultivating the vision for future directions of the SEC. I cannot emphasize enough on the importance of stepping out and becoming involved and how it can influence your personal growth.

Why the Student Engineering Council? SEC is a unique place where you can learn about all the things that go on with students in the college. It is an organization that has a huge impact on many people, even if the SEC has little contact with your society or with you on a personal basis. It is also one of the few ways that students can interact with and influence the Dean, the administration, faculty, and all others who shape the academic environment.

Lastly, I have had the opportunity to get to know and work with some of the finest and coolest engineering students here at UT, which is a great privilege. It is a real thrill to be able to learn from my fellow officers and other SEC members about life, UT, classes, and how to get things done. Each person has his or her own style, and I enjoy learning that and sharing my own style with people. It has been said by Zack, who is the new prez, that simply gathering a group for five minutes in the SEC office can lead to explosive fun and productivity. In my experience, that has been true.

The Student Engineering Council has done some great things and has a bright future with the other organizations and the college. It was founded in 1952 to help organize students to dig a basement study lounge in Taylor Hall, and the SEC has since established the career fair, the Halloween Canned Food Drive, and many other fun and important events and services. It is a uniter, and I hope to see it unite you with others in the coming years. The SEC has bright plans slated, such as a 50th anniversary this fall and perhaps an exciting new concept for Town Hall Meetings involving high-level speakers.

What's next for Chris? I will continue to be involved with the college and the SEC even as I prepare to graduate, helping to upgrade the SEC website and introduce some other tools for collaboration. I plan to pursue further classes at UT in the fall as a graduate student and I will continue working as a programmer at a local software firm in the meantime. Look for more in this space and elsewhere, and enjoy the rest of the semester! ✓

Special: The Vomit Comet Diary

on the plane I could see the entire range of human emotions. The team from Drury University was next to us and they seemed nervous and apprehensive. Others nearby looked timid but excited about what was to come. Jay and I were focused on our goal, but we still had trouble hiding smiles. When the experiment was ready I had a few moments to reflect on where I was and what I was about to do. The only word that comes to mind is "stoked." I wanted the experiment to work but knew that the experience of floating in microgravity, the reason we got the project started in the first place, would be great regardless of any malfunctions with the apparatus. In thinking these thoughts I knew I was asking for something to go wrong, but I didn't care. Sooner than I expected we were pulling into the first parabola. Everything on the plane was pulled to the floor with an apparent force of double its weight. I was sitting up against the wall of the plane, and as we pulled up I could feel the blood draining from my head. My vision was affected momentarily, and the funny feeling I had during takeoff came back in a big way. I felt nauseous but I repeated the trick of focusing my eyes on a fixed spot, something the NASA instructors had taught us, and before too long the weight lifted. The transition to zero gravity was gradual at first. The feeling of heaviness went away and I began feeling lighter. More suddenly than anyone was ready for, microgravity set in. Anyone who had been trying to stand up the instant before suddenly flew up against the ceiling, the resistance to the pressure on the floor suddenly gone. Any feeling of sickness was gone once we came out of the first pull-up. At the end of microgravity the flight directors yelled "feet down, coming out!" and everyone pointed their feet in the general direction of the floor before collapsing like rag-dolls when the next period of 2-g acceleration set in. People watching the live video feed from the ground said the pull-up at the end of each parabola was hilarious to watch – a plane full of people falling helplessly, and quickly, to the ground as if they had just passed out. Jay and I took it easy during the first few parabolas, letting ourselves float off the ground and orienting ourselves to the sensation of weightlessness. We knew that our experiment had limited fuel and could only complete about ten parabolas before running out of methane, so we were in no rush to get the experiment started. By the tenth parabola Jay and I had the hang of floating in microgravity. Jay had already started doing flips and showing off for the cameras, so we got set to start the experiment.

After the turn around we went into the next set of parabolas – I had given up on sitting against the wall during the 2-g phase and was instead lying flat on the ground as Jay had been doing. We had been through the experiment a thousand times, and Logan's control program was extremely easy to use. We went into the eleventh parabola and began the experiment. The flame lit after a few tries from Jay, which was a relief since the igniter system was one of the weak links in the experiment. The camera started recording and the speaker started pulsing the flame. Jay said that the flame looked beautiful - tall, narrow, and straight as we predicted – and that the data would probably look great. After 3-4 seconds the flame shut off automatically, and I started downloading the pictures just as the plane went into the 2-g phase. The experiment worked like a charm! With all the little bugs we had seen and all the problems we had it was amazing to me that the thing worked, especially since we had done everything on such a hectic schedule. Now we had to wait for the pictures to download and repeat the process until the fuel ran out. We both felt great. Superimposed on the ear-to-ear smiles we had from floating around the cabin was a look of pride that we had been successful despite all the challenges.

My happiness that the experiment was working was interrupted when I saw the two LED indicators on the apparatus. The LEDs were there to indicate the status of the solenoids so that we would know if anything was going wrong. At this point in the experimental procedure there should have been one LED lit up and the other off, saying that both solenoids were closed and no gas was flowing. We were just sitting through the 2g phase waiting for the next parabola, and everything had run smoothly, but both LEDs were on. As soon as I could, I tried to fix the problem. My reaction time was way to slow, however, and by the time we went into the next parabola we were completely out of gas. We tried to run the experiment one more time, hoping that we had a little bit of methane left, but no luck. We had small tanks and the short period of open flow had depleted our fuel supply, and our experiment was over. Given the situation, it was hard to be too upset by the failure, but the speed with which the malfunction occurred was devastating. Just 30 seconds before we had been celebrating the success of the first run, and now the whole flight was over, at least as far as the experiment was concerned. Two years of work for three seconds of data... now I know how NASA engineers feel.

With the experiment finished, there was little left to do but enjoy our time in microgravity. I switched from focused-scientist mode to kid-in-a-candy-store mode, and started doing flips, standing on the ceiling, and generally just having a good time. Jay did likewise, and we soon broke out our cameras to start taking fun pictures. Soon it was our turn to talk to the ground over the live feed, so we stopped playing and put on our headsets. We talked to our teammates, describing the failure and discussing what went wrong. We did a little interview with the NASA photographer, said our good-byes to the ground, and took off the headsets.

Soon, another NASA photographer came by taking still photos of the groups performing their experiments. She asked us to pose as if we were doing real work, so I took the opportunity to stand on the ceiling and type on the laptop. Jay floated into similar cool-looking positions and we had a regular photo shoot, both of us trying to outdo the other and get the coolest photo.

After about the 30th parabola students began dropping like flies, throwing up into the little bags NASA issued and being escorted to the back of the plane to ride the rest of the flight out. As they left, the front section of the cabin where we were opened up, and Jay and I had more room to mess around during the parabolas. By now I had no sensation of being sick at all, and was just having the time of my life floating around. My favorite maneuver was pushing very gently on the wall at the beginning of the parabola and slowly drifting across the cabin with a small rotation rate. I felt complete isolation, and if I closed my eyes it felt like I was the only object in the universe, floating completely independently from the objects around me. It was like drifting underwater in a swimming pool, except a lot more comfortable and free.

After several more parabolas, when I was trying to squeeze the last bit of fun from the flight before we had to land, I noticed Jay wasn't playing around so much anymore. I realized he was beginning to feel sick, something I expected because he started doing flips and messing around very early in the flight. I snapped some photos of him lying on the floor of the plane, not looking too great, for posterity and because I thought it was funny. On the 38th parabola it happened. Jay was the last person on the flight to get sick, and I got a pretty good photo of him holding the little bag. He sat out the last two parabolas, and we went to the back of the plane to sit down for landing. Despite getting sick towards the end, Jay had a great time, and our teammates could tell from our expressions that they were in for quite a ride. They were scheduled to fly the next day. We posed for some pictures in front of the KC-135 with the rest of the people on the plane, and went to the post-flight briefing.

The next day, our last in Houston, Jay and I went down to watch the downlink from Nick and Jamin's flight. We were unable to talk to them, but we saw them on camera and could see what they were up to. The experiment gave them the same trouble it had for us. We never figured out what went wrong to make the fuel solenoid get stuck open, but they made sure to open and close the manual valves between each test so that the same thing wouldn't happen again. It didn't, but the flaky igniter system acted up and they wasted most of their fuel lighting the flame. Like us, they got one good run for which there were decent data, and then they had nothing to do but play in microgravity. It was hard to see Nick from the screen on the ground, but Jamin appeared to be having lots of fun. He had remembered to bring the yo-yo that I was planning to take up the day before but forgot, and he was doing little experiments of his own to see what the toy did in reduced gravity. He was floating around and having fun like Jay and I had the day before.

Sentimental. It was fun to see my teammates from the ground but also made me a little depressed. The whole experience had come and gone so quickly, and I wanted more than anything to go back up and do it all again. Since the time I set foot back on the ground I've been thinking of ways to get back up there in that plane (or something else like it) and feel those sensations again. It was over for now, however, and Jay and I greeted our teammates when they landed. We shared our experiences with one another and talked at length about every detail we could remember about our flights. We were happy that the whole thing had been a success, but shared a common feeling of sadness that we had to go back to our normal lives stuck on the ground.✓

The science of it all

Jay Berger
Contributing Writer

A group of students from the University of Texas participated in the 2002 KC-135 Student Flight Program which is run through NASA-JSC. With much help from the Department of Aerospace Engineering, they studied the effects of buoyancy on an accoustically pulsed non-premixed, laminar jet-flame. One of the specific goals behind their experiment was to develop a better understanding of turbulent flow. They used a speaker mounted under an exit flame nozzle to pulse the speaker at different frequencies and amplitudes. This gives a repeated excitation to the flame which makes it easier to analyze. Turbulent flow in general is very hard to study . However it is basically a wild mixture of many laminar flames. So this experiment is somewhat on the middle ground between laminar and turbulent flames which when analyzed should give useful data about turbulent flow.

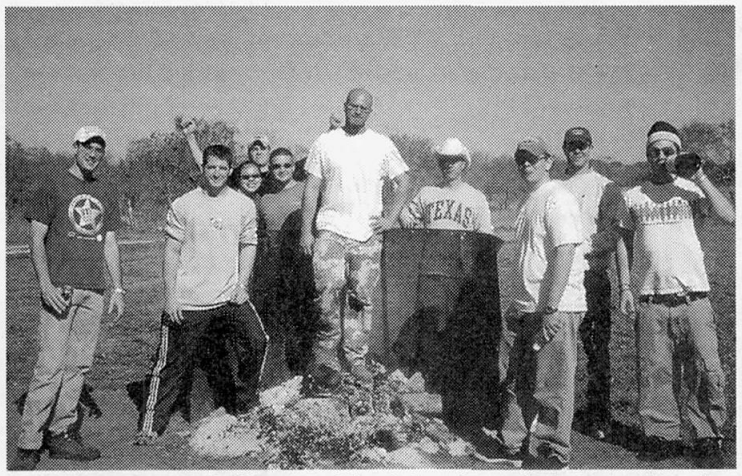
The reason the experiment is required to operate in a zero-gravity environment is to minimize the effects of buoyancy on the flame. In a normal one-g environment, gravity plays a major role in the development and characteristics of flames, especially turbulent flames. When analyzing turbulent flames on the ground it is hard to decipher if the flame is responding to normal 1-g force or if it is responding to a particular characteristic of the flame. If the experiment is performed in zero-g, the buoyancy effect is not a factor and the flame may be studied in its pure form. This allows for extremely precise data on turbulent flames and allows for a comparison to be made between the zero-g and one-g flames. ✓

Looking for something fun? ASME is the place to be

Nathan Stahl
Contributing Writer

The American Society of Mechanicl Engineers (ASME) is an organization that tries to bridge the gap between the academic and social facets of college primarily for students enrolled in the Mechanical Engineering program. With this goal in mind, ASME organizes events to cater to the various wants and needs of its few hundred members.

At the end of March, members of the organization elected a new officer group. These new officers want to bring forth a new face to the organization and will make ASME the best it can be for its members. The officer group is always open to innovative ideas and suggestions on how to bring out the best of the club for you. If you are interested in being a member or have any fresh ideas to share, feel free to email the new president, Ellen Bayer (ebayer@mail.utexas.edu), or just drop by the office in ETC 2.104.



ASME members and officers work hard, but always find plenty of time for fun. The Sping and Fall Retreats give these students a chance to see the great outdoors and get a breath of fresh air.

The following is a list of current ASME events and benefits.

Study Files. One of the greatest benefits of being an ASME member is access to the huge selection of study files. Accumulated over the years, it is an excellent source of old tests, homework assignments, and projects. These files are made available to members in order to help them become more prepared and study more efficiently. ASME always accepts any donations of such academic stock. So, if you have stacks of old homeworks and tests collecting dust in your apartment or just never want to see those evil documents again, know that there will always be a place where they can feel loved and accepted. Donations are always welcomed whether you are a member or not.

ASME members get ready to barbeque at a Friday in the Park with Billy Wood, ME undergraduate advisor. From left to right: Nathan Stahl, Nick Cune, Todd Scaggs, Wood, and Michael Bruns.

Speaker Meetings. Free food! Now really, what more could you want? Besides the obvious answer to those hunger pangs when you are stuck at school in the evenings, speaker meetings are a great way to start figuring out what you want to do when you graduate. They also provide students with an opportunity to talk with people in industry and yet another opportunity to practice networking skills. Whether you are in the market for internships, co-ops, or permanent employment, this is the place to be and be seen.

Tech Classes. So you like learning about exciting new topics, but you are not so keen on homework and tests? If so, this is definitely the event for you. Scheduled in the evenings like speaker meetings, tech classes offer a chance to learn about the fun things that are left out of your regular classes. They can cover a variety of topics and give you a chance to see a potential professor's lecture style. Besides nourishing yourself with more free food, you can always go home more enlightened without having to take a test or even lift a pencil.

Friday in the Park (FITP). This event is likely one of the most popular and most social. It has also become an ASME tradition. They occur appropriately on Friday afternoons, and FITP's help people to transition from the stress of the week to the relaxation of the weekend. Adam's Park, the usual location, is a short walk away, where a big, grassy area surrounded by trees will greet your arrival. When not eating barbeque or shooting the breeze with your fellow classmates, there is plenty of time to play basketball, ultimate frisbee, softball, or you can just sit back and relax.

SFITP. April 19th is the first ever ASME **Super** Friday in the Park. Instead of the usual hamburgers, hotdogs, and sausages, there will be a Tony Chachere's-inspired shrimp and crawfish boil. Instead of Adam's Park, SFITP will be held at Pease Park, which is the second reason this FITP will be super. For those of you who have been around a while, remember what was so cool about FITP three years ago? Transportation will be provided to the Park, located in the Shoal Creek Greenbelt near MLK and Lamar.

Fall and Spring Retreats. Once a semester, ASME offers a weekend retreat. Usually this consists of a camping experience away from the city. These retreats occur toward the end of the fall semester and the beginning of the spring semester, so that building a fire is actually necessary. In the past the themes of these events were "leadership," but recently there has been a shift toward "team building." All in all, retreats offer an excellent opportunity to meet people and have fun.

Round Rock Thursday. On Thursday, April 18th, ASME is taking a group to the Dell Diamond in Round Rock for a night of minor league fun. The Round Rock Express is a minor league baseball team (AA) in the Houston Astros' organization. The team was started by Texas native Nolan Ryan, and games are always full of fun. ASME has conveniently planned this event on a Thursday so that people of age can take advantage of the dollar beer special.

Happy Hour. A few times a semester on Thursday evenings, ASME will pick up the first few rounds at Posse East. There is no a better way to sit down and relax for an hour or two near the end of the week, and anyone who has been to Posse knows that JV will do everything he can to make the short walk to San Jacinto and Duval worthwhile. So even if you can only stop by for a few sips and a few chips, the Thursday afternoon breaks are always a nice way to give yourself a pat on the back for working so hard.

T-shirt Design Contest. Every year ASME hosts a T-shirt design contest for the new shirts to be proudly worn by ASME members all over campus. You can enter whether you are a member or not. Look for information and contest rules soon if you have a great idea for a new T-shirt design that you want everyone to see.

Intramural Sports. ASME almost always has an intramural team in each IM sport. Right now, the only sport going on is softball. To join us, head out to the intramural fields Sundays at 7 pm. Everyone is invited. But don't forget IM football, volleyball and basketball next year.

Broomball. A couple of times each semester, ASME challenges another engineering organization to a friendly game of broomball. Broomball is a lot like hockey, except with tennis shoes instead of ice skates, brooms instead of hockey sticks, and a ball instead of a puck. Okay, maybe it's not like hockey, but there is ice and a lot of running towards a goal. The last ASME victim was IEEE, who was shut out 2-0 If you have not played before, it is definitely worth coming out to see. The ice serves as the great equalizer, since everyone falls *at least* once. ✓

2002-2003 Officers

President	Ellen Bayer
Vice President	Nathan Stahl
Secretary	Carlos Galan
Treasurer	Jennifer Rupe
Corporate	Sam Gatzert
Publicity	Meredith Estes
Social	Chris Kurr

Upcoming ASME Events

April 17	Speaker Meeting
April 18	Round Rock Express Game
April 19	Super Friday in the Park
May 1	Speaker Meeting

Special: Zero G Engineers

Continued from page 9

when he saw our project sitting there half-built. I could tell he was an engineer in the making from the emphasis in his voice when he said, "that's what I want to do" to his mom. It was a proud moment. We weighed the device from time to time, but we were so close to the 300-lb limit that we really couldn't tell how much weight we had to trim – our best guess was about 40 pounds. After a period of brainstorming we decided to make last minute structural changes to cut pounds. During the week leading up to our departure we brought the control system Logan had created online and put the systems together. After more weight shaving and debugging, we departed Wednesday night, March 6. I went home after working on the apparatus all day to get some sleep before the drive and pack my bags for the week in Houston.

We left between 11 pm and midnight in a rented SUV, our experiment 90% complete in the back seat. I drove Jay's car and he drove the SUV, since Jay was the only team member authorized to drive the SUV. Those on the team who were not going to Houston – only 5 of us went down – now had to relax and enjoy their Spring Break while trusting us with the product of so much of their work. From now on they had to rely on phone calls and emails from us to tell them how the project was going. Driving to Houston in someone else's car on about 30 minutes of sleep was interesting; luckily I had grown accustomed to operating with no sleep and the drive went smoothly. We all arrived in Houston early Thursday morning. In just over five hours we would drive to Ellington Field in Clear Lake to check in for what was sure to be one of the most memorable weeks of our lives.

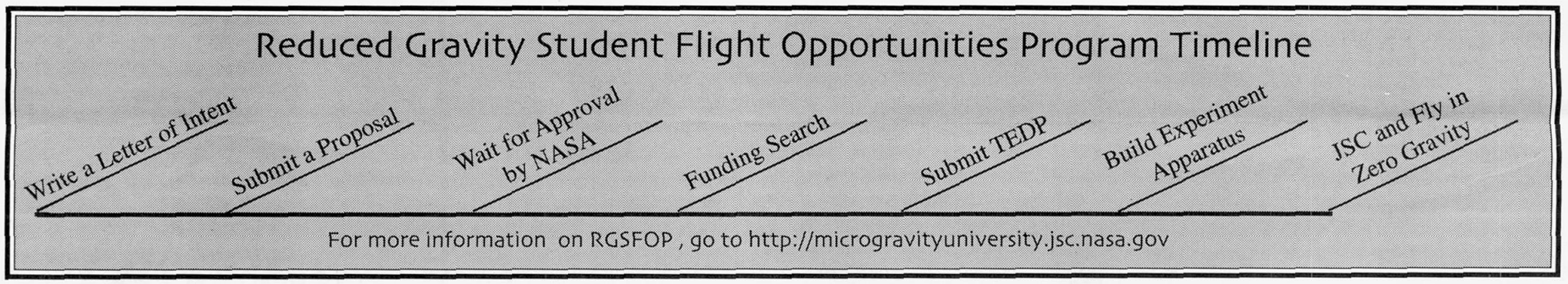
At the airfield. We found the airplane hangar at Ellington by shear luck. When we arrived we saw the "Super Guppy," a very large transport airplane that is well known for transporting space station components and other oversized cargo, parked outside the hangar. To one side of the hangar was a division of the Texas Air National Guard and on the other was a huge span of runways and taxiways. In our week there we saw about a dozen Apache helicopters parked every morning, regular landings and takeoffs of F-18's and other cool aircraft of various descriptions. When we went inside the hangar we saw an experimental high-altitude jet parked on one side, and a section roped off for student experiments. After a welcome from the staff of the Reduced Gravity Office (RGO), the people that run the program, we unloaded our experiment and set up our equipment on the tables they provided. Immediately we got to work putting the finishing touches on the experiment. Wires had to be tucked away, the computer had to be set up correctly, and some components still needed to be mounted. Of the teams there, about ten in all, we seemed the least prepared. There were teams from all over the country, including a team that had driven from Vermont and another from Montana. The list of projects made us wonder why we had chosen such a tough experiment to execute. Many schools had very simple experiments that probably didn't require half the work ours did but were ingenious in their own right and often quite impressive. Rest assured that the team from UT had the heaviest, most complicated, and coolest project there. Most teams avoid things like flames and pressure systems because they present considerable hazards that NASA engineers don't like at all, but our project took on just about every challenge in the book and I was proud that ours stood out from the rest. We had plenty of time to work on our experiment but there was plenty of work to be done, and we had from Thursday until Monday to get our experiment in full working order. The next hurdle was the Test Readiness Review (TRR), when a group of NASA safety engineers examine every aspect of the experiment, including the apparatus and the procedures to use it, trying to find reasons why it might be unsafe. Monday's TRR was the sole remaining hurdle between us and a flight on the KC-135, so we got to work.

Trouble. Our first problem came early, when the RGO officials told us that the pressure regulators and valves we had brought to use on our refueling tanks were not certified and that we could only use valves that had been calibrated, tagged, and stamped by a NASA technician. We had to wait for them to provide valves that met their requirements in spite of the fact that we had been using the valves for weeks and had borrowed them from a lab in WRW where they were used all the time. NASA policies win every time, so we had to wait while they brought us what seems like every possible combination of valves that were wrong in some way – incorrect relief valve settings, faulty gages, you name it. It wasn't until several days later that we had everything we needed, and we couldn't test our experiment until they had sorted it all out. The guy in charge even misspelled methane when he labeled the regulators. We also had a minor problem with our structure, but it was obvious looking at our apparatus, nicknamed "Sherman" because it's a tank, that it could take any loads the KC-135 could throw at it. Logan didn't come to Houston, so I had to make quite a few phone calls to change small nuances in the program that controlled the experiment. Eventually everything came together and the experiment appeared to be working correctly. We passed the TRR easily, with only a few issues regarding – guess what – the certification stamps on our pressure system. Professional inspectors had checked the system but it was lacking some stamp of approval that it needed. Otherwise we were all set to fly.

The Friday after we arrived we were sent to complete physiological training. The training consisted of a four-hour classroom session and a trip to the Sonny Carter Neutral Buoyancy Laboratory where rode in the pressure chamber. They locked us in a room with oxygen equipment and decreased the pressure to what it would be at about 25,000 feet. We then removed our masks and spent five minutes exposed to the sparse atmosphere. The students in the chamber took a simple test with questions like "spell your name backwards." The purpose of the test was to show you how the brain turns to mush when it is deprived of oxygen. The experience for me was a lot like drinking tequila, except that the effects showed up after about 30 seconds and the room wasn't spinning. Most students just sat there and giggled, failing the test miserably.

Before the apparatus could be loaded, it had to be weighed so that the officials could check that we met the requirement and the plane could be loaded correctly. We made sure that every unnecessary object was removed from the device and took it to the scale. We wrestled the heavy experiment onto the scale. The fact that it took four of us to lift the thing was a bad sign, but I stared at the digital readout dial while it decided how much the thing weighed. To our extreme surprise the readout leveled out to 300 on the dot. We hit the weight limit exactly! We were so thrilled at this that we even took a picture. We must have looked crazy cheering for what to an outsider looked like a routine measurement.

After passing all of the tests and meeting all of the requirements to fly, we boarded the plane to mount our experiment to the floor of the aircraft. To our dismay we found that the holes on our experiment where it's supposed to bolt to the floor were aligned wrong. We couldn't line them up to bolt the experiment down, and we had to find a new way to secure the device pronto. As they always do, the NASA guys demanded that we complete an analysis to prove that the new way of bolting down was safe, so I ran back to the hangar to get started. Very frustrated that such a simple thing would go wrong when so many complicated things had gone smoothly, I tried to think of an easy way to secure the apparatus without drastically changing it. I had just about given up when Jay's mom, who was there to see Jay fly and offer support, came in from the plane and told me that they had managed to bolt the apparatus down by brute force. I was relieved to say the least.



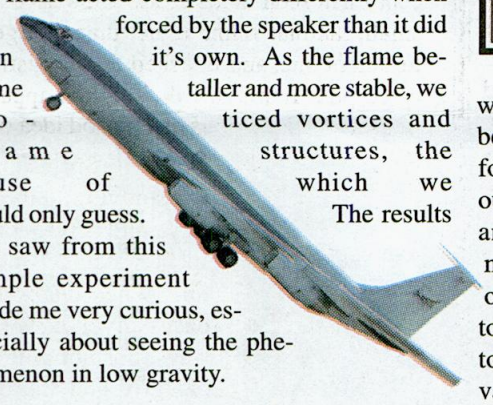
About an hour before takeoff, everyone scheduled to fly was called into the RGO to receive the optional motion sickness medication. Called SCOPE-DEX, the medication is a combination drugs that simultaneously dulls the senses and raises the heart rate, given to anyone who takes it. It is a strange sensation indeed. The medicine helps your body ignore the mixed signals it gets when the information from your eyes, your inner ear, and your past experiences fail to agree with one another. The end result is that people who take it are less likely to get sick during the flight. I'm usually suspicious of medications, so I was unsure whether I would take the medication. I swallowed my pride and took the medicine because I knew how stupid I would feel if the whole flight was ruined by my fears of a well-tested and proven substance.

Flight. The SCOPE-DEX gave me a very uneasy feeling while the aircraft was taking off and climbing to flight altitude. The sensation was similar to the feeling I get when I've had too much to drink and I'm trying to endure a car ride home from the backseat. I found myself focusing on a fixed spot on the seat in front of me and riding the whole feeling out. Once we got to altitude and had the chance to walk around the airplane, the feeling went away. Until then everyone onboard was seated in the rear section of the airplane with seatbelts and seats like those on commercial airliners. The rest of the plane was open, with white padded surfaces everywhere while the only rigid objects were the students' experiments and the light fixtures. We spent about fifteen minutes unpacking the stowed items like our laptop and personal cameras and getting the experiment ready for the first parabola. On the faces of the students

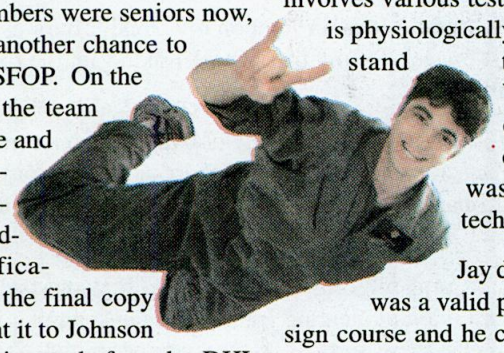
Special: The Vomit Comet Diary

that disturbing a flame with sound waves has interesting effects on the nature of the flame, including reduced soot production and increased stability. We met with Dr. Ezekoye to discuss the possibility of including acoustic forcing in our experiment. Dr. Ezekoye let us perform some simple experiments in his lab that gave us an idea of the effects of acoustic forcing on the airflow out of a nozzle (we used incense smoke instead of flames for the first experiments). He also let us borrow a speaker and showed us how to set up experiments of our own. Jay bought a funnel and some hardware, and he and I got to work on some further experiments.

Taking advantage of the opportunity to play with fire, Jay and I talked to Isaac Boxx and Dr. Clemens to arrange an experiment in one of the labs in WRW. Using duct tape, we connected the small speaker that Dr. Ezekoye gave us to a funnel, and we set up a nozzle connected to a fuel source. We hooked up a home stereo amplifier and a function generator to pulse the flame, and set up the apparatus in a place where the exhaust gases could be removed from the room. We began looking at the effects of changing the frequency, amplitude, fuel flow rate, and other aspects of the experiment. The results were encouraging – the flame acted completely differently when forced by the speaker than it did on it's own. As the flame became taller and more stable, we noticed vortices and flame structures, the cause of which we could only guess. The results we saw from this simple experiment made me very curious, especially about seeing the phenomenon in low gravity.



The Second Proposal. We bought the materials for a better, safer experiment setup and continued testing our idea. The team broke into groups and began writing a new proposal. For about a week during midterms, team members focused all their attention on the proposal and worked to tackle each of the requirements set forth by NASA for the proposal. The pressure of the situation was greater than ever, because most of the team members were seniors now, and would not have another chance to participate in the RGSFOP. On the day of the deadline, the team stayed on campus late and finished the first complete draft of the proposal. After proofreading and final modifications, Jay and I took the final copy to the airport, and sent it to Johnson Space Center five minutes before the DHL truck left for Houston. At this point, all we could do was wait and hope for the best.



Good news. Sure enough, word eventually came from NASA that we had been selected as one of 50 teams from across the country to participate in 2002. Now the real work began.

We had about a month and a half to design the entire experiment and submit a Test Equipment Data Package (TEDP), the document that NASA safety officials use to determine if the experiment is safe and whether or not it would work. Much of the work had already been completed for the proposal, but details for the TEDP had to be completely worked out. Every element in the structure had to be analyzed to show that NASA-prescribed maximum flight loads could be carried without danger. The pressure and fuel system had to be completely described, from the gas tanks to the nozzle including every connector and valve between them. Each component of the control and electrical system had to be documented. Our in-flight procedures, plans for ground operations, aircraft loading schemes and emergency contingencies had to be spelled out in great detail.

Team Members

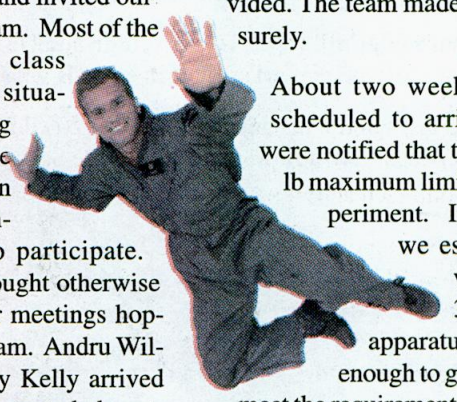
Jay Berger	**Project Manager, Flight Crew**
Waheed Bhuyan	**Ground Crew**
Nick Espinosa	**Flight Crew**
Meredith Estes	**Ground Crew**
Jamin Greenbaum	**Flight Crew**
Stacey Kelly	**Ground Crew**
Logan Kunitz	**Ground Crew**
Robert Wallsgrove	**Flight Crew**
Andru Williams	**Ground Crew**

Visit the team website at http://www.ae.utexas.edu/design/kc135/index.htm

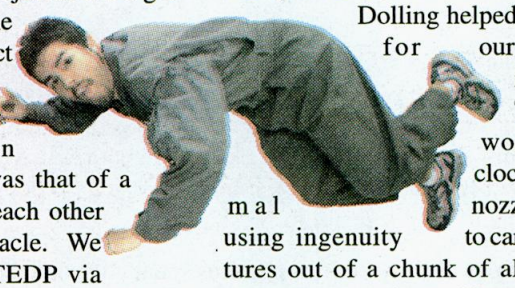
Between being notified that we were accepted and turning in the TEDP, the flight crew had to pass a class-III FAA physical exam, which involves various tests that ensure the patient is physiologically sound enough to withstand the pressures of flight. While most of the flight crew was eventually qualified to fly, Meredith was disqualified due to a technicality. Devastating.

Jay decided that the RGSFOP was a valid project for the senior design course and he convinced the design instructor, Dr. Stearman, to allow us to use the KC-135 experiment as our project. Since four team members were in the class, this decision had a profound impact on our prospects. The likelihood of finishing the TEDP on time was increased greatly, and our experiment was much more likely to be a success.

One condition of the agreement to use the project in the design course was that other students in the class had to be allowed to participate. Jay and I put together a short presentation in which we described the project, told the class about our tight schedule (at this point we had about 2 weeks left to submit the TEDP), and invited others to join the team. Most of the students in the class laughed at our situation, expressing doubts that we would finish on time and declining the offer to participate. Two of them thought otherwise and came to our meetings hoping to join the team. Andru Williams and Stacey Kelly arrived at the meeting eager to help out. Andru was older than the rest of the team and had experience working with hardware. Stacey had no such experience but was optimistic in spite of the amount of work that had yet to be done. The team welcomed the extra help, and in retrospect I realize that we couldn't have been successful without them.



We used the results of our experiments and what little we knew about designing hardware to put together a design for the apparatus. The team had grown to include 10 members, so we broke into groups according to the strengths and specialties of each person. The process of coordinating the group efforts – structure, pressure, electrical, safety, and funding – was a case study in project management. Within each group the technical issues of the project were analyzed, while regular meetings kept everyone informed and on track. The atmosphere was that of a group of friends helping each other confront an immense obstacle. We arranged to turn in the TEDP via email so that we could work longer and still meet the deadline, and worked to perfect the document. Dr. Clemens also read over the TEDP and checked for errors before sending it to NASA for approval. This time there was no suspense involved with the submission.



Building commences. With funds secured, it was time to go on a shopping spree. We had no time to wait for NASA to comment on our design – we had six weeks to build the experiment from the ground up. The structure team bought metal and supplies from the University, the electrical team went to town in a local RadioShack, and the pressure team got busy ordering components from the internet. Dr. Clemens let us borrow a high-speed digital imager, a *very* expensive black and white camera, and Logan and I learned how to use it and integrate it into the experiment's control and data acquisition systems. With the help of all our supporters, we found an accelerometer, two piezoelectric igniters, a photodiode, and other components that we could borrow. Rick Maldonado in the WRW machine shop helped us with building materials. Andru's experience working at a hardware store was invaluable, as he knew details about the "nuts and bolts" of things that our education had not provided. The team made progress slowly but surely.

About two weeks before we were scheduled to arrive in Houston, we were notified that there was now a 300-lb maximum limit on each student experiment. In writing the TEDP we estimated our weight would be well over 300 pounds, but the apparatus was not complete enough to get a good idea if we'd meet the requirement. Frustrated that such an important design requirement had not been pointed out earlier, we had no choice but to complete the design and come up with ways to cut weight.

One component of the experiment, the Pulsed Flame Assembly (PFA), had to be custom built to meet the needs of the experiment. I fired up AutoCAD and designed two parts that would have to be machined. One was a base plate with a specific cross section that reduced damping of the sound waves beneath the flame, and the other was a nozzle chamber that straightened the fuel flow and reduced turbulence in the flame. With about a week and half left before we had to leave, I approached Travis Crooks in the ENS machine shop about getting the job done as soon as possible. He was busy with other projects and I had to work my way through the chain of command to get our job bumped to the front of the line. Dr. Dolling helped out and arranged for our job to get priority in the shop. Travis then worked around the clock to get the abnormal nozzle chamber done, using ingenuity to carve the correct features out of a chunk of aluminum without proper tools to do so (if such tools even exist – there weren't any on campus). He finished the job right on time, leaving a few days to put the thing together and make sure everything fit correctly. If anything had been wrong with the PFA, it would have been too late to fix it and the entire experiment might have failed. The parts fit together perfectly, and the PFA was mounted to the structure without incident.

Crunch Time. The final weekend was the epitome of crunch time. In 72 hours I spent about 60 in the basement of WRW, and the whole team put in about the same amount of time. Delirious from lack of sleep, we constructed our version of Frankenstein's monster like mad scientists. Visitors who came to WRW during UT Explore got a bonus glimpse into the project, and we took time out to explain what we were doing to bystanders. One kid, probably about 10 or 11 years old, came into the lab with his mom and his eyes lit up

Continued on page 12

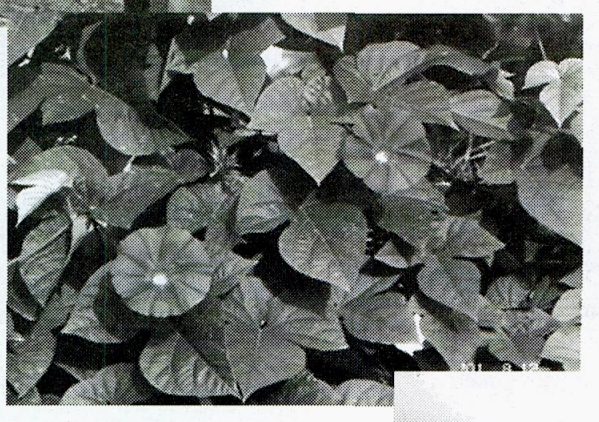
Diary of engineering pilgrim reveals unique journey

Ian Blair
Vector Staff

"Soy perigrino [I am a pilgrim], which is to say, little numbers rule my life for two days more. Whittling away at the kilometer markers cast in stone is what I *do* as a peregrino."

I wrote those words last summer, counting down my 120 kilometers on El Camino de Santiago as one might pluck petals from a flower. El Camino de Santiago is a pilgrimage trail in Northwest Spain. These numbers are etched in trailside stone markers, and they counted down my progress during the four days I walked on the Camino.

The Camino de Santiago, or "Way of St. James," is not typical student travel in Europe. In Paris, nobody walks around with socks fastened to their pack by clothespins—last night's laundry, still damp. The Camino is far from raucous Irish bars and obese Americans wheezing up Italian stairwells. On the Camino, I found a piece of European history that's grand because of its simple endurance. Instead of following the worn tourist trails in my *Lonely Planet* guidebook, for all these kilometers, I followed nothing more than *flechas amarillas*.



Flechas amarillas are yellow arrows, humbler versions of the Star of Bethlehem. Painted on the sides of abandoned stone houses or tree trunks, they always, *always* point the way to St. James' cathedral in Santiago de Compostela, the destination of the pilgrimage. As if by divine will, whenever the trail isn't clear, a flecha pops up to point the way.

During the Middle Ages, the Camino was a great pilgrimage route of the Catholic world. The route was part of the pilgrimage "triple crown": if a believer completed Santiago, Rome and Jerusalem, heaven was a foregone conclusion. Though it fell into disrepair, in the past fifteen years the Camino has risen again with help from the Spanish government and private benefactors. In fact, I think Europe is so delighted with the Camino that they're trying to keep it secret from America.

Each year, hundreds of thousands of pilgrims spend their vacations trickling along different routes, from Lisbon, Seville, and the Pyrenees. Assuming that my average step was 2 feet long, each gram I carried hit my shoulders and kidneys about 198,000 times, once per step during the 120 km meander. Most perigrinos take far more—some walking from even as far as Germany.

Peregrino Ian Blair also had a camera on his pilgrimage through Spain. Here he captures roadside sights and a couple of his fellow travellers in the foggy morning mist.

What did these Europeans think about this garden-variety American who's not even Christian? In the true spirit of the faith, all are welcome—rich and poor, the devout and the carefree. Stubbornly marching over blisters and cobblestones, everyone is a pilgrim, watching periodic kilometer-markers drop as Santiago draws nearer.

Kilometer 111: Just outside the town of Sarria, I sight my first flecha amarilla with a rush of hope, pointing the way to Santiago. Like a true pilgrim, I also have no idea where I'm going to sleep tonight. My Spanish friend Marcos advised me to pack light, so I have these things: one change of clothes, laundry detergent, a toothbrush and soap, a Leatherman, and my journal. I'm walking next to singing Spaniards and wine-drunk Italians, all at our own pace and all intoxicated by the march towards Santiago.

Kilometer 99: Several homegrown businesses bloom during summer to aid the high tide of pilgrims. In tiny Ferrerios, I eat in one such family establishment for about $5.00—a hearty meal of potato soup, red wine, roast chicken, and tarta de Santiago, the traditional almond pastry of the region, dusted with the pattern of a cross in powdered sugar. A family business, the father cooks in the kitchen, the mother runs the register, and the daughters, age 9 and 11, smile as they bring out food.

Kilometer 89: According to Marcos, I could stay each night on the Camino at "refugios," or refuges, spaced along the trail for weary pilgrims. They are simple flophouses, with little more than bunks and bathrooms. Unfortunately, the first in Portomarin is completely full when I arrive at 7:30 pm. Undeterred, I trudge into the evening towards the next refugio, reportedly in the town of Gonzar at 84 km.

Kilometer 84: The sun sets as I pass 84 km, and there's just one problem: I don't see a Gonzar to speak of. In fact, I don't see any town. Just a stretch of naked highway and two buildings on the roadside: the refugio and a small bar. It never occurs to me that I won't find a place to sleep. I walk up quietly to a group of pilgrims chattering in Spanish outside the refugio, and say I need a blanket. A motherly Spanish lawyer pipes up, "This young man needs a blanket, and a bedroll. Who has an extra for tonight?" Several of the other pilgrims are amazed I have no sleeping roll or pad, but someone answered "I do" all the same. The Camino is full of generosity and compassion, and of people who answer yes to such questions.

Kilometer 54: After rising at the psychotic, misty hour of 5:30, I walk with sporadic company through squat abandoned towns before reaching the flourishing town of Melide. Fresh from mass, families fill "La Pulperia" (an octopus restaurant, serving *only* fresh Atlantic octopus) where I eat lunch, with two Germans and the Spanish lawyer who found me a blanket the night before. They all said they were going to continue walking, but the snippets of octopus and the wine got the better of their ambitions.

I return to the huge Melide refugio and talk about the United States with Antonio, a street artist from Seville. Antonio tells me he loves America and "Señor Bush," and I have no trouble believing him, in this town where there are no other Americans. He has walked 35 km per day with a girlfriend he met on the Camino. He has to stop here because his testicles have mysteriously swollen to the size of kiwis, which he pantomimes to me with cupped hands. Then, looking me straight in the eye and nodding earnestly, he swears to return next year to Melide and finish his pilgrimage, all the way to Santiago.

Kilometer 42: I meet a Spanish couple—Victoria and Daniel—from Madrid who speak English, but humor my Spanish. Both are studying anthropology, and Victoria has spent a summer in Austin. When our walking paces diverge, we part ways, but not without a big grin and the trail's refrain: "Buen Camino!" [Have a good walk!]

Kilometer 20: After checking into a tiny refugio, I shuck my clothes and jump into the shower. The funny thing is that I leave my money belt—containing my credit cards, cash, and passport—in plain sight on my bunk. Minor as that might sound, it's a stark contrast to the first 3 weeks of my trip, where I didn't let the thing out of my sight, let alone in a roomful of strangers.

Kilometer 0: I arrive at Santiago in the company of five girls from Barcelona and Madrid. We almost lost the trail in the early fog of morning, but arrive in time for the daily noon pilgrims' mass. Though happy to have reached Santiago, I am outraged by the fact that *there is no marker for 0 km*!

Apparently, inside the cathedral, pilgrims are supposed to stick one hand inside a beast statue's maw. There is also the tradition of banging your head against a pillar for wisdom. When one has been walking for weeks, these sorts of releases are permitted—but alas the line was too long for my weary feet.

Perhaps if they encouraged more Swedes to make the journey—a massage while you wait… ✓

To learn more, email the author at yopu@mail.utexas.edu, or walk the web to www.xacobeo.es/ or http://www.caminosantiago.com/.

Graduate Council wins Alec Building Contest

Kristine Carbonell
Vector Staff

In celebration of April 1st, students weren't putting plastic wrap on people's toilets or slime in people's shoes, but rather celebrating a birthday—Alec's birthday. Alexander Frederick Claire, or Alec for short, is the College of Engineering's patron saint. A statue, which once stood in Jacoby's beer garden, turned into the subject of a historical tug-of-war between the Law School and College of Engineering since 1910. Check out the timeline on page 4 for an accurate Alec history.

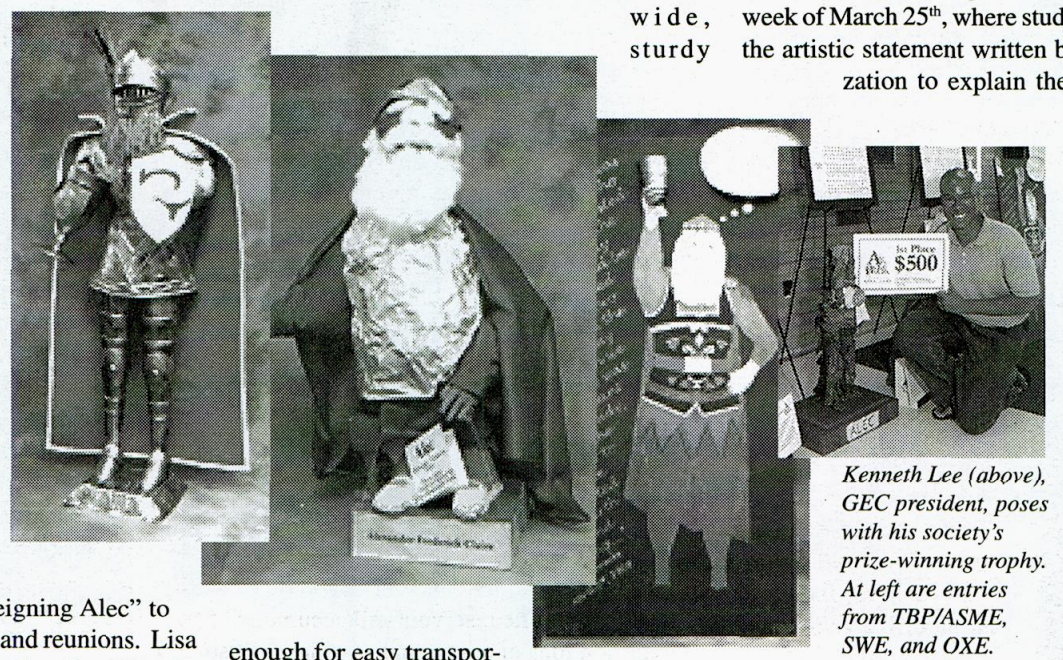
This year, the College of Engineering and Dean's Office hosted the first annual Student Organization Alec Building Contest. Different student organizations competed to build the best Alec statue that would serve as the "reigning Alec" to be taken to College events and reunions. Lisa Schooley, Alumni Relations Coordinator in the Dean's office, organized the event to help educate students on the Alec tradition.

"Most people hear about Alec during freshman orientation. We wanted to do something fun, keep the tradition alive, and the student organizations also get money in return," Schooley said.

Student organizations were given a week and a half and $20 petty cash to build the statue. Other requirements were that the statue be between 2-4 feet tall, no more than 2 feet wide, sturdy enough for easy transportation, represent the values and traditions of the original Alec, and, of course, be creative.

Although there was a small time frame to build, the students stretched their usually inelastic engineering imaginations for this contest. The Society of Women Engineers made their statue from scratch with paper maché, cotton, foil, and a mirror so that students looking at it can feel like part of the tradition.

The four statues submitted were displayed in different engineering buildings during the week of March 25th, where students could read the artistic statement written by each organization to explain the different features of their statues. There was also a timeline behind the statues to give an overview of the history of Alec, a great way to educate students on this tradition.



Kenneth Lee (above), GEC president, poses with his society's prize-winning trophy. At left are entries from TBP/ASME, SWE, and OXE.

"The thing that most students know is that Alec still exists," said Jana Sze, one of the builders of the TBP/ASME statue, which won second place. The only existing part of the statue is the torso, which resides in the Engineering Library in ECJ.

Alec Winners

1st Place:Graduate Engineering Council ($500)

2nd Place: Tau Beta Pi and ASME ($250)

3rd Place: OXE ($100)

4th Place: SWE ($50)

The Graduate Engineering Council won first place. Council president Kenneth Lee, doctoral candidate in chemical engineering, built the statue solely from pieces of bark from the tree where Alec's torso was hanged in 1927.

The winners were awarded on April 1st, Alec's birthday, amidst a sea of balloons and streamers. Friends of Alec staff handed out pieces of cake and bookmarks. Ben Mohler, from the Alumni Relations office, dressed up in an Alec costume and lured students to the celebration inside the ECJ second floor lobby.

For the future of the Alec Building Contest, Schooley plans to give the students more time to build the statue.

"We wanted to do this contest to create a new tradition of stories and reinforce the historical aspect of the College of Engineering," Schooley said. "Overall, I think it was a success." ✓

Moonlight Prowl enlightens

Continued from page 3

ture on campus. It was built in 1904 as the original home of the College of Engineering.

The Prowl gives those in attendance the chance to hear interesting anecdotes, such as how the abolition of the dress code began in 1913, when one student dared to remove his suit jacket. Pranks have been an important aspect of the University's history as well. Prowlers learn why the South Mall statue of George Washington was sporting a bra in 1955 and why Littlefield Fountain, often the source of soap suds, has catered to ducks, canoe races, avid swimmers, and even an alligator taken from the San Antonio Zoo. Nicar explains the lengths some students have gone to obtain exams from professors. One inspired student went on a *Les Miserables*-esque tour of service tunnels and passages to get his hands on a test.

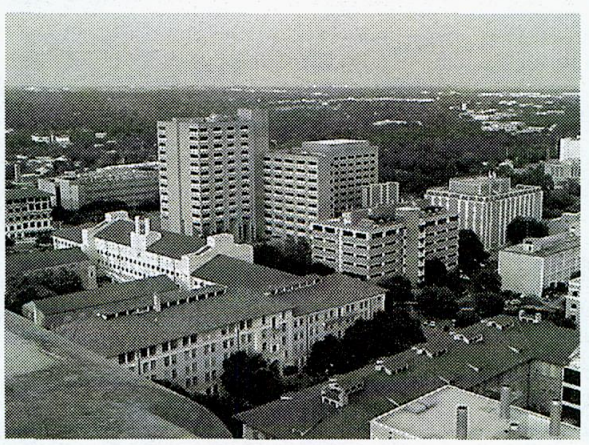
There are some facts relating to our institution which some may choose not to recognize. But by now we should be far enough removed from 1974 to acknowledge proudly the first and only Southwest Conference title for streaking, which we won after a student answered the challenge of Texas Tech's *University Daily* newspaper. Prowlers get to see exactly what path the streaker took across campus without getting caught by authorities. Nicar also explains why UT's colors were almost orange and maroon and how it came to be that Bevo I was eaten by the football team in 1920.

Participants in the prowl can also learn more about the impact of residents of Brackenridge Hall, the first men's dormitory on campus. B.Hall, as it was affectionately known, was built in 1890 to cater to students who could not afford other forms of housing. B.Hall residents not only created the "Eyes of Texas" and "Texas Fight," but also pulled some of the more interesting pranks in UT history. Let's just say they involve some creative costumes and some innocent but very gullible freshmen.

The Moonlight Prowl remains a great way to become better acquainted with the University. Most prowlers I spoke to agreed that they came away from their experience with a much higher level of appreciation for the University, the campus, and the men and women who have walked these same forty acres for more than a century. ✓

Tower view impressive except for RLM

Continued from page 3



To the left is the Texas-shaped roof of the Perry Castañeda Library. The Jester towers somehow do not seem so ominous from up here. Yet, the Darrell K. Royal Texas Memorial Stadium stands proudly under the Tower. When you look to the east, you see the distant fountains at the Lyndon B. Johnson Library. Trees and construction obscure the view of the East Mall. A soaring yellow crane does not quite fit into the picture.

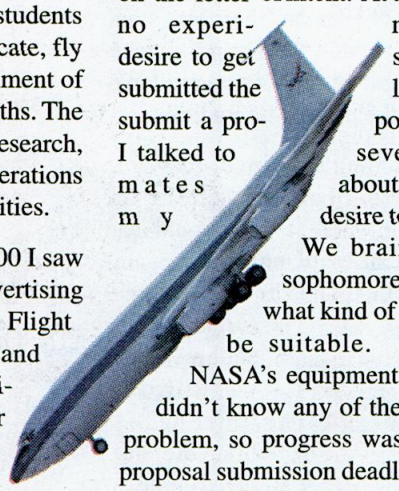
If you look hard enough towards the northeast, you can spot the HEB on Red River, hidden away in the forest of Hyde Park. Look right below you and you see our wonderfully brown engineering buildings. Our second "Tower," RLM, just doesn't quite match up to the main Tower. Unfortunately, it does block the view of my beloved ETC. As you keep moving you see the lush gardens within the Quad and Gearing. The Himalayan pine tree in front of Littlefield home especially makes its presence known from up here. As you move west, you observe the scenic hills and red glow of the forest of signal towers. However, the compact buildings of West Campus quickly grab your attention. You can see just about all your friends' apartments and houses from here. Look a little closer and you will see the white cube of concrete known as UGL. As you approach south again, your eye catches something. The luscious greens within the architecture building, palm trees included. Next, you see the distant glints of traffic on MoPac, and then, the Capitol again.

For over twenty years the observation deck was closed to students. Thanks to student initiative in 1998, it was reopened. I strongly urge all students to take the Tower Tour before graduating. It will be as memorable as the Westminster Chime every fifteen minutes to which we have grown so accustomed. Tours cost $3 and are led every Friday and Saturday except University holidays from the Texas Union. Remember the tour is *only* offered by reservation through the Texas Union Information Center. For information on availability and the schedule of tour reservations, call (512) 475-6633. Hook 'Em! ✓

Special: Zero G Engineers

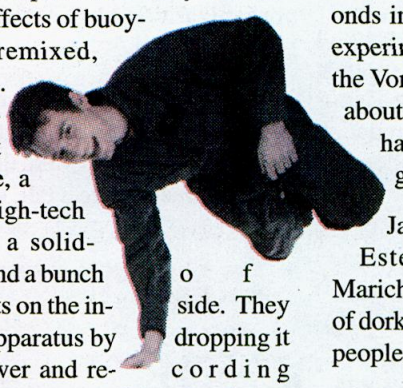
Robert Wallsgrove
Contributing Writer

The NASA Reduced Gravity Student Flight Opportunities Program provides a unique academic experience for undergraduate students to successfully propose, design, fabricate, fly and evaluate a reduced-gravity experiment of their choice over the course of six months. The overall experience includes scientific research, hands-on experimental design, test operations and educational/public outreach activities.



Idea Conception. In the spring of 2000 I saw a flyer outside the LRC in WRW advertising the NASA Reduced Gravity Student Flight Opportunities Program (RGSFOP), and decided to get a team together. Basically, the program is an opportunity for students to devise and carry out an experiment to be performed in zero gravity aboard the KC-135 "Vomit Comet" aircraft. The letter of intent was due shortly after I saw the flyer, so I rushed around to find a faculty member who would support the team. One professor passed me on to another, until I convinced Dr. Ronald Stearman to let me use him on the letter of intent. At this point there was no experiment in mind, just desire to get something going. I submitted the letter of intent to submit a proposal on the due date. I talked to several of my classmates about the program and my desire to get a team going. We brainstormed but as sophomores we had no clue what kind of experiment would be suitable. We didn't have NASA's equipment requirements and didn't know any of the constraints of the problem, so progress was impossible. The proposal submission deadline passed without our getting anything together.

The summer went by and I had, for the most part, forgotten about the RGSFOP when I came back to school. I was taking Dr. Noel Clemens' fluid mechanics laboratory, and he brought in a few of his grad students to show off their research experiment. They were investigating the effects of buoyancy on non-premixed, turbulent flames. They had a drop-rig apparatus that had a pilot flame, a fuel source, a high-tech digital camera, a solid-state computer, and a bunch of other cool gadgets on the inside. They were using the apparatus by dropping it down a drop tower and recording images of the flame as it fell, simulating microgravity. The students, Isaac Boxx and Cherian Idicheria, ran the experiment as a demonstration, and the flame was about two feet high and looked very cool. The gadgets, the big flame, and the microgravity aspect of the experiment all swirled together in my head and I remembered the RGSFOP. Dropping the rig down a drop tower was essentially the same thing as flying a parabola in the KC-135, except the KC lets you fall for 30 seconds instead of one or two, so I thought the experiment would make a great project for the Vomit Comet. I approached Dr. Clemens about it and he liked the idea, although he had a good deal of recommendations regarding the details of the experiment.



Jamin Greenbaum, Jay Berger, Meredith Estes, Nick Espinosa, and Jeremiah Marichalar comprised the team – a good mix of dorks like myself, people who can deal with people, and even an ME major.

During the spring 2001 semester Jamin learned of a program that provides funding to undergraduates interested in doing research projects. He applied and we were awarded our first funds for the project. The grant was small ($1000) but it represented a huge step forward, giving the team confidence that we would actually get a good project going and that we would eventually be floating on the KC-135.

With the help of Dr. Clemens we formed our own experiment based on the concept I had seen in his class. Ours used a small, laminar flame rather than a large turbulent one, and it lacked the sophisticated pilot flame that the original apparatus had. None of us had a good idea of the scientific objective of the experiment, and we couldn't come up with too many practical applications for the data we were to record. Nonetheless the team worked to get a decent proposal in on time. Unfortunately, due in part to spring break and other time constraints, we agreed not to submit a less-than-complete proposal. The semester's efforts were scrapped until the fall.

Jamin introduced a new member to the team, Logan Kunitz. A senior in electrical engineering, Logan had worked at National Instruments and knew a lot about using Labview to automate experiments. He used his experience to design a control system that would make operating our apparatus in microgravity a lot more feasible. Logan had contacts at NI, and when he told them about the project they offered to donate hardware to the team. EE freshman Waheed Bhuyan also joined at this time. Though he had no research experience, he wanted to help out and get involved.

The First Experiments. Back at school in the fall of 2001 and after a failed first attempt, the team put thought into the topic of the experiment and ways to improve it before the next proposal deadline. Dr. Clemens suggested we think about introducing acoustic forcing to spice things up. Jay found out about a professor in the ME department, Dr. Ofodike Ezekoye, who has been conducting experiments involving acoustically forced flames. Much research indicates

Flight week: training and apprehension

Jamin Greenbaum
Contributing Writer

Arrival. On Thursday, March 7th, the NASA Reduced Gravity Student Flight Opportunities Program officially began. Upon arrival, all teams were given a table and work area in NASA's primary airplane hangar at Ellington Airfield close to the Johnson Space Center in Houston. All fine-tuning, ground testing, and subsequent safety reviews would take place at the airfield. The teams, representing universities from as far as Vermont, Montana, and Alabama were welcomed and addressed by the flight directors that would be in charge for the next twelve days. Distinguished astronaut Bonnie Dunbar gave an inspiring keynote address emphasizing her congratulations and encouragement of each of the participating teams. Following the welcome ceremony, the teams were left to themselves to unload and setup their experiments in the work area.

Physiological Training. Friday, March 8th was dedicated to physiological training for each flying member of the university teams and was held at the NASA Johnson Space Center. Training began at 8 am with 4 one-hour lectures concerning different issues in space physiology and the effects of microgravity on humans. Topics included spatial disorientation while in low gravity, the chemistry of the upper atmosphere, and the symptoms and effects of lack of oxygen on the human body. The latter topic, referred to as hypoxia, however unlikely in a KC-135 flight, was addressed to all teams in case of an emergency. The highlight of the experience came in the afternoon when all flight team members were given continued hypoxia training at NASA's training facility. This exercise was intended to further familiarize crew members with the symptoms of the condition by subjecting students to reduced oxygen. A "chamber flight" to an oxygen-equivalent altitude of 25,000 feet was used. After a safety briefing, each team member was fitted with an oxygen mask and all necessary accessories, then led into the hypoxia chamber. Before taking the oxygen out of the chamber to begin the "flight" all participants pre-breathed 100% oxygen for thirty minutes to eliminate the presence of excess nitrogen in the bloodstream to avoid a condition known as "the bends." When taken to altitude and while being closely monitored by flight directors, each student removed their mask and attempted to complete a short quiz of simple mathematics and logic questions designed to illustrate how such abilities are impaired.

Safety Review. The final hurdle to a flight team was NASA's Test Readiness Review (TRR). To fly, all experiments must pass this review. The twelve inquisitive and skeptical safety conscious engineers that carry out this inspection created a serious and intimidating atmosphere. Each team explained their test setup and argued for its safety. If a mistake was detected, it would have to be corrected or the team would not fly. The TRR for the University of Texas passed without a hitch.

Astronauts and Tours. Ten of the twenty teams flew on the following Tuesday and Wednesday, and the remaining ten teams, including UT, flew on the following Thursday and Friday. Before the flights, all teams were given tours of various NASA facilities, attended a lecture by an astronaut representing the European Space Agency, and fine-tuned their experiment setups. Incidentally, the space shuttle crew of the Hubble telescope-servicing mission landed on that Tuesday. Their welcome reception was held in the hangar that the university teams were using. Since NASA shares Ellington field with the U.S. Coast Guard, take-offs and landings of F-16 fighter jets, T-38 training jets, and various helicopters in front of the hangar work area provided further entertainment. Two high-altitude reconnaissance aircraft also occupied the popular hangar. On return from one of their flights, two pilots donning pressure suits climbed out of the planes after flights in a stratospheric altitude close to 70,000 feet.

Zero-gravity. As the culmination and exciting conclusion to a full week of preparation, the teams flew on the KC-135 "Weightless Wonder." All team members were encouraged to use the motion sickness medication SCOPE-DEX, a heavy-duty drug composed of two different kinds of medication to counteract the confusing physiological effects of zero gravity on the body. By dulling the senses and numbing one's stomach, this medication added to the surreal-ness of the experience. Each flight included forty zero-gravity parabolic trajectories. During each parabola, the KC-135 initiates a steep climb with a flight path angle of approximately 45 degrees. After less than a minute the airplane begins the top portion of the parabola initiating the microgravity portion. This effect is experienced for about 25 seconds until the downward portion of the parabola begins and shortly thereafter there is a short period of high-gravity while the pilots start the ascent once again. The complete effect is analogous to a roller coaster ride in which there are hills and valleys. At the top of the hill, you feel yourself jumping out of your seat and in the valleys you feel yourself pressed hard against your seat. The flight also included one Moon-equivalent parabola and one Mars-equivalent parabola in which the pilots modified the trajectories to simulate the gravity of the those two celestial bodies. ✓

Rec'd 1-31-02

from Purdue U.
Ap 2002

KC-135 Team

giving us an experience we will never forget. We appreciate all of your efforts to help with our experiment ~~xxx~~ as well as your guidance. It has been an excellent learning experience for us in so many ways! So, thank you so much for everything!

Sincerely,
Whitney, Mac, Emma, Amber, Josh, Mike + Olivia

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NP2011

Dear KC-135 Team,

First we would like to apologize if these reports have come later than expected. We were not sure of the due-date but recalled that the reports last year were due during the summertime also, as you will read, our outreach program is still in the works and we plan to do even more which we can send updates about. Most importantly we would like to thank you for all of the time and hard work you contributed to this program and to helping make our flight go well and for

Janette Dill of Long Beach, left, and Kayce Leard of Natchez watch the arcs from a plasma ball in a laboratory at the University of Southern Mississippi. The two are part of a four-student team that will conduct an experiment with the plasma ball under near-weightless conditions on a NASA KC-135 jet plane March 12-14. USM was one of only eight universities in the country to place two teams in the highly competitive NASA Reduced Gravity Student Flight Opportunities Program. A second USM team will conduct experiments to test the effects of reduced gravity on jellyfish and comb jellies.

USM jellyfish experiment out of this world

Kayce Leard knows exactly what to expect next week when she boards a KC-135 jet at the NASA Space Center in Houston, Texas. Janette Dill doesn't.

That's not to say the two University of Southern Mississippi students aren't equally prepared for intellectual and physical demands of conducting an experiment in microgravity conditions.

As members of one of two USM teams tabbed by NASA to fly next week in its Reduced Gravity Student Flight Opportunities Program, they are part of a USM program that is getting pretty adept at catching NASA's eye.

The university is one of only eight universities in the country to get more than one team into the highly competitive program.

One team — of which Leard and Dill are members — will conduct a continuation of an experiment conducted in the program last summer. A second team will conduct an experiment to gauge the effects of reduced gravity on jellyfish.

"Once the students learned (NASA's application and screening process), it gave us that local expertise," said Dr. John Pojman, a chemistry professor who was the guiding force behind USM's first two student flights and is the advisor for one of the teams. "The (experiment) apparatus is built, so that cost is down. The students know a doctor who can certify them to fly.

"They've been through this before," he added.

Leard, a senior chemistry major from Natchez, and Kristi Budzinski, the team leader, will be making their second trip on the KC-135. Dill, a senior chemistry major from Long Beach, and Shelly Gallender, a senior chemistry major from Natchez, will be making their first trip.

To achieve microgravity, the plane makes a series of 40 high-altitude, up-and-parabolas, with each achieving about 20-30 seconds of weightlessness.

The extreme motion has earned the plane the graphic nickname "The Vomit Comet."

"My dad said it looks like the plane is going to flip over backwards," said Dill.

Budzinski, a junior biochemistry major from Clinton, said the second go-around will be different. "Last time, we were so nervous," she said. "But we're confident this time. We know the experiment inside and out."

Before they get airborne, the two USM teams will undergo demanding preparation and training at NASA. Christina Watters, who is the team leader of the second USM team, has been through that before. She was an alternate on the lone USM team last summer, which meant she went through everything except the actual flight.

"I got to go on the airplane when it was on the ground last time, and that's when I knew *I wanted to put together a team and go* back," said Watters, a junior biological sciences major from Mobile, Ala.

Watters' team, which is under the guidance of Dr. Patricia Biesiot, includes Jennifer Anderson, a biological sciences graduate from Hattiesburg; Michael Dodge, a sophomore biological sciences major from Long Beach; Brian Robinson, a senior microbiology major from Atlanta; and alternate Brittney Hemba, a sophomore biological major from Hattiesburg.

In its experiment, the "Jellies in Space" team will be testing the effects of microgravity on jellyfish and comb jellies, which use a gravity-sensing statocyst to orient themselves in the water.

Using a flat panel light, the team members also will test the impact of light on the jellyfish when gravity is reduced.

"Ours is the only straight-out biology experiment," Watters said.

Budzinski, Leard, Dill and Gallender will conduct a follow-up experiment to the one the team conducted last summer, when they tested the effects of gravity on plasma motion to gain a better understanding of the role convection (the transfer of heat) plays in the plasma arc movement. Then, the magnetic force given off by the plasma ball's core had an unwanted effect on the experiment.

"We've made a few modifications," said Leard. "We've taken the magnet and moved it, trying to decrease the effect on the streamers."

THE ADVERTISER NEWS -

3-13-02

THE ADVERTISER NEWS

Vol. 20, No. 27 | Wednesday, March 13, 2002 | Voluntary pay 25 cents

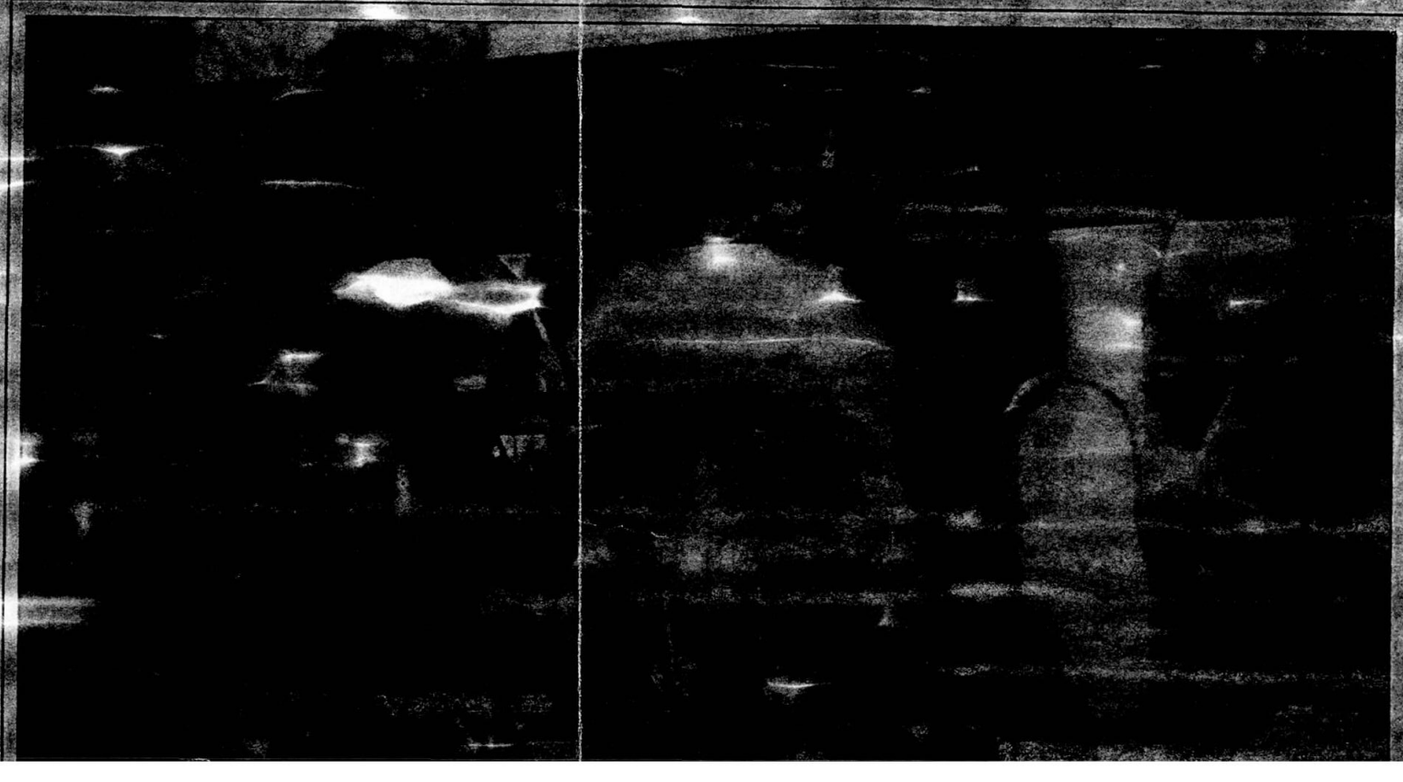
PRCC bids due April 2

Construction, landscape work slated on campus

POPLARVILLE - Building projects were the main focus of attention at the Pearl River Community College Board of Trustees meeting.

The March meeting was moved up a week because of spring break next week.

Bids will be opened April 2 on two projects, including construction and landscaping for a new entrance to the Poplarville campus, and construction of a new parking lot on the Forrest County Center in Hattiesburg.



Museum comes to life on the computer

Feel like taking in a museum, but can't leave the office?

Take a cyberstroll through the virtual exhibit, "Will D. Campbell: A Man of the Word."

The online exhibit through the University of Southern Mississippi Libraries Special Collections uses photographs, text and sound and video clips for viewers to make the acquaintance of this "bootleg preacher."

The virtual exhibit is based on the Will D. Campbell Papers held at the USM McCain Library & Archives. "Will D. Campbell: A

Reduced-gravity flight by NASA conducted with USM students

HATTIESBURG — While floating in a jet thousands of feet above the ground may hardly be an ideal place to make scientific observations, it's got to be one of the coolest.

At least that is the consensus of two teams of University of Southern Mississippi students who took part in NASA's Reduced Gravity Student Flight

Opportunities Program during spring break earlier this month. The four-person teams conducted two experiments while flying in a special KC-135 plane that was performing a series of high-altitude parabolas.

The resulting weightlessness made conventional experimentation a little difficult.

"When you're floating up on the ceiling and your experiment apparatus is bolted to the floor, it's kind of hard to make observations," said Christina Watters, the leader of one of the teams and a junior biological sciences major from Mobile, Ala. "So we video-taped it."

Watters's team — which included biological sciences graduate Jennifer Anderson of Hattiesburg, biological sciences sophomore Michael Dodge of Long Beach, microbiology senior Brian Robinson of Atlanta and alternate Brittney Hemba, a biological sciences sophomore from Hattiesburg — tested the effects of microgravity on jellyfish and comb jellies.

The second team, led by junior Kristi Budzinski of Clinton, conducted a continuation of an early experiment on the effects of gravity on plasma motion. Budzinski, a junior biochemistry major, and team member Kayce Leard, a senior chemistry major from Natchez, were making their second flight, while the other half of the team, seniors Janette Dill and

Mississippi

Shelly Gallender, were — like all the members of the other team — on their first flight.

"It was wonderful, awesome," said Gallender, a chemistry major from Natchez.

"Fantastic," echoed Dill, a senior chemistry major from Long Beach.

While their experiment got mixed results — suggesting that even reduced gravity was too much gravity — Leard said her team, as well as the other USM team, can hold their heads up.

"We had zero kills for USM," she said, referring to the all-too-common attacks of nausea participants suffer during the up-and-down maneuvering. The airplane carries the nickname "The Vomit Comet."

"The flight Shelly and I were on was only the fifth flight in the history of the program not to have a single kill," Leard said.

The results of the "Jellyfish in Space" experiment are still pending, since the team has just started analyzing data. Cursory looks at the video have indicated that the jellyfish showed erratic movement, indicating the importance of gravity in how they stay oriented in the water.

"We're going to have to look at it parabola by parabola," Watters said.

She added, however, that some team members already have started talking about a follow-up experiment. That will require them to submit another proposal to NASA and go through the competitive process for a slot on the plane.

"The NASA program is such a good opportunity for an undergraduate student," Watters said. "And not just because of the flight. It's a chance to work on proposal writing and grant writing."

USM photo

University of Southern Mississippi student Kayce Leard gives the thumbs-up before taking off on a NASA KC-135 plane earlier this month. Leard was one of eight USM students who participated in NASA's Reduced Gravity Student Flight Opportunities Program, which gives college undergraduates the opportunity to conduct experiments in near weightless conditions. USM had two teams participate in the program during the second week in March. Leard, a senior chemistry major from Natchez, was part of a team that studied the effects of reduced gravity on plasma motion.

VERTISER NEWS
Wednesday, March 13, 2002 Voluntary pay 25 cen

Janette Dill of Long Beach, left, and Kayce Leard of Natchez watch the arcs from a plasma ball in a laboratory at the University of Southern Mississippi. The two are part of a four-student team that will conduct an experiment with the plasma ball under near-weightless conditions on a NASA KC-135 jet plane March 12-14. USM was one of only eight universities in the country to place two teams in the highly competitive NASA Reduced Gravity Student Flight Opportunities Program. A second USM team will conduct experiments to test the effects of reduced gravity on jellyfish and comb jellies.

USM jellyfish experiment out of this world

Kayce Leard knows exactly what to expect next week when she boards a KC-135 jet at the NASA Space Center in Houston, Texas. Janette Dill doesn't.

That's not to say the two University of Southern Mississippi students aren't equally prepared for intellectual and physical demands of conducting an experiment in microgravity conditions.

As members of one of two USM teams tabbed by NASA to fly next week in its Reduced Gravity Student Flight Opportunities Program, they are part of a USM program that is getting pretty adept at catching NASA's eye.

The university is one of only eight universities in the country to get more than one team into the highly competitive program.

One team — of which Leard and Dill are members — will conduct a continuation of an experiment conducted in the program last summer. A second team will conduct an experiment to gauge the effects of reduced gravity on jellyfish.

"Once the students learned (NASA's application and screening process), it gave us that local expertise," said Dr. John Pojman, a chemistry professor who was the guiding force behind USM's first two student flights and is the advisor for one of the teams. "The (experiment) apparatus is built, so that cost is down. The students know a doctor who can certify them to fly.

"They've been through this before," he added.

Leard, a senior chemistry major from Natchez, and Kristi Budzinski, the team leader, will be making their second trip on the KC-135. Dill, a senior chemistry major from Long Beach, and Shelly Gallender, a senior chemistry major from Natchez, will be making their first trip.

To achieve microgravity, the plane makes a series of 40 high-altitude, up-and-parabolas, with each achieving about 20-30 seconds of weightlessness.

The extreme motion has earned the plane the graphic nickname "The Vomit Comet."

"My dad said it looks like the plane is going to flip over backwards," said Dill.

Budzinski, a junior biochemistry major from Clinton, said the second go-around will be different. "Last time, we were so nervous," she said. "But we're confident this time. We know the experiment inside and out."

Before they get airborne, the two USM teams will undergo demanding preparation and training at NASA. Christina Watters, who is the team leader of the second USM team, has been through that before. She was an alternate on the lone USM team last summer, which meant she went through everything except the actual flight.

"I got to go on the airplane when it was on the ground last time, and that's when I knew I wanted to put together a team and go back," said Watters, a junior biological sciences major from Mobile, Ala.

Watters' team, which is under the guidance of Dr. Patricia Biesiot, includes Jennifer Anderson, a biological sciences graduate from Hattiesburg; Michael Dodge, a sophomore biological sciences major from Long Beach; Brian Robinson, a senior microbiology major from Atlanta; and alternate Brittney Hemba, a sophomore biological major from Hattiesburg.

In its experiment, the "Jellies in Space" team will be testing the effects of microgravity on jellyfish and comb jellies, which use a gravity-sensing statocyst to orient themselves in the water.

Using a flat panel light, the team members also will test the impact of light on the jellyfish when gravity is reduced.

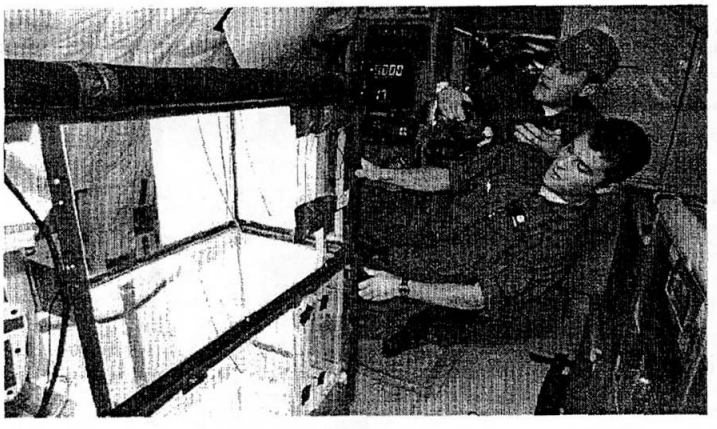
"Ours is the only straight-out biology experiment," Watters said.

Budzinski, Leard, Dill and Gallender will conduct a follow-up experiment to the one the team conducted last summer, when they tested the effects of gravity on plasma motion to gain a better understanding of the role convection (the transfer of heat) plays in the plasma arc movement. Then, the magnetic force given off by the plasma ball's core had an unwanted effect on the experiment.

"We've made a few modifications," said Leard. "We've taken the magnet and moved it, trying to decrease the effect on the streamers."

DISCOVERY
Newsletter of Research and Scholarship

MSU Satellite to Fly on Converted Missile



Students Cody Pinion and Ian Barnes on board the KC-135 to test the antenna and release mechanism they helped design.

By Evelyn Boswell

A missile that once waited for orders to fire at the United States will someday carry a tiny satellite developed by students at Montana State University-Bozeman.

Kazakhstan, a country in the former Soviet Union, is expected to launch a converted intercontinental ballistic missile (ICBM) anywhere between November and next spring, said physics professor Dave Klumpar. But instead of heading for the United States, it will soar into space. MSU's satellite will ride along to help measure radiation trapped in the Van Allen belts that surround the earth.

"There are no launch facilities in Montana," Klumpar explained. "The two or three possibilities in the United States don't work out because of cost and other things. It turns out that foreign launchers are by far the least expensive."

The first satellite ever built in Montana is the size of a toddler's toy, a cube measuring about four inches per side. Known as the Montana EaRth-Orbiting Pico Explorer (MEROPE), it will contain scientific instruments and two antennas. The satellite will be shipped to Kazakhstan and loaded onto the carrier with satellites from other U.S. universities.

"To be here and have students involved, to give them the same kind of experiences I had, is just really exciting for me," said Klumpar who was involved in space experiments 40 years ago as an undergraduate.

Several students in MSU's Space Science and Engineering Laboratory (SSEL) have worked on the satellite, and four of them flew in the infamous "vomit comet" this spring to test the antennas they designed for it. The KC-135 flies out of the Johnson Space Center, then soars and dives over the Gulf of Mexico to create weightlessness.

"It's kind of like swimming under water, but

MSU satellite continued on page 2

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MSU satellite continued from page 1

even that isn't realistic," Cody Pinion commented. "When you are in zero gravity, it's really difficult to position yourself."

"It's a fun time. That's for sure," added Ian Barnes.

Pinion is a junior from Great Falls, and Barnes is a junior from Billings. Other MSU students who flew on the KC-135 were Trevor Grove, a senior from Great Falls; and James Black, a senior from Williston, N.D. Alternates were Michelle Galvin, a senior from Kalispell, and Andrew Ross, a senior from Missoula. All six are majoring in mechanical engineering.

"This has been a tremendous experience for the students," said Tom Wilson, head of Swales Aerospace. "They built their mechanism in less than eight weeks, and we understand it worked as designed."

Swales and the Montana Space Grant Consortium are two major sponsors of the MEROPE project.

The students went into "space" to see which of three metals would work best in their antennas. They also wanted to see if the antennas would deploy in near-zero gravity. The antennas started out as ordinary tape measures and were coiled inside the satellite waiting for the students to press a button. If all went well, the antenna burst out of the cube and straightened out in less than 15 seconds.

"We have to have a way to keep them self-contained in the satellite until the satellite gets kicked out into space," Klumpar said. "Once it gets kicked out into space, those antenna have to open up so we can talk to the satellite. If the antenna don't open up, we are fried. We have just launched a piece of space junk."

Fortunately, the antenna and release mechanisms usually worked the way they were designed, he said. As for the students, they said they appreciated the opportunity to work on the project.

"It was really a unique experience," said Pinion who wants to work or contract with NASA someday.

Galvin flew on the KC-135 last year and said it's been a popular topic on job interviews.

"It's the one thing they always ask," she said.

Evelyn Boswell is the technical writer for the Office of Research, Creativity and Technology Transfer.

Figure 12. May 2002 article published in Discovery, a monthly bulletin published by the Office of the Vice President for Research, Creativity and Technology transfer, Montana State University, Bozeman.

SpaceLog

Space Infrared Telescope Undergoes Testing

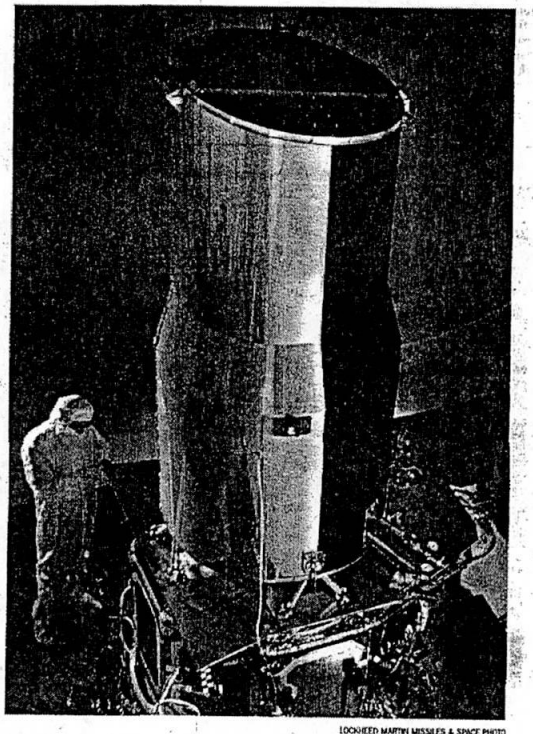
MILESTONES

NASA's Space Infrared Telescope Facility (SIRTF) is undergoing testing at Lockheed Martin Space Systems' facility in Sunnyvale, Calif.

Lockheed Martin recently integrated the Ball Aerospace & Technologies Corp.-built Cryogenic Telescope Assembly (right) with the spacecraft platform, according to a Lockheed Martin statement.

Lockheed Martin, which built the spacecraft platform, is performing environmental and other tests to verify SIRTF's readiness for launch aboard a Delta 2 launch vehicle in January 2003.

Once in solar orbit, SIRTF will have an unobstructed view of a large portion of the sky. SIRTF's highly sensitive instruments will enable scientists to study regions of space that cannot be seen with optical telescopes, according to the SIRTF Web site.



LOCKHEED MARTIN MISSILES & SPACE PHOTO

SIRTF Integration: A technician (above) examines the Ball Aerospace & Technologies Corp.-built Cryogenic Telescope Assembly in Boulder, Colo., before shipping it to Lockheed Martin Space Systems in Sunnyvale, Calif., for integration with the Space Infrared Telescope Facility (SIRTF) spacecraft platform.

■ CASSINI COURSE ADJUSTED

New procedures maneuvered NASA's Cassini spacecraft one step closer to Saturn by completing a course adjustment in early April.

In a NASA statement, Joel Signorelli, who leads Cassini's maneuver-design team at NASA's Jet Propulsion Laboratory, said the process is now streamlined, which will be important when the craft reaches Saturn in 2004.

The statement said the new procedures automate some of the steps in initiating and planning engine burns.

During orbit, Cassini will need to fire its main engine as often as once every five days, the statement said.

Launched October 1997, Cassini has undergone 13 engine burns to adjust its trajectory. The burns also provide routine maintenance of the craft's propulsion system by keeping the fuel lines flowing freely.

■ LAST TITANS ROLL OUT

Marking the coming end of a launch era, Lockheed Martin shipped its last two Titan 4 launch vehicles from its Denver production facility, Joan Underwood, Lockheed Martin spokeswoman, said in a written response to questions.

In a company statement, G. Thomas Marsh, president and general manager of Lockheed Martin Space Systems-Astronautics Operations, said he was sad to see the "amazing rocket system approach the final phase of its service."

The Titan 4 is the largest in a line of Titan vehicles dating back to the Titan Intercontinental Ballistic Missile, which was first launched in 1959.

The final launch will occur in 2003.

■ STUDENTS DEPLOY ANTENNA

Students at Montana State University successfully deployed a satellite antenna using an experimental release mechanism during a recent test on the NASA KC-135 JET aircraft that uses hyperbolic maneuvers to create microgravity conditions like those in space.

The successful demonstration secured a spot for both components on the Montana Earth Orbiting Pico Explorer (Merope) satellite, slated for a November launch. The craft will measure radiation in the Van Allen belts that surround Earth's atmosphere, according to the Merope Web site.

The students built the antenna and the release mechanism, said William Hiscock, director of the Montana Space Grant Consortium, which funded the program together with NASA. Swales Aerospace professionals mentored the students.

■ IMAGERY CLASSIFICATION PATENT

The U.S. Patent and Trademark Office awarded a patent for a new way to classify multispectral satellite imagery.

Clyde H. Spencer, president of Bio-Geo-Recon, a company that specializes in remote sensing services, received the patent.

Dubbed Ternary Multispectral Analysis, the method uses a triangular diagram to display the three key multispectral bands, according to a company statement.

The method works particularly well on imagery from NASA's Landsat spacecraft, the statement said.

Using a triangular rather than statistical approach to mapping provides easy-to-read plots of such features as vegetation and water, the statement said.

Points on the plot represent a percentage of the reflectance of the three bands, Spencer said in a written response to questions.

Figure 13. Article in April 22, 2002 issue of Space News.

Life

PHOTO COURTESY OF NASA

Members of the "Magnetic Micro-gravity Mountaineers" hold up a school banner while in zero gravity. The group will return to a NASA program in Houston during spring break to conduct another experiment and return to the feeling of weightlessness.

TOM HINDMAN/DAILY MAIL

WVU Professor Donald Gray uses a magnet to push a manganese chloride solution in a vial. On earth, it's hard to get the magnet to push the liquid because the force of gravity outweighs the force of the magnet. In zero gravity environments, however, WVU students learned it's quite easy to use magnets to move the solution.

Floating through science

Four students to study gravity in NASA program

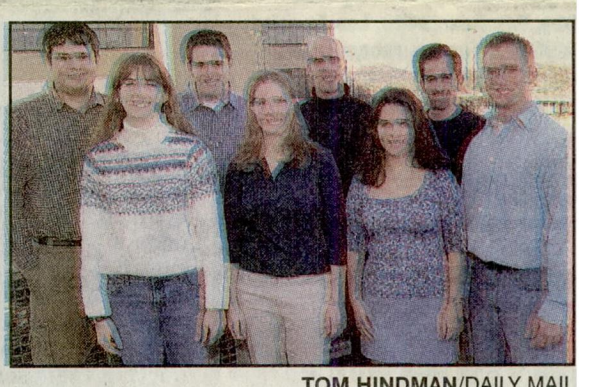
By DEANNA WRENN
DAILY MAIL STAFF

MORGANTOWN — Trying to get a liquid to move by using only magnets may not seem like the most exciting thing on Earth, but when you're floating around in zero gravity, the experiment becomes quite exciting.

Everything becomes exciting in zero gravity.

West Virginia University's "Magnetic Micro-gravity Mountaineers" will return to a NASA program in Houston over spring break to conduct another experiment and return to the feeling of weightlessness they experienced last year for the first time.

A group of four students will go up in a modified Boeing 707 this March. The airplane acts as a giant roller coaster car, only the passengers aren't connected to a solid object. Students experience zero gravity when the plane reaches the top of its flight path, just like people in a roller coaster are lifted out of their seats at the crest of a hill.



TOM HINDMAN/DAILY MAIL

Members of the microgravity team. Front: Jennifer Hazleton, Shannon Glaspell, Michelle Lechliter, and Charlie Battleson. Back: Austin Barnard, Paul Kreitzer, Andrew Starn and Matt Lichliter.

The airplane climbs from 24,000 feet to 34,000 feet in only 20 seconds. During this rapid ascent, students feel almost twice the normal gravity — which leaves them lying on the floor of the plane. Then, at the crest of the flight path, students feel complete

■ Turn to **STUDENTS/2D**

Seniors receive some relief from drug companies

By THERESE SMITH COX
DAILY MAIL HEALTH REPORTER

Paying for name-brand prescription drugs can cause headaches for seniors.

So at least three pharmaceutical companies are offering their own formulas for helping people over 65 deal with buying costly medicine — at least while Congress debates comprehensive drug coverage under Medicare.

GlaxoSmithKline, Novartis and Pfizer have hatched up discount drug card programs for low-income seniors who have no other insurance coverage for medicines.

"This is just a stop-gap measure," said Jack Graham, area vice president for state government affairs for GlaxoSmithKline. "We hope Congress would get their arguments out of the way and come out with a very meaningful program."

Of course, West Virginia has its own approach, the Golden Mountaineer Discount Card, which Gov. Bob Wise says has saved up to 17 percent for seniors so far.

"We're encouraged by that," Wise said, noting that other discount cards average about 10

■ Turn to **DRUG/2D**

HOW THE CARDS STACK UP

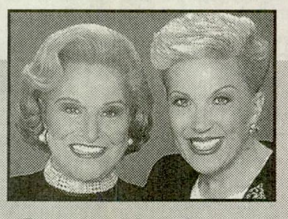
The Care Card from Novartis will shave 25 percent or more from some Novartis drugs. To qualify, seniors must have an income of less than $26,000 or $35,000 a couple and not have alternative drug coverage, such as Medicaid, Medigap or employer-sponsored coverage. To apply, call (866) 974-2273 or check the Web site **www.novartis.com/carecard/how.shtml**.

Seniors who have an income of less than $26,000, or $35,000 for a couple, could qualify for GlaxoSmithKline's Orange Card, which went into effect Jan. 1. Seniors can expect to save between 25 percent and 40 percent of the usual retail price of the prescription drug. For an application, call (888) ORANGE6, also (888) 672-6436.

The Pfizer Share Card can be used at participating pharmacies beginning March 1. Medicare-eligible seniors with low incomes will pay a $15 flat fee for a month's supply of any Pfizer prescription drug. To qualify, annual income must fall below $18,000 for individuals and $24,000 for couples. To get an application, call (800) 717-6005 or check the Web site **www.pfizerforliving.com**.

DEAR ABBY

E-mail fantasies may crash mom's real life



ABIGAIL VAN BUREN & JEANNE PHILLIPS

DEAR ABBY: I found out that my mom has been exchanging e-mail love letters with a man from out of state. I know because she had been staying up until 2 and 3 a.m. on the computer. I did a little detective work and found the letters. They talked about meeting and how much they love each other.

Mom uses a fake name and has told this guy numerous lies about her life. She's portraying herself as a young, pretty girl when she's really a 53-year-old frumpy housewife. The man is married with two kids; Mom has been married for 30 years and has three kids and two grandchildren. She is seriously addicted to the Internet and has been sneaking around to get on it. I found out she also calls this guy.

I know personally how addictive the Internet can be. It can ruin your life by making infidelity easier. I don't know if I should confront her. Please help. I'm desperate for advice.

Daughter in the Lone Star State

DEAR DAUGHTER: Talk to your mother in confidence. Apologize for snooping and tell her what you have discovered. Ask her what she would do if your father were to find out what has been going on. If she has been spending so much time on the computer that it aroused your suspicions, it would be interesting to know what your father is thinking. She needs to consider if her creative writing is worth jeopardizing her marriage. Read on:

DEAR ABBY: After reading the letter from "Disillusioned in Clarksville" about the flake she married after meeting him on the Internet, I want to let you know that sometimes meeting someone on the Internet DOES work out. I met my husband online.

I wanted to chat with people all over the world. The Internet was new to me, and I thought it was a great way to talk to people everywhere, all at the same time. I wasn't looking for romance. We met when he was in the Marine Corps in California and I was living in New York. We hit it off from the start. It was almost "love at first talk." We met online in July 1998 and in person in late November of that year. We were married the following month and just celebrated our third anniversary.

He is everything I could ever want in a man, and so much more. God bless the U.S. Marines. (They do laundry, iron and clean!)

Izabela
Sciota, Pa.

DEAR IZABELA: Now that's a ringing endorsement. May you enjoy many more years of happiness together.

The Internet is a wonderful tool. Although a decade ago people were predicting it would replace letters, telephones and malls, those predictions were a bit premature. For the foreseeable future, they will all co-exist together.

As for meeting people online, the same precautions should be observed as for meeting people through a personal ad, at a nightclub or a gym. The dating game is both a gambol and a gamble. Take your time. Check the facts. Caveat emptor (Let the buyer beware). The person can turn out to be a lump of coal in your Christmas stocking or the jewel of a lifetime.

Everyone has a problem. Get it off your chest by writing Dear Abby, P.O. Box 69440, Los Angeles, CA 90069. For a personal reply, please enclose a stamped, self-addressed envelope.

HOROSCOPE

JOYCE JILLSON
Astrologer

FORECAST FOR WEDNESDAY

ARIES (March 21-April 19). Today, you're learning the rules of love. Indiscretion is not recommended. Vibes for harmony will improve soon; meanwhile, encourage those around you to make progress in areas where they've failed before. Search for security.

TAURUS (April 20-May 20). Extraordinary effort is required if you want to meet your own expectations. Utilize your influence wisely. Strong disagreements among your teammates can be set aside until later. Your efforts to improve yourself are finally paying off.

GEMINI (May 21-June 21). Snatch the chance to get a good job. Exercise authority; you'll bring out the best in others. A harmonious domestic scene is your great inspiration. Problem-solving will be your specialty tonight. Family love is a source of power.

CANCER (June 22-July 22). Try new methods, even if they are suggested by someone you find overbearingly opinionated. True love is one of your basic needs, so don't play fast and loose with the affections of a sincere person. Confess to a Virgo.

LEO (July 23-Aug. 22). Work and health are emphasized. You feel terrific, but don't overdo it. Exercise is the best medicine. Tact is necessary in job matters; what you do now will carry great weight with those around you later. Your plan changes — what a relief!

VIRGO (Aug. 23-Sept. 22). Cast off old habits, and turn a new leaf. Friendship with someone you once admired from afar will be the highlight this evening. You'll wisely counsel your mate or business partner, and you'll be privy to new information you receive.

LIBRA (Sept. 23-Oct. 23). Your public image may seem more important than it is. Glitz and glamour are featured this afternoon. A little extra style goes a long way. Don't let the weeds of daily living hold you back. Everyone wants to be entertained constantly tonight.

SCORPIO (Oct. 24-Nov. 21). If there is nothing left to celebrate, make something up! You may need to resort to plan B at work. If you revise things, the new way will bring more profit in the long run. Your charisma is a magnet for creative, ambitious people.

SAGITTARIUS (Nov. 22-Dec. 21). Set your sights on reaching the top. Watch your reputation. Others will try to link you with objectionable people or activities. All travel is lucky and full of excitement. You'll find a new love interest in a distant but intriguing city.

CAPRICORN (Dec. 22-Jan. 19). A loved one wants more of your attention and may create a crisis of sorts just to get attention. Children have wild imaginations, and you can challenge them to reach new creative heights. Singles: It's time to take a chance in love.

AQUARIUS (Jan. 20-Feb. 18). It's time to come out of your shell. Communication is the key: Meet new people, learn to e-mail or fax, if you don't know how to already. Tonight, dress up if you plan to go out, because you'll meet valuable business contacts.

PISCES (Feb. 19-March 20). You'll be completely absorbed in home projects. Finding ways to make repairs cheaper and more efficient provide great satisfaction. Grab the opportunity for romance. You could make money selling something you made or fixed.

IF YOUR BIRTHDAY IS FEB. 6: Your career frustrations are due to the decisions you've recently made. Focus on monetary investments in March, but investments of time and energy will be better made in July. They will yield big bonuses by this summer's end. The best months to travel are June and September. Your luckiest months are March and October. Complete projects at home. Your lucky numbers are: 33, 19, 41, 34 and 3.

CELEBRITY PROFILES: Oscar De La Hoya will choose between music and boxing — both areas of his work tease him with promise of big riches and fame. Splitting interests isn't such a fantastic idea for Aquarians this year, but they will be tested by their desires and pulled in many different directions. The ability to focus equals success. De La Hoya will also be blessed with more good news. He may have young ones in July.

If you would like to write to Joyce Jillson, please go to www.creators.com and click on "Write the Author" on the Joyce Jillson page, or you may send her a postcard in the mail.

Fight heating up over hemp

Entrepreneurs hot over rule barring hemp in food

THE ASSOCIATED PRESS

SAN DIEGO — The energetic 60-year-old woman with cropped white hair and sea-green eyes doesn't fit the usual profile of a drug pusher.

But inside Gertrude Spindler's cozy condominium, there's trouble cooking.

The Drug Enforcement Administration is steeling itself to put Spindler out of business and make sure she keeps her wares away from would-be buyers.

There's no meth lab in Spindler's bath tub, nor an Ecstasy ring in the garage. She's using a family recipe to create her Alpsnack snack bars that include hempnuts. And under a recent DEA ruling, she may as well be selling heroin.

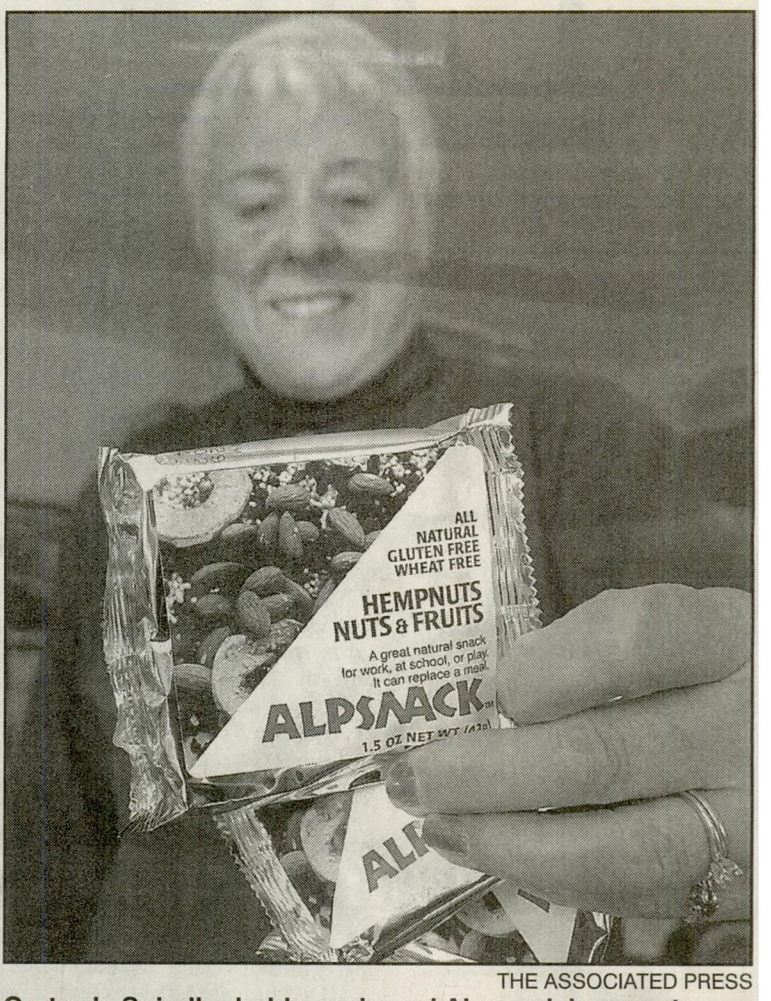
Hempnuts come from hemp, an industrial plant grown outside the United States that is related to marijuana. Fiber from the plant long has been used to make paper, clothing, rope and other products. Its oil is found in body-care products like lotion, soap and cosmetics.

Entrepreneurs like Spindler argue the nuts and oil from hemp are among nature's best sources of essential fatty acids. Twice a day, she swallows a spoonful of raw hempnuts, which she says improves — no pun intended — her joints.

"I hate chemicals. I like natural things," Spindler said. "God has given us those natural things and we should use it."

But the DEA objects. In October, the agency declared that food products containing even trace amounts of tetrahydrocannabinol or THC — the psychoactive chemical found in marijuana — were banned under the Controlled Substances Act.

It ordered an immediate halt to the production and distribution of all goods containing THC that were intended for human consumption. It gave until Wednesday for all such products to be destroyed or removed from the United States.



THE ASSOCIATED PRESS

Gertrude Spindler holds packaged Alpsnack hempnut energy bars that she makes at her home in San Diego. Because the bars contain hempnuts, the government has said they are illegal for human consumption.

DEA spokesman Will Glaspy said the agency simply is upholding the law.

"A lot of people did not understand the law. The clarification says if a substance contains THC and is intended to enter the body then it is an illegal product," Glaspy said.

Hemp and marijuana, as the DEA sees it, are different parts of the same plant, he said. And THC in any amount is an illegal drug.

The ruling has galvanized hemp-product manufacturers, who contend the DEA violated the law by failing to hold hearings or accept public comment before issuing its declaration.

The Hemp Industries Association, which represents U.S. hemp product manufacturers and Canadian hemp exporters, has challenged the ruling in federal court and asked for a stay of the deadline.

Meanwhile, association members are continuing to produce and sell their goods, arguing that since the DEA did not issue a standard to measure THC levels they will follow standards set by Canada: that scale, the THC is so negligible it could be considered undetectable — and certainly far below any level that would produce a "high."

Association members argue that hemp is not marijuana, just as field corn used for livestock feed is not the same as sweet corn eaten by humans.

So far the DEA has not taken enforcement action against people continuing to produce hemp food products, Glaspy said. What will happen after Wednesday remains to be seen.

Students

■ Continued From 1D

weightlessness for about half a minute. Coming down, the students feel double the gravity again.

The flight lasts four hours, giving students about 30 chances to feel that 25 seconds of microgravity. During that time, they adjust to the sudden change between zero gravity and double gravity, while at the same time conducting their scientific experiment.

No wonder the airplane's nickname is "The Vomit Comet."

"The first time you hit zero G's, it's something completely new," said team member Austin Barnard, who enjoyed his time conducting the experiment and getting in some zero-gravity somersaults.

The students will have to go through the same training this year to prepare for the experiment.

First, students are subjected to a chamber flight, where they experience what the atmosphere is like at 25,000 feet — where most people have between three to five minutes of useful consciousness before they actually pass out.

Barnard doesn't remember that part of the Houston trip since he passed out almost immediately. Others remember feeling tingly and shaky.

Then each student's experiment had to be checked by NASA to make sure nothing would go wrong. At first they thought the strong magnets used in the experiment might throw off the airplane's mechanisms, but NASA tested it and found it would work fine.

Then NASA told the group there were some problems they have to solve with the experiment.

Since they were dealing with a liquid, there needed to be a way to contain the liquid while allowing air pressure to adjust. And some of the device's edges were too sharp.

The team had to fix the problems before going up in the plane.

"We just made a mad dash to Home Depot," Barnard said. "We bought everything we thought would work."

In the end, duct tape covered the rough corners and vacuum cleaner bags helped contain the liquid.

NASA wants the teams, which come from universities all over the country, to think fast and learn problem-solving skills, said John Kuhlman, a mechanical and aerospace engineering professor at WVU who helped organize the trip.

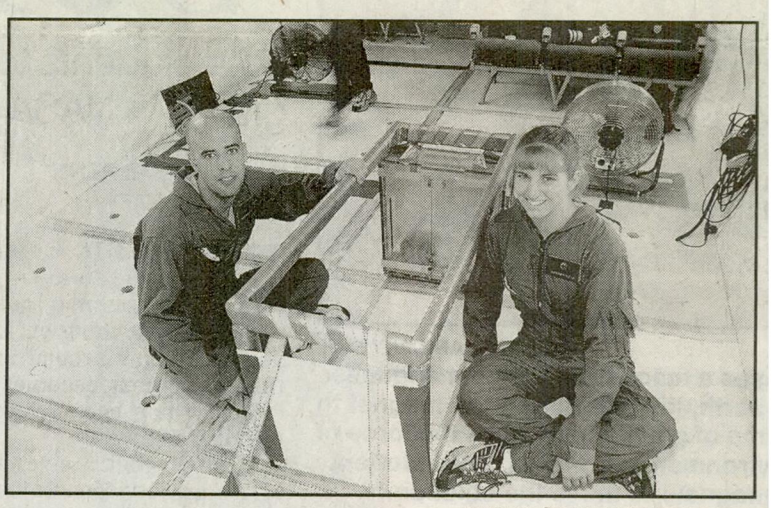


PHOTO COURTESY OF NASA

WVU students Andrew Starn and Jennifer Hazleton prepare the experiment, which was wrapped in duct tape to prevent punctures in the wall because of sharp edges. The experiment is strapped down so it won't float away when the students enter zero gravity.

KUHLMAN

"The team did really well," Kuhlman said. "It wasn't pretty, but it worked."

The team will return this year to conduct a similar experiment. The same four fliers will go up in the plane, although new students will attend and work as a ground crew.

In future years, officials hope those students can experience the micro gravity program. It costs about $22,000 each year to travel to Houston and conduct the experiments.

"Everybody was really pleased last year," Kuhlman said. "They sounded almost like little kids (when coming back from zero gravity). Hopefully it will continue year after year."

Writer Deanna Wrenn can be reached at 348-1796 or by e-mail at dwrenn@dailymail.com.

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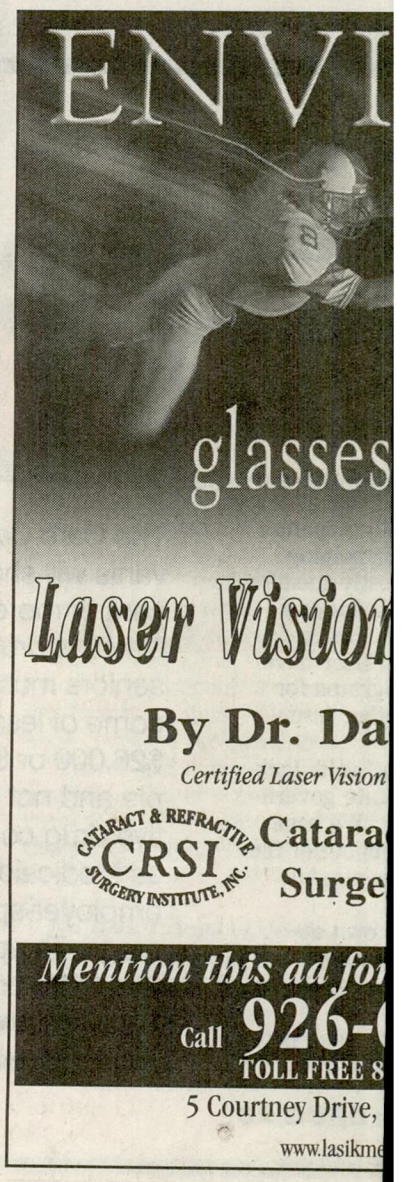


2-10-02 Fairmont News

Students to study gravity while in NASA program

Boeing 707 used to simulate life in zero gravity

MORGANTOWN. – Trying to get a liquid to move by using only magnets may not seem like the most exciting thing on Earth, but when you're floating around in zero gravity, the experiment becomes exciting.

Everything becomes exciting in zero gravity.

West Virginia University's "Magnetic Micro-gravity Mountaineers" will return to a NASA program in Houston over spring break to conduct another experiment and return to the feeling of weightlessness they experienced last year for the first time.

A group of four students will go up in a modified Boeing 707 in March. The airplane acts as a giant roller coaster car, only the passengers aren't connected to a solid object. Students experience zero gravity when the plane reaches the top of its flight path, just like people in a roller coaster are lifted out of their seats at the crest of a hill.

The airplane climbs from 24,000 feet to 34,000 feet in only 20 seconds. During this rapid ascent, students feel almost twice the normal gravity – which leaves them lying on the floor of the plane. Then, at the crest of the flight path, students feel complete weightlessness for about half a minute. Coming down, the students feel double the gravity again.

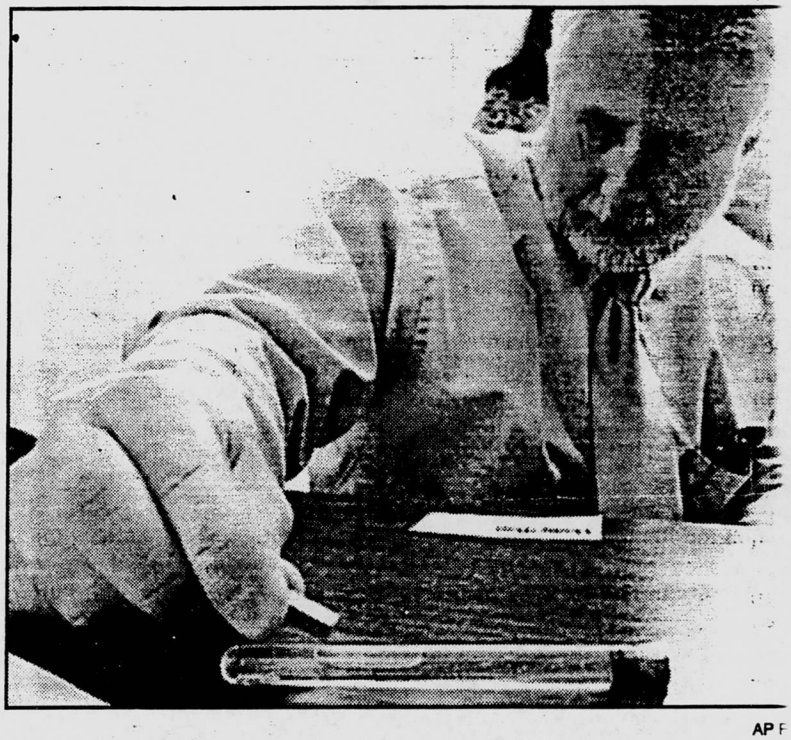
The flight lasts four hours, giving students about 30 chances to feel 25 seconds of microgravity. During that time, they adjust to the sudden change between zero gravity and double gravity, while at the same time conducting their scientific experiment.

No wonder the airplane's nickname is "The Vomit Comet."

"The first time you hit zero G's, it's something completely new," said team member Austin Barnard, who enjoyed his time conducting the experiment and getting in some zero-gravity somersaults.

The students will have to go through the same training this year to prepare for the experiment.

First, students are subjected to a chamber flight, where they experience what the atmosphere is like at 25,000 feet – where most people have between three to five minutes of useful consciousness before they pass out.



AP F

West Virginia University Professor Donald Gray uses a magnet push a manganese chloride solution in a vial in Morgantown.

Barnard doesn't remember that part of the Houston trip since he passed out almost immediately. Others remember feeling tingly and shaky.

Then each student's experiment had to be checked by NASA to make sure nothing would go wrong. At first they thought the strong magnets used in the experiment might throw off the airplane's mechanisms, but NASA tested it and found it would work fine.

Then NASA told the group there were some problems they have to solve with the experiment.

Since they were dealing with a liquid, there needed to be a way to contain the liquid while allowing air pressure to adjust. And some of the device's edges were too sharp.

The team had to fix the problems before going up in the plane.

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In the end, duct tape covered rough corners and vacuum clea bags helped contain the liquid.

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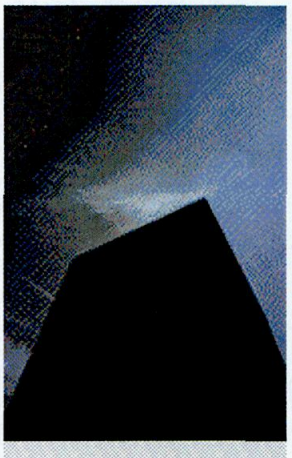
Photos/Graphics: · Magnetic Micro-gravity Mountaineers

Floating through science

Four students to study gravity in NASA program

Deanna Wrenn <dwrenn@dailymail.com>
Daily Mail staff

Tuesday February 05, 2002; 11:00 AM



WHO'S WEST VIRGINIA'S ONLY FORBES 500 LISTED COMPANY?

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'Microgravity Mountaineers' poised for encore float

MORGANTOWN, West Virginia (AP) --Trying to get a liquid to move by using only magnets may not sound exciting. But when you're floating around in zero gravity, it becomes exciting.

In fact, everything is exciting in zero gravity. Just ask members of West Virginia University's "Magnetic Microgravity Mountaineers."

The four-student team traveled to Houston last year for a NASA program that lets college students perform experiments in zero gravity. They're going back in March to conduct another experiment with magnets and liquid.

To experience zero gravity, the students will go up in a modified Boeing 707 that will climb 10,000 feet in 20 seconds. During the rapid ascent, students feel almost twice the normal gravity. Then, at the crest of the flight path, students feel complete weightlessness for about half a minute.

Team member Austin Barnard says he enjoys doing somersaults in zero gravity.

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http://www.cnn.com/2002/TECH/space/02/07/floating.students.ap/index.html

☐ Check the box to include the list of links referenced in the article.

Greeks organize philanthropies

By Diane Pilkington
Staff Writer

Several Greek organizations at West Virginia University have recently participated in their philanthropy events for the spring semester. Philanthropy issues include raising awareness on AIDS and HIV, raising money for a book scholarship, Cardiac Care, juvenile arthritis research, and Service for Sight.

The Alpha Phi sorority set up a booth Monday and Tuesday in the Mountainlair to raise money for their national philanthropy of Cardiac Care.

Alpha Phi also organized a basketball tournament that will take place Tuesday and Wednesday. Last year, the sorority succeeded in raising $2,200, said Kelly Morris, Alpha Phi member.

"Everyone likes doing it because it goes toward a major women's health issue," Joy Victory, Alpha Phi member said. "We are looking to send a portion of the money to the research part of University hospital."

The Delta Sigma Theta sorority sought to inform WVU students about the deadly effects of AIDS and HIV last week at the Mountainlair. Sorority members set up a safe sex booth in the 'Lair and handed out packets on safe sex and AIDS and HIV awareness. Morgantown, which does work with AIDS and HIV patients, had three patients speak at the sorority's forum last Thursday in the Shenandoah Room at the 'Lair. Patients spoke about their own experiences with the disease. Friday's HIV and AIDS Jeopardy challenge ended the sorority's philanthropy week.

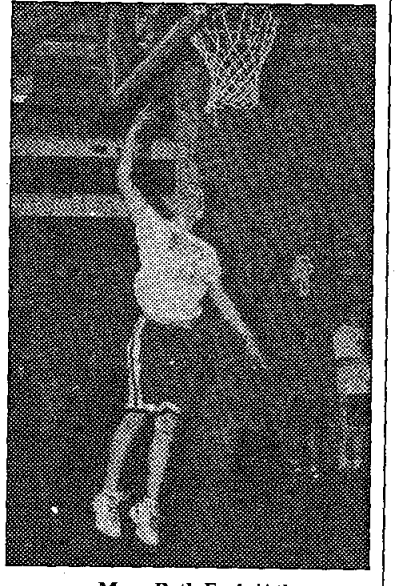
Service for Sight, which helps to aid the blind, is Delta Gamma's national philanthropy, sorority member Tonya Graser said.

The sorority also helps a local family on disability and collects old eyeglasses for donation. Their major philanthropic event, the Anchor Bowl, will be held this Thursday through Saturday on the Mountainlair Plaza.

Participating teams must be representative of a student organization and contribute $50 to the sorority's philanthropy fund.

"We visit area elementary schools and talk about eye safety and eye protection," Graser said.

If love is on your mind, the Iota Phi Theta fraternity has the perfect raffle giveaway for you. For $1, a raffle ticket can be bought at the fraternity's booth, set up in the 'Lair today and March 18 for a chance at winning a "Five Star Lovers Basket." The basket contains all of the essentials for a romantic evening, according to Michael Biggs, fraternity member.



Mary Beth Fazio/Athenaeum

Alpha Phi sorority sponsored a basketball tournament for their spring philanthropy.

is open for anyone to win. An essay contest has been scheduled for April and the winner receives the book scholarship. Biggs said the fraternity succeeded in raising $200 for the scholarship last year.

"It's an original theme that makes people interested," Biggs explained.

Coin collections and a slow-pitch softball tournament were the

Microgravity Mountaineers head to Houston

By Jessica Karmasek
Staff Writer

Spring Break is more than sun, sand and surf for the Magnetic Microgravity Mountaineers. For one week, this group of eight West Virginia University students will be testing their engineering skills at NASA's Houston, Texas base.

This year's crew includes returning seniors Austin Barnard, Jennifer Hazelton, Matthew Lechliter and Andrew Starn, along with juniors Paul Kreitzer, Charlie Battleson and Shannon Glaspell and sophomore Michelle Lechliter.

The team will be traveling to the NASA base for a week of reduced gravity experiments that are based on the results from last year's findings.

A large box containing four other boxes and strong magnets placed in the bottom with paramagnetic fluid placed on the top is the basis for the team's experiment. The purpose of the procedure is to see how the magnets hold up to oscillation and other outside stresses.

The experiment is a "simple idea," according to Battleson.

Barnard, Hazelton, Matthew Lechliter and Starn were in attendance last year, forming a smaller four-person team. However, this year the group expanded to eight students.

"I think it's a wonderful opportunity. It's just a great research opportunity for us," Glaspell said.

Having the additional four students allows for a ground crew, which completes a majority of the preliminary work and allows for the education of the younger team members.

"I think the seniors found it was a lot to plan a trip, do the experiment and write reports," Battleson said.

The group of students will leave for Houston on March 21, while their faculty advisers, civil and environmental engineering professor Dr. Donald Gray and mechanical and aerospace engineering professor Dr. John Kuhlman will leave March 23.

Team members will arrive earlier due to specific physiological training that must be completed in order to fly, along with various tests and information that must be gathered.

"The plane is like an airliner, having no seats," Gray explained. "It's like the kind used in the filming of Apollo 13."

Microgravity is defined as the idea that an aircraft is falling in a parabolic pattern, like the sensation felt on a rollercoaster, according to Gray.

In scientific terms, the team will be experiencing 32 parabolas per flight. Over the course of two days there will be a total of four flights, in which the students will complete their experiment.

The program's goals and objectives are to promote education in the areas of science and engineering, along with emphasizing interest in microgravity research and knowledge of WVU's participation in NASA programs.

The students have to form a group, develop an experimental concept and then design an experiment. They also must file reports with NASA, based on their findings and results.

"I think it's very good training. These are the kind of things they'll have to do," Gray said.

Check out the group's Web site at http://www.cemr.wvu.edu/~wwwzerog/index.html for additional information and pictures.

Jessica Karmasek can be reached at: Jessica.Karmasek@mail.wvu.edu

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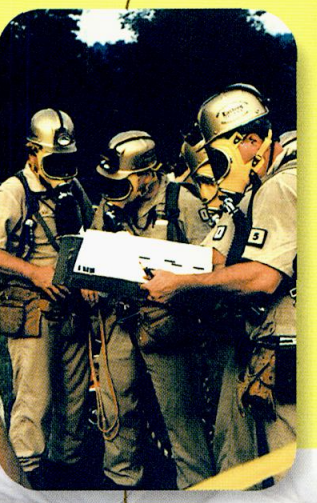

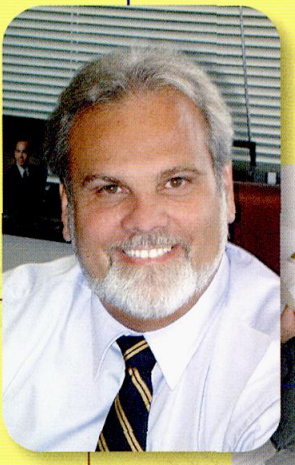

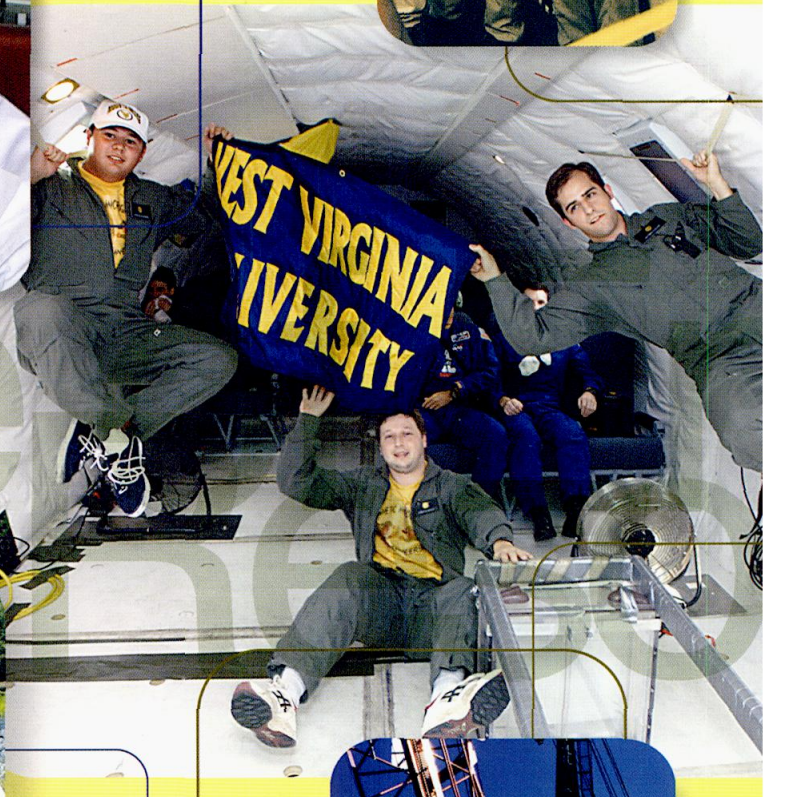

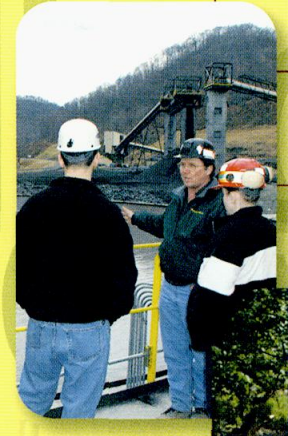

WestVirginiaUniversity

COLLEGE OF ENGINEERING AND MINERAL RESOURCES

West Virginia University College of

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Chemical Engineering undergraduate student, Andrea Albert, and lab technician, Scott Fallecker, demonstrate the insulating properties of WVU carbon foam.

Petroleum and Natural Gas Engineering Department trains students to design, build, and operate deep water platforms and drilling rigs that power America.

A nanostructure solar cell device fabricated in the Micro/Nano-Fabrication Laboratory of the Lane Department of Computer Science and Electrical Engineering.

Mining Engineering students tour the Fork Creek Mine's coal preparation plant near Coal River, WV.

(Standing l-r) Drs. Stewart Welsh, Roger Viadero, and (kneeling) James Anderson collecting benthic macro-invertebrate samples as part of a stream monitoring project.

Dean Gene Cilento

Aerospace Engineering Senior Student Team getting "hands-on" learning experience aboard NASA's Microgravity Experiment "Weightless Wonder" KC-135 aircraft in Houston, TX.

Safety and Environmental Management off-campus class in Wheeling, WV, visiting the U.S. Army Corps of Engineers repair facility on Neville Island in the Ohio River as a part of a maritime construction safety project.

Mine rescue team planning next steps during mine rescue contest sponsored by Extension and Outreach.

Starting salaries ranged from the high $40's to low $50's with numerous individuals receiving signing bonuses of $2,000 to $3,000. Major employers were Accenture, General Mills, General Motors, IBM, Milliken and Terramite.

- IBM recruited a record 10 students - 25% of our employed student pool.

- Graduation of undergraduates continues to grow - from an average of 25 students per academic year during the period 1996 through 1998, to 33 students per academic year during the period 1999 through 2001, respectively.

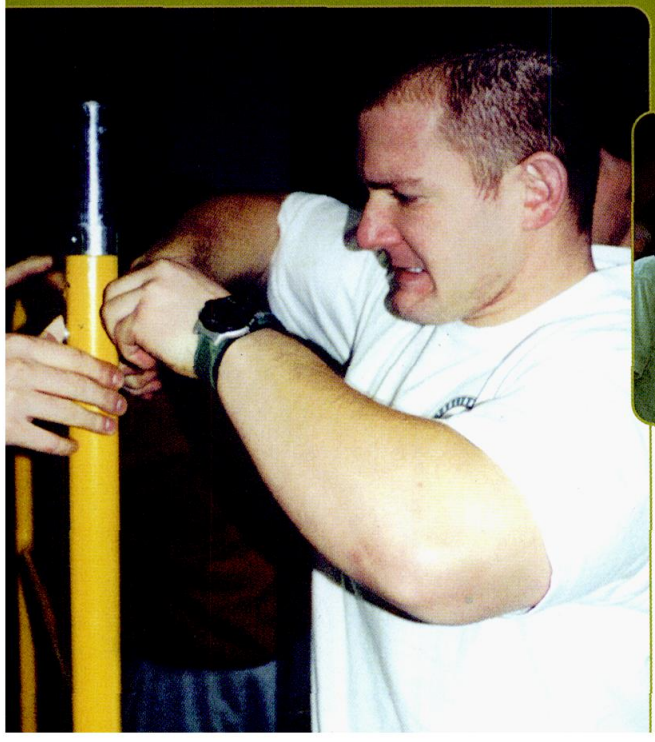
The WVU Student Chapter of the Institute of Industrial Engineers (IIE) hosted the Region VI IIE Student Conference in March 2001. Ten faculty and 92 students from six Universities hosted the conference. The conference consisted of:

- Tours, lead by IE professionals at the National Institute for Occupational Safety and Health, Swanson Plating and Mylan Pharmaceuticals;

develop our students' strengths....

- Two panel discussions, one by recent IE graduates on their positions and thoughts for success and a second on the challenges of two career families;
- A technical paper contest in which Brad Stewart of WVU placed third; and,
- An interactive session on the "Role of Industrial Engineers in the New Economy."

Shawn Crawford, SEM graduate student, finishes a scaffold inspection project in Dr. Winn's Spring 2001 construction safety class.



Congratulations to the WVU student IIE Chapter for receiving the Bronze Award in a national IIE Chapter Recognition Program based upon the student chapter's activities during the year.

FACULTY COMINGS AND GOINGS

- Dr. Steve Guffey, a Certified Industrial Hygienist, joined the faculty January 1st, and Dr. Steve Wiker is joining the faculty as a Visiting Professor for the Fall 2001 semester. Both individuals have academic responsibilities in the Industrial Engineering and Industrial Hygiene, and Ergonomics Programs.

- Dr. Dianne McMullin left the faculty after 6 years to join the Ergonomics Research Group at The Boeing Company.

- Dr. Wafik Iskander was elected to the IMSE Academy of Distinguished Industrial Engineers.

- Dr. Daniel Della-Giustina was named as the 2000 West Virginia Safety Professional of the Year.

INDUSTRIAL ENERGY ASSESSMENT CENTER

While 2001 may be known as the "year of spiraling energy costs," energy engineering has had a home in the Department since 1994. The Industrial Energy Assessment Center (IEAC), funded by the U.S. Department of Energy, helps small and medium size businesses in West Virginia and its Border States manage energy utilization resulting in average energy cost savings of 10 percent.

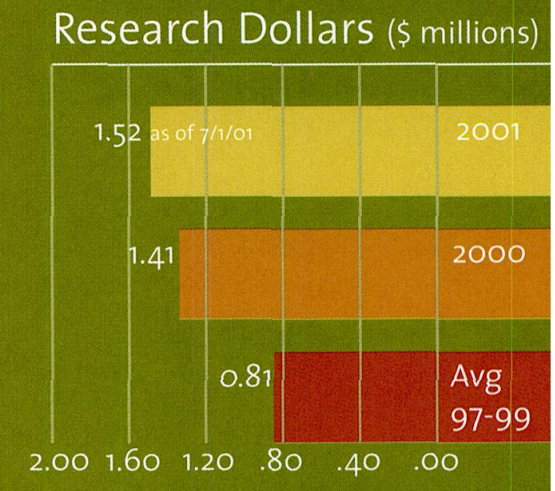
(l-r): IE undergraduate students Jared Ramsburg, Gina Larry, Meredith McCoy, and Joe Buchan and IE graduate student Johnna Stimpak enjoy good food and friendship at the IMSE fall picnic.

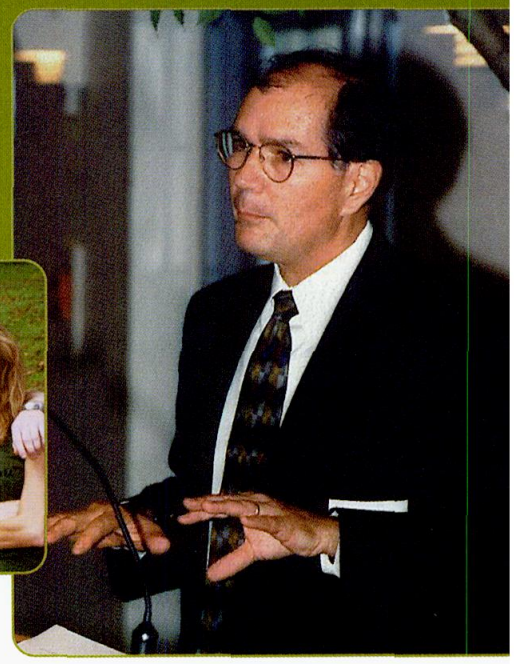
THE CENTER FOR ENTREPRENEURIAL STUDIES AND DEVELOPMENT

IMSE's Center for Entrepreneurial Studies and Development (CESD) provided high-quality professional services during 2000/2001 to over 80 organizations including:

- Workforce development,
- Operations management,
- Marketing assessments and business development,
- Organizational development, and related areas.

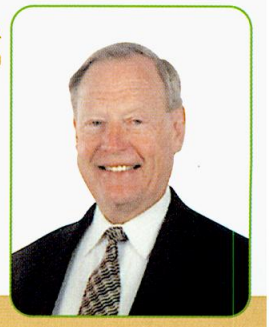
Online Safety Academy, a spin-off of CESD activities, created a new business to deliver safety training over the Internet to the mining and general manufacturing industry nationwide.





Dr. Paul Specht of Millersville University speaking on behalf of the American Society of Safety Engineers stated, "The OSH Doctorate Program at WVU is filling a recognized, national training priority."

Donald W. Lyons, Ph.D.
Chairman



Programs of Excellence

The Department of Mechanical and Aerospace Engineering (MAE) administers the Mechanical Engineering and Aerospace programs. The Mechanical Engineering program traces its origins at West Virginia University to 1894 and the Aerospace Engineering Program in 1944. The administration of the two programs was combined into one department in 1983. Over 3,500 students have graduated from these programs.

The Department is committed to providing:

- The highest quality teaching,
- A continuously updated curriculum,
- Modern laboratories to train students for the careers of the future,
- Internationally recognized research, and
- Service to the State to contribute to economic development.

At the undergraduate level, the Department is recognized for the hands-on design experiences that it provides its students, with award winning senior design projects participating in national competitions:

- Future Truck and Hybrid Electric Vehicle challenges,
- Mini-Baja and Mini-Formula Cars,
- Radio Controlled Model Aircraft,
- Man Powered Submarine, and the
- Projects with Industry Program.

At the graduate level, the research programs are especially strong in the areas of alternative fuels for vehicle propulsion, aircraft flight controls, aerodynamics, composite and metal materials, biomedical engineering, computational fluid mechanics, and computer simulation and design.

The service programs of the Department, such as the industry focused research programs and the Student Projects with Industry Program, help the state and region retain jobs and develop new entrepreneurial industries.

ACCOMPLISHMENTS

Last year MAE awarded 64 bachelors degrees, 26 masters degrees and 6 Ph.D. degrees. Undergraduate student enrollment increased 25 percent to 280 students (does not include freshman) and graduate student enrollment increased 10 percent to 130 students. Research expenditures increased 10 percent to over $6.3 million or approximately $275 thousand per tenure track faculty member. The faculty of the Department published over 50 papers in referred archival journals and 150 in reviewed conference proceedings.

Once again MAE student design projects enjoyed a successful year in national competition.

- Projects with Industry – Teams of students completed five major engineering design projects for West Virginia industrial companies.

"Over 3,500 students have

- Future Truck Challenge hybrid electric vehicle – Placed 6th overall in National Competition, including 1st place in trailer towing. WVU students have developed one of the most fuel-efficient environmentally friendly, heavy duty, sport-utility vehicles in the world!
- International AIAA Design, Build, Fly Radio-Controlled Aircraft Competition - 11th place in a field of 38 with an electric battery powered, 8-foot wing span cargo plane designed to carry as a cargo load the maximum number of tennis balls the furthest distance in a specified time.
- Society of Automotive Engineering (SAE) Mini-Baja Competition – Successfully competed at the Mini-Baja East competition in South Carolina and the Mini-Baja Midwest in Ohio for the best off-road vehicle performance.

The Mini-Baja Race Car Student Design Team in preparation for the competition.

The Mini-Formula Race Car Student Design Team at the competition in Detroit.

Mechanical Engineering students from WVU and the Universidad de Queretaro conducted a Team Senior Design Project at SPICER Corporation in Mexico.

Syd S. Peng, Ph.D.
Chairman

Recognizing Achievements

A SNAPSHOT OF SUCCESSES

The Department of Mining Engineering continues to respond to the needs of the mining industry. This year the Department focused on enhancing our communication efforts to ensure that industry, alumni, and students are made aware of what we are doing and Department activities and expert capabilities. Toward that end, we established a Distinguished Engineer of Mines Award to recognize those alumni who have demonstrated exemplary leadership in the field of mining. This award not only recognizes individual achievements but also serves as a tangible example of the quality of graduates produced by the Department.

Our alumni and friends of the Department received the inaugural issue of *Black Diamonds*, our bi-annual newsletter. Dr. Syd Peng's Annual Ground Control Conference continues to be the world's primary venue for exchanging rock mechanics research, and it continues to grow each year. Of course, we continue to serve industry through research. In addition, external relations is the key to the Department's ability to serve our state, our state's major industry, and our state's youth – our future leaders.

DISTINGUISHED ENGINEER OF MINES LECTURE SERIES

Upon the recommendation of the Department Visiting Committee, the Distinguished Engineer of Mines Lecture Series was initiated in 2000 to recognize the achievements of and introduce the unique experience of West Virginia University's Mining Engineering Alumni to the Mining Engineering faculty and students. Candidates for the Lecture Series Award are alumni who have exceptional achievements and unique experience in the mining industry. Selected candidates are required to present a seminar to the Mining Engineering faculty and students at West Virginia University in conjunction with the award ceremony. Each year two candidates will be selected; one in each semester.

For the 2000-2001 academic year, the two candidates selected were Bob Quenon (BSEM '51) and Doug Blackburn (BSEM '72) for the Spring and Fall Semesters, respectively. Quenon's lecture was entitled "Reflection on a Career in Mining, 1948-2001." The full text of his lecture can be found in the Mining Engineering website:

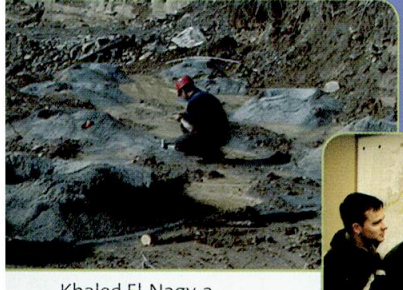
"The Department

http://www.cemr.wvu.edu/~wwwmine.

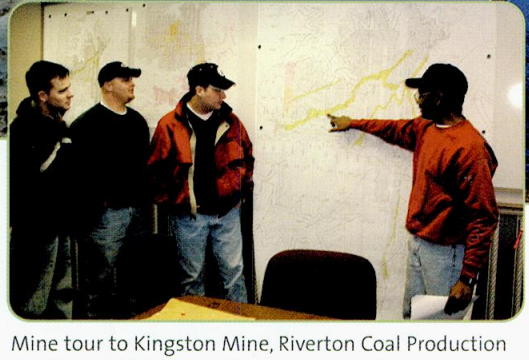
Blackburn's lecture was entitled "Development of the Largest Mining Complex in China."

19TH INTERNATIONAL CONFERENCE ON GROUND CONTROL IN MINING

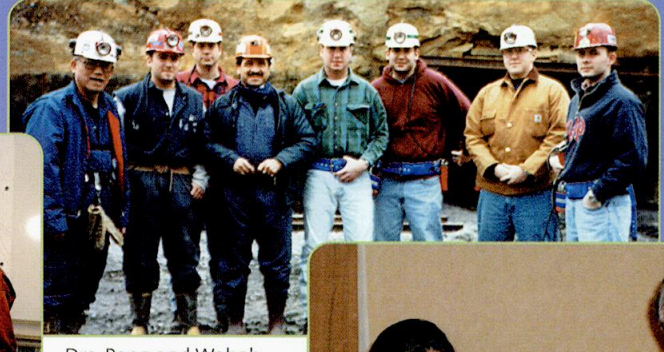
The 19th International Conference on Ground Control in Mining, August 8-10, 2000, held in Morgantown, WV, set new records in attendance and papers presented. More than 220 participants attended from all coal producing states in the U.S. and 8 foreign countries. The conference program reflected the trend of internationalization of the world coal industry with strong representation both in attendance and speakers from major coal



Khaled El-Nagy, a graduate student with the Department, maps holes containing explosives as part of a project measuring fugitive fumes and dust from surface mine blasting.



Mine tour to Kingston Mine, Riverton Coal Production Co., Mossy, WV. James Hancock, superintendent, explains a map of the mine workings to visiting undergraduate students.



Drs. Peng and Wahab Khair (4th from left) and MinE undergraduate students on a field trip to the new Fork Creek Mine, Coal River, WV.

Shelly Shalvis receives her Old Timers Award from Richard Whiting at the 2001 Spring Awards Banquet.

Governor Wise congratulates the three faculty selected as the Most Outstanding in West Virginia. Among the recipients was (r) Dr. John Kuhlman, Professor of Mechanical and Aerospace Engineering.

graduated from our programs."

- SAE Mini-Formula Race Car Competition - Successful design of a high speed, beautiful, mini-formula racer that competed in the national competition in Detroit, Michigan.

- Reduced Gravity Flight Operations – A team of five students designed and built an experimental apparatus to study fluid surface tension and flew the apparatus and took data aboard the National Aeronautics and Space Administration (NASA) "Weightless Wonder" KC135 aircraft at Johnson Space Flight Center in Houston, Texas.

The students performed exceptionally well in the classroom as well as in their design projects. Last year over 50 students were honored by receiving competitive academic scholarship awards from the University, the College and the Department. Mathew Lechliter, a dual degree ME/AE graduating senior, was awarded a national Goldwater scholarship.

Several MAE faculty members received awards for their outstanding teaching and research.

- Dr. John Kuhlman was a finalist for the State of West Virginia Most Outstanding Faculty Member Award.

- Drs. Kuhlman and Marcello Napolitano were selected as College of Engineering and Mineral Resources (CEMR) Outstanding Teachers of the Year.

- Dr. Bruce Kang received the George W. Weaver Award for Excellence in Instruction in Engineering Mechanics.

- Dr. Nithi Sivaneri was selected to be the recipient of the Donald T. Worrell Teaching Award.

- Dr. Eric Johnson received the MAE Academies of Distinguished Alumni Award for Excellence in Teaching.

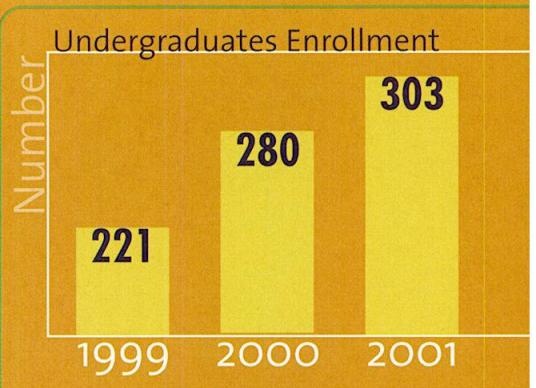
- Dr. Nigel Clark received the CEMR Researcher of the Year Award for the most outstanding research performance in the College.

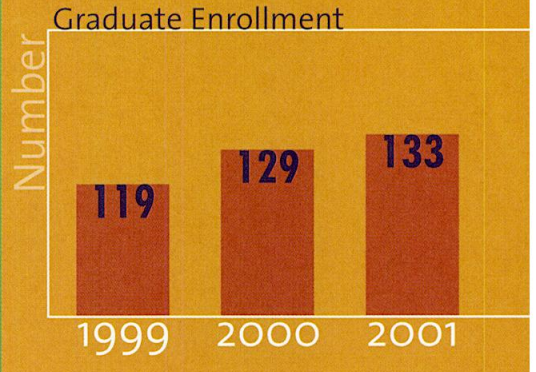
NEW ENDOWMENT

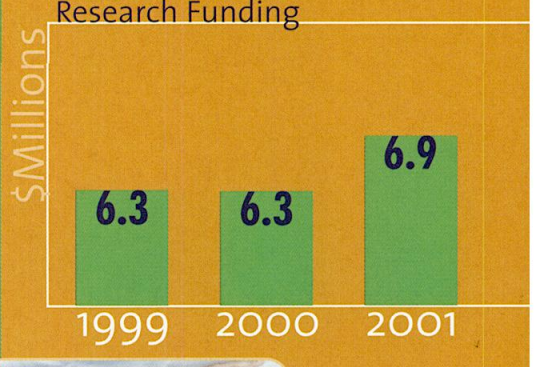
A new endowment was established in honor of the long admired and much respected faculty member, Dr. Nathan Ness, who passed away this past year. The endowment, funded by Mrs. Francis Ness and family, will provide income earnings to fund a scholarship for outstanding undergraduate students majoring in the Department. This new endowment brings to 20 the number of endowment-supported academic-based scholarships that the Department can award to outstanding students.

TRENDS

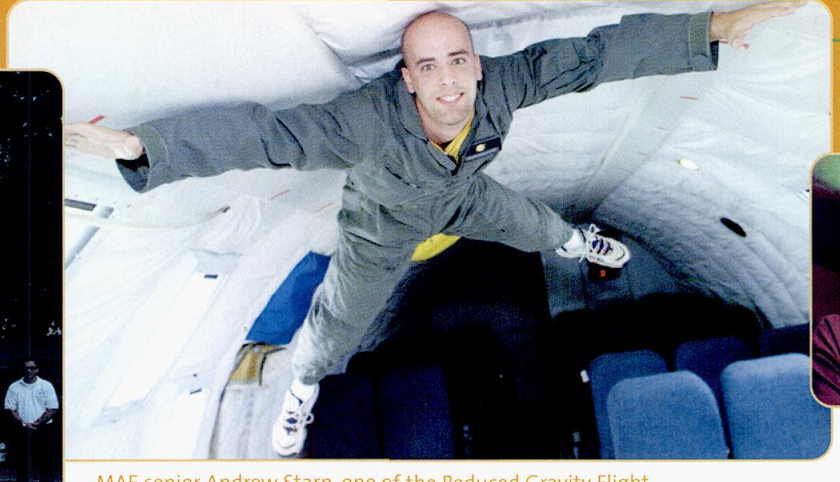
All of the programs of the Department have been increasing over the past three years. Undergraduate and graduate enrollment has increased and the amount of contract research has increased. These increases have been accomplished without an increase in State support or resources because the Department benefits from an experienced, dedicated, and committed team of faculty and staff.



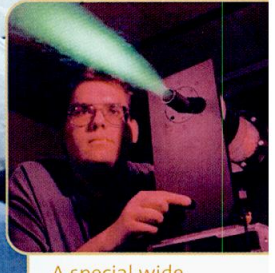




The Future Truck Competition Student Design Team at the awards ceremony in Washington, D.C.



MAE senior Andrew Starn, one of the Reduced Gravity Flight Experiment Team members, flying aboard the NASA KC-135 "Weightless Wonder" aircraft in Houston, TX.



A special wide beam laser light being developed for studying aerodynamic flow.

VEST VIRGINIA
IVERSITY

Magnetic Microgravity Mountaineers

Engineering Student Team Experiences Zero Gravity with NASA

Engineering students took the initiative to "boldly go" where "a select few have gone before" by competing for and securing a position in the Reduced Gravity Student Flight Opportunities Program sponsored by NASA's Johnson Space Center.

For four decades the Johnson Space Center has provided a true three-dimensional "weightless" test and training environment for countless numbers of astronauts and researchers through its Boeing KC-135A aircraft. Now, the Boeing KC-135A use has been expanded to offer the Reduced Gravity Student Flight Opportunities Program, a unique avenue to engage student-investigators in hands-on research.

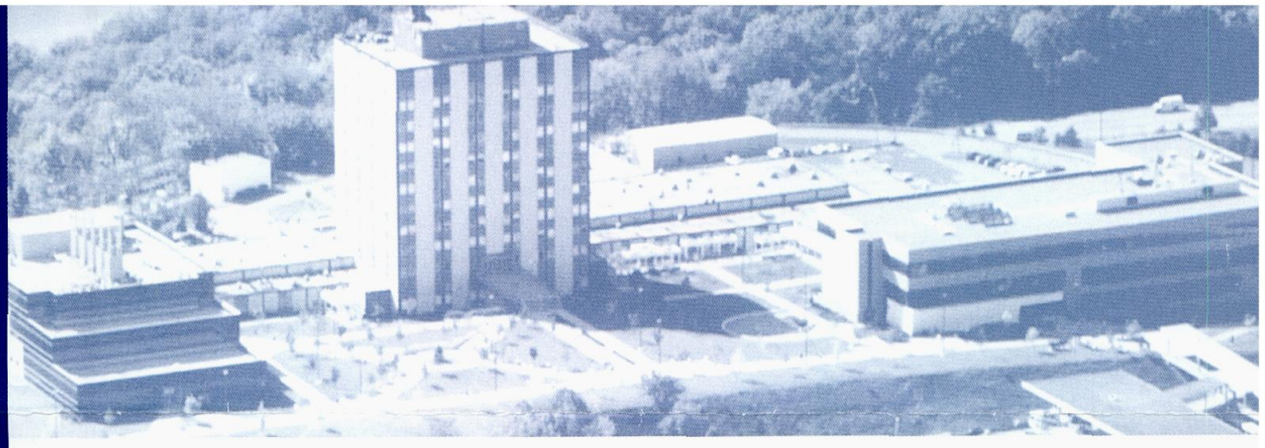
(l-r) MAE senior Austin Barnard; journalist Bob Pacsula; and MAE Senior Matt Lechliter show their Mountaineer Pride while "flying" in Zero Gravity.

The Program provides an academic experience for undergraduate students to successfully propose, design, fabricate, fly and evaluate a reduced-gravity experiment of their choice over the course of six months. In addition, this program encourages first-hand knowledge of the documentation necessary for an experiment, hands-on designing, building, and conducting the experiment, and outreach to academic, professional, and general communities.

"This project was definitely the best experience that I have had here at WVU" said Team Member Austin Barnard. "It was great to travel to Houston and do the same things that all the astronauts do in training. As far as the actual weightlessness goes, it's difficult to explain. It was everything that I expected and more. This project has really turned me on to the idea of pursuing research through graduate school and hopefully a career."

Faculty advisors for the Microgravity Mountaineers are Dr. John Kuhlman of Mechanical and Aerospace Engineering, and Donald Gray, of civil and environmental engineering. The team was sponsored in part by the West Virginia Space Grant Consortium, which is housed in the College of Engineering and Mineral Resources and is directed by Industrial Management Systems Engineering Professor, Majid Jaraiedi.

College of Engineering & Mineral Resources



WestVirginiaUniversity

Winter 2001

Engineering Lab Project Receives $500,000 Gift From Dow Chemical

Efforts to upgrade the Chemical Engineering Department's undergraduate laboratory received a major boost recently when Dow Chemical Company gave a half-million dollars to the project.

Executives with Dow, the world's leading chemicals, plastics and agricultural products company, presented a $500,000 check to WVU President David C. Hardesty, Jr. during a November 2 visit to campus.

(l-r) Kathleen DuBois, College Director of Development; David Summers Dow Research & Development Leader; Peter Berner, Dow Vice President West Virginia Operations; President Hardesty; Jerry Ring, Dow Director o Global Contributions and Public Affairs; and Dean Cilento.

"We are very appreciative of the leading gift made by Dow Chemical Company to this important project," said Dady Dadyburjor, chair of the Department. "It is imperative that we support students in their academic endeavors by supplying them with the best tools possible. Dow will have made an impact on our students and our department for many years into the future."

The Dow gift is imperative to maintaining a state-of-the-art learning environment that will allow the department to be more competitive with its peers. Proposed upgrades include the addition of modern computer-controlled experiments and more sophisticated analytical equipment.

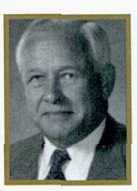
The two-level laboratory was recently named in honor of retired professor, Alfred F. Galli, who taught for four decades in the department. The lower level will now be known as the Dow Level in honor of the company's support.

"The chemical engineering program at WVU has had a track record of recognition and success," said Peter Berner, vice president of Dow's West Virginia operations. "This grant is a strong vote of confidence in the leadership of WVU and its commitment to faculty and students to provide the resources to enhance the school's position as a leader in chemical engineering education and research in the years ahead."

(l-r) WVU Provost Gerald Lang, Dean Cilento, Bea and Fred Galli, and Chair Dadyburjor at the ceremony to name the undergraduate chemical engineering laboratory: The Alfred F. Galli Laboratory.

The following chemical engineering alumni made leading gifts and pledges to the Alfred F. Galli Laboratory Fund that helped to leverage the major gift from Dow: Pat Simms '66, Leo Mehl '59, Verl '64 and Joyce Purdy, Jim '61 and Pat Mitchell, Bill Blake '64, Tom Harrick '60 and Robert Pyle '60.

(top) Purdy, (center) Pyle, Simms, (bottom) Mehl, Harrick, Blake, Mitchell.



We want to express our sincere gratitude to these alumni for making their alma mater a better place.

Campus Life

Jeff Messing to retire, but stay in touch

BY JIM BISSETT
The Dominion Post

WVU's Dr. Jeff Messing has made a career of simply helping people get along, in the board room and the living room.

Messing, who chairs WVU's departments of counseling, rehabilitation counseling and counseling psychology, is retiring at the end of this month. He and his wife will relocate to Maryland's Chesapeake Bay to enjoy their grandchildren, sailing and simply spending time together.

Of course, he said, chuckling, those activities will have to commence in-between telephone calls from WVU and his colleagues across the state and country.

His Allen Hall colleagues keep stopping by his office, not to say goodbye, but to ask for advice.

"They always say 'Look, we know you're not going to be here next year, but what do you think about this, or that?'" Messing said on a recent Thursday as rain pelted the windows of his office. "I feel pretty good about that. It's actually pretty rejuvenating."

In his 28 years at WVU, Messing has helped rejuvenate counseling programs across West Virginia, helping found, advise or oversee counseling programs in all environments.

Programs that provide official training, and official certification.

That word, "counselor," packs a lot of weight, he said, and when it's going under someone's name on an office door, that person had better be professionally trained and certified.

Rehabilitation counselors, mental health counselors and high school guidance counselors all hold immense responsibilities, he said.

In 1986, former Gov. Arch Moore and the Legislature put together an official review board for counselors, and Messing was one of the first people appointed to that body's advising board by the governor.

Fairmont-based vocational consultant John Panza headed that board for 11 years, and he said was impressed by Messing's commitment to counseling in the state.

"I call him an 'ocean of resources,'" Panza said. "He just has this vast knowledge. He went above and beyond to serve his university and our state. We'll miss him and his expertise."

But while Messing won't be on campus come fall, he'll still be a phone call away, he said. He'll do some freelance counseling in the months ahead and will also coach executives on how to manage employees in a more humane manner.

"This is the next phase of my life," the 63-year-old educator said. "It'll be an adventure."

Submitted Photos

WVU's Magnetic Microgravity Mountaineers took a couple rides on the "Weightless Wonder" at Johnson Space Center in Houston. They are Shannon Glaspell (front, left), Paul Kreitzer, Charlie Battleson, adviser Dr. John Kuhlman (back, left), Austin Barnard, Andrew Starn, Jennifer Hazelton, Matthew Lechliter, adviser Dr. Donald Gray and Michelle Lechliter.

Weight loss made easy

8 from WVU perform low-G experiment

The Dominion Post

Spring break was more than sun, sand, and surf for the Magnetic Microgravity Mountaineers. For 10 days, the group of eight WVU students tested their engineering skills at NASA's Houston base.

This year's crew includes returning seniors Austin Barnard, Jennifer Hazelton, Matthew Lechliter and Andrew Starn, along with new members juniors Paul Kreitzer, Charlie Battleson and Shannon Glaspell, and sophomore Michelle Lechliter.

Last year, the four returning seniors formed a smaller four-person team. This year, the group expanded to eight students. The additional four allows for a ground crew, which completes a majority of the preliminary work.

The extra four also allows for the education of the younger team members and prepares them for leadership positions and flight crew for next year's experiment.

The group of students left for Houston on March 20, while their faculty advisers — mechanical and aerospace engineering professor Dr. John Kuhlman and civil and environmental engineering professor Dr. Donald Gray — joined them on March 23.

Shannon Glaspell tries on her helmet and breathing gear aboard the "Weightless Wonder" in Houston.

Team members arrived earlier to complete required physiological training and various tests, and to give information that must be gathered.

Gray said the KC135 is an airliner with no seats. It's the one used in the filming of "Apollo 13." The KC135 is also affectionately known as the "Weightless Wonder" and not so affectionately as the "Vomit Comet."

Microgravity is the near-weightless sensation felt as the aircraft reach the top of an arc, like the sensation felt on a roller-coaster, Gray said.

The students completed their experiment in two flights during two days.

The basis for the team's experiment was four tanks with paramagnetic fluid with strong magnets under the tanks. The purpose was to control the oscillation of the fluid using the magnets.

The program's goals are to promote education in the areas of science and engineering, along with emphasizing interest in microgravity research and knowledge of WVU's participation in NASA programs.

The students must form a group, develop an experimental concept and then design an experiment. They also must file reports with NASA, based on their findings and results.

BRIEFS

The Dominion Post

Katherine Aaslestad chosen for fellowship

Katherine B. Aaslestad, a historian at WVU, has been chosen to receive a fellowship from the WVU Humanities Council. Aaslestad, assistant professor of modern German and European history in the Eberly College of Arts and Sciences, will receive a $2,500 fellowship for her proposed study titled "Local Patriots: Civic Heroes and National Commemoration in 19th Century Hamburg."

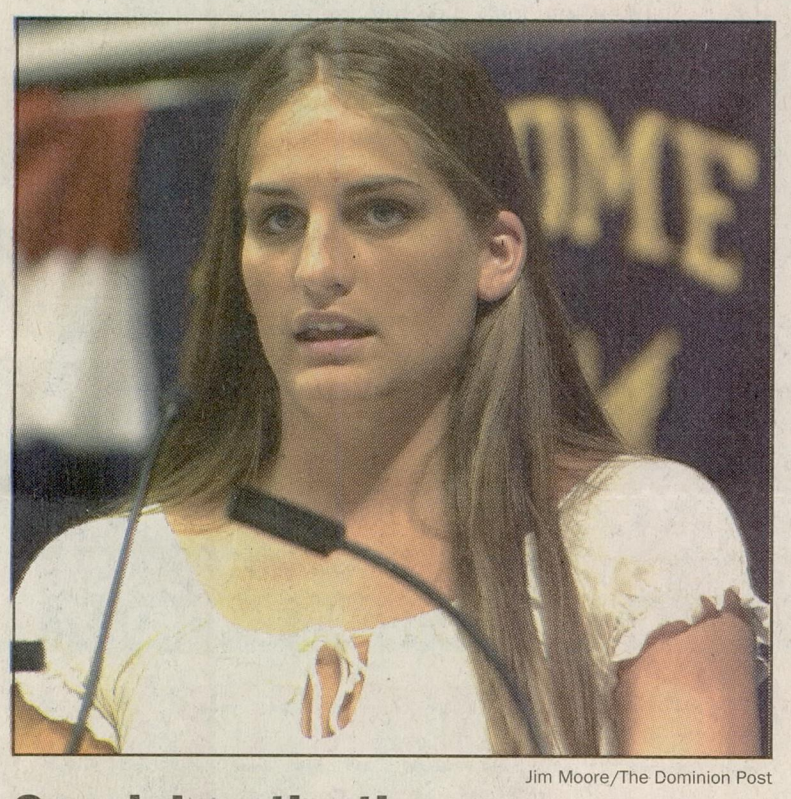
W.Va. Humanities Council fellowships are awarded to accomplished scholars with advanced degrees in humanities disciplines.

PSC-WVU now offers Associate of Arts Degree

Potomac State College-WVU now offers an Associate of Arts Degree in Business and Economics at WVU's main campus in Morgantown.

This is the first time PSC-WVU has offered the program in Morgantown. Classes are designed for working adults, and courses for the two-year program are held at night and over the Internet.

An informational session will be from 7-9 p.m. Wednesday at WVU Extended Learning. Info: 293-2675, or radean@mail.wvu.edu.



Jim Moore/The Dominion Post

Special motivation

WVU junior point guard Kate Bulger makes a motivational presentation before a crowd of nearly 2,000 at the opening ceremonies of the 2002 Special Olympic Games held Friday evening at the Coliseum. Bulger shared the dais with WVU National Wrestling Champion Greg Jones.

WVU's Forensic researc garnering some nation

The Dominion Post

WVU's new research initiative in forensic science is attracting national attention. Twice in May a video crew representing Court TV filmed and interviewed WVU forensic science researchers.

On May 7, a three-person crew from New York and Pittsburgh spent several hours with Clifton P. Bishop, associate professor of biology, who is developing a method to determine the amount of time that has past after a blood stain has been left at a crime scene.

"This method could be important in cases where the time of the crime is disputed or unknown, like in the O.J. Simpson case," Bishop said. "Being able to tell whether a blood stain is the same age as when the crime occurred would be of great benefit to law enforcement agencies."

On May 21, a second crew from Pittsburgh and south Florida interviewed Max M. Houck, projects director for the Forensic Science Initiative, about a case he worked on while a Supervisory Physical Scientist with the FBI Trace Evidence Unit in Washington, D.C.

Houck examined human and animal hairs and textile fibers in the case of a young girl who was abducted from her apartment complex near Orlando, Fla., and later murdered. Houck worked with Scott Ryland, from the Florida Department of Law Enforcement Crime Laboratory, and together they described the case in a book Houck authored and edited in 2001 titled Mute Witnesses. Houck is co-authoring a second book in the series to be published by Academic Press sometime early next year.

The Forensic Science Initiative is a new multi-million dollar research effort that operates out of the WVU Office of Research and Economic Development. It is part of the University's Forensic Identification Program. The initiative sponsors research and education efforts in forensic science at WVU to benefit local, state and federal forensic science laboratories.

"The research we are beginning to develop here in forensic science will be very useful in the future for

Kalispell student working on MSU satellite launch

MSU University News

A Kalispell woman is part of a team of students at Montana State University who are working on a project to launch a tiny satellite via a converted intercontinental ballistic missile in the former Soviet Union.

MICHELLE GALVIN

Michelle Galvin, a senior who works in in MSU's Space Science and Engineering Laboratory, is among the students who have worked on the satellite, which will be launched from Kazakhstan sometime between November and next spring.

MSU's satellite will help measure radiation trapped in the Van Allen belts that surround the earth.

"There are no launch facilities in Montana," said physics professor Dave Klumpar. "The two or three possibilities in the United States don't work out because of cost and other things. It turns out that foreign launchers are by far the least expensive."

The first satellite ever built in Montana is the size of a toddler's toy, a cube measuring about 4 inches per side. Known as the Montana EaRth-Orbiting Pico Explorer (MEROPE), it will contain scientific instruments and two antennas. The satellite will be shipped to Kazakhstan and loaded onto the carrier with satellites from other U.S. universities.

"To be here and have students involved, to give them the same kind of experiences I had, is just really exciting for me," said Klumpar, who was involved in space experiments 40 years ago as an undergraduate.

Four of the students at MSU flew in the infamous "vomit comet" this spring to test the antennas they designed for the satellite. The KC-135 flies out of the Johnson Space Center, then soars and dives over the Gulf of Mexico to create weightlessness.

"It's kind of like swimming under water, but even that isn't realistic," Cody Pinion said. "When you are in zero gravity, it's really difficult to position yourself."

"It's a fun time. That's for sure," Ian Barnes said.

Pinion is a junior from Great Falls, and Barnes is a junior from Billings. Other MSU students who flew on the KC-135 were Trevor Grove, a senior from Great Falls; and James Black, a senior from Williston, N.D. Galvin and Andrew Ross, a senior from Missoula, were alternates. All six are majoring in mechanical engineering.

"I have been helping with the structural and outreach components of the project," said Galvin. "I flew with the Microgravity Project in summer 2001, and I hope this year's fliers had as much fun as I did."

Swales Aerospace and the Montana Space Grant Consortium are two major sponsors of the MEROPE project.

Galvin flew on the KC-135 last year and said it's been a popular topic on job interviews.

"It's the one thing they always ask," she said.

Figure 10. Article published by Kalispell's Daily Interlake newspaper.

EBADAT, BARBARA A. (JSC-AH) (SJC)

From: Courtney Fritz [courtneyfritz@onebox.com]
Sent: Friday, June 07, 2002 8:41 AM
To: EBADAT, BARBARA A. (JSC-AH) (SJC)
Cc: SICKOREZ, DONN G. (JSC-AH) (NASA)
Subject: RGSFOP Group 2002-036 TEDP submission

tedp 2002-036.ZIP

Dear Barb,
Here's our TEDP, thank you for your help with those questions! This caliber of research is very new, and often daunting, to the majority of out team; however, the incredible support and guidance that members of the JSC community have been giving has allowed us to grow as scientists. Thank you so much!

We've got a hard copy (six actually) of the TEDP on its way to Jon Yaniec later today, but I would like to forward him an electronic copy as well. Would you happen to know his email address there at JSC?

Thanks again, and I'll be communicating with you soon in regard to IRB matters.

P.S.
The TEDP is in microsoft word and has been zipped (win-zip) for convenience of email.

Sincerely,
Courtney Fritz
courtneyfritz@onebox.com - email
(866) 365-8138 - voicemail/fax
http://www.angelfire.com/trek/cdf - web site

Glass Notes
P.O. Box 2039
New London,
NH 03257
PHOTO BY JOAN EATON

Brown University

JM Eaton

5/18/02

DR. SICKLOREZ,

WE JUST WANTED TO THANK YOU FOR ALL YOUR WORK IN PUTTING TOGETHER THIS YEAR'S "RGSFOP" AND FOR YOUR INFINITE HELP WHILE WE WERE IN HOUSTON. ALL OF US HAD AN EXPERIENCE THAT WE WON'T FORGET AND WE HOPE TO COME BACK IN THE FUTURE WITH SOME NEW FLYERS FOR ANOTHER EXPERIMENT.

THANKS SO MUCH,

BROWN UNIVERSITY "IV" TEAM

WestVirginiaUniversity
Department of Mechanical and Aerospace Engineering

May 9, 2002

Dr. Donn G. Sickorez, Ph.D.
University Affairs Officer
Mail Code AH2
The Johnson Space Center
Houston, TX 77058

Dear Donn,

We of the Magnetic Microgravity Mountaineers Team from West Virginia University successfully flew our second experiment in NASA's Reduced Gravity Student Flight Opportunities Program during the month of March in 2002. This was a wonderful opportunity for the eight student team members to utilize the engineering skills that they have acquired in their studies. It also was great fun for all of us, and our experiment was quite successful.

We have enclosed a framed, signed team photo from our campaign this year. Again, we all greatly enjoyed and benefited from our participation in your RGSFOP program, and look forward to our next round of experiments.

Sincerely,

John M. Kuhlman

Dr. John M. Kuhlman
Professor

(Enclosure)

Phone: 304-293-3111 | PO Box 6106
Fax: 304-293-6689 | Morgantown, WV 26506-6106

Equal Opportunity/Affirmative Action Institution

Daily Southtown

Lifestyles

Flight school

UIC students' spring break plans include NASA experiment

Tuesday, March 19, 2002

By Guy Tridgell
Staff writer

Biljana Zdravevski and James Knight will spend spring break under sunny skies, losing their sense of equilibrium, fighting queasy stomachs and generally feeling like they are floating in outer space.

That might not sound much different than the itineraries for scores of other college students this month.

But Zdravevski and Knight, both University of Illinois-Chicago students from Palos Hills, will be experiencing the rigors of a NASA study about the effects of weightless on liquids.

"We are representing the school, so we have to do well," the 24-year-old Knight said. "I am nervous for myself because I don't do well on roller coasters."

The two mechanical engineering students leave today for the Johnson Space Center in Houston.

After undergoing a battery of medical tests, Zdravevski and Knight board a special military jetliner for two days of flights over the Gulf of Mexico, where NASA enjoys unrestricted air space for astronaut training missions.

vertical zigzags called parabolas. Descending 15,000 feet at 45-degree angles, the dives — about 50 are taken in one flight — are designed to simulate 25 seconds of zero gravity.

Throughout those moments, Zdravevski and Knight will photograph and chart the behavior of liquid droplets suspended in the air. The droplets will be spiked with varying amounts of glycerin to alter the viscosity and flow patterns.

"We are actually floating around with the equipment," said the 22-year-old Zdravevski. "We really want to get decent data. Work is definitely first."

The findings will be used to devise new applications in space for liquid products, such as fuels, pesticides, paints and cleansers.

There is a small window to grab the information needed for the experiment.

"We are hoping to get, altogether, between five and 10 good sets of data, which is enough to answer questions posed in a research project," said Constantine Megaridis, their faculty adviser and associate head of the school's mechanical and industrial engineering department. "You are under pressure. The experiment in flight gives you 2 minutes to prepare each run and 20 seconds to make it work."

Joining Zdravevski and Knight will be two other UIC students. The trip is part of a group project, an independent study needed to complete graduation.

The students have been logging about 20 hours a week to prepare for the experiment. The entire process is meant to mirror the experiences of engineers in the working world.

"I had no idea about all of the safety issues involved. There is so much to do," Knight said. "It is a big constraint."

NASA has offered the flights, called the "Reduced Gravity Student Flight Opportunities Program," for six years.

UIC students have made the trip twice before Zdravevski and Knight. Of the five who graduated, two were hired by aerospace

engineering firms and three were accepted into doctoral programs at major universities.

Zdravevski and Knight do not have their heads too far in the clouds to understand the opportunity before them.

"The competition is very tough to get into. They only let in a select amount," Zdravevski said. "I hope our experiment goes well, and I hope I don't get sick."

Guy Tridgell may be reached at gtridgell@dailysouthtown.com or (708) 633-5970.

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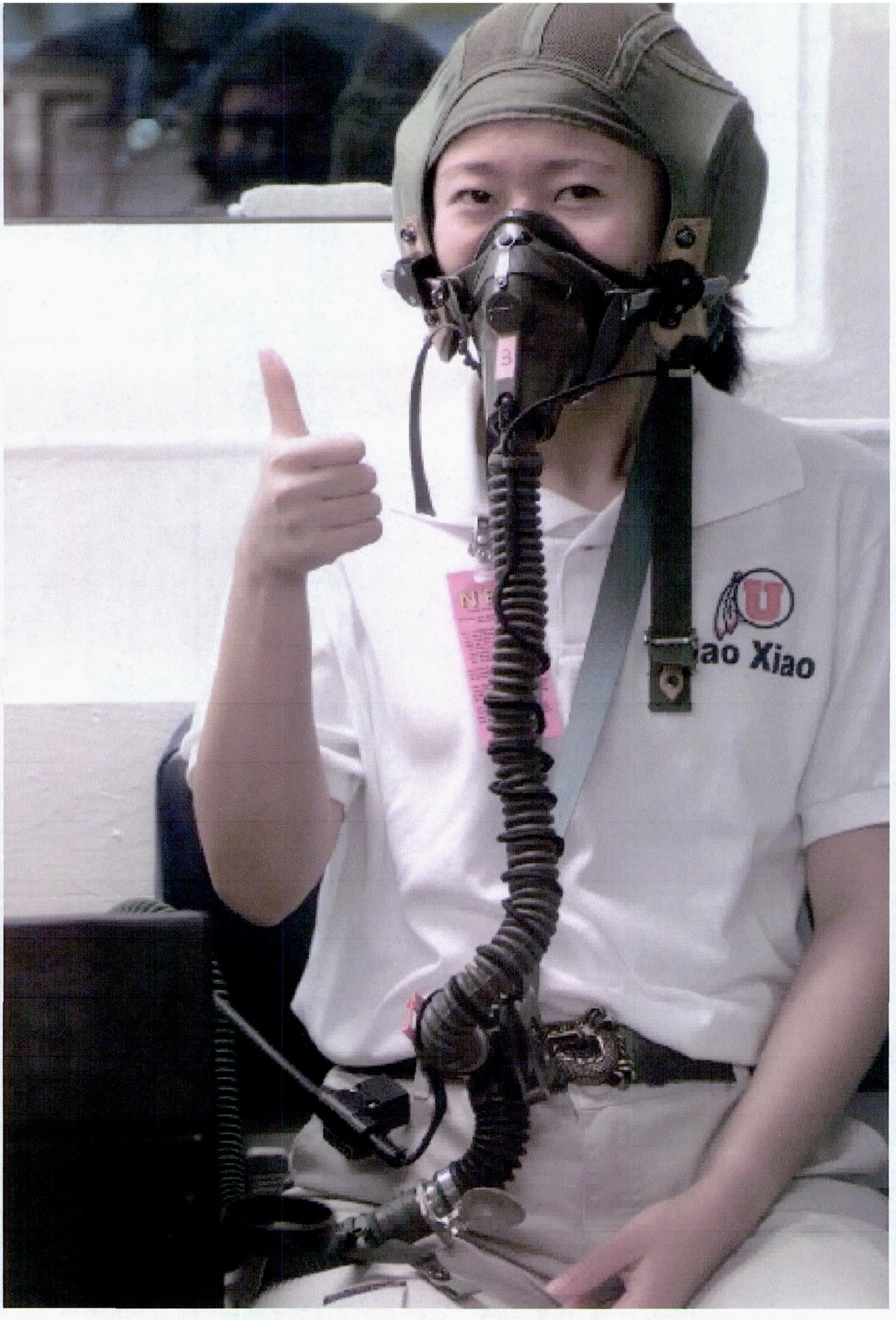
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UICNEWS
The University of Illinois at Chicago

News

UIC three-peats free fall team on NASA project

03/06/02
Paul Francuch

Four UIC engineering undergraduates will spend part of their spring semester break doing dives over the Gulf of Mexico.

What sets them apart from countless others is they won't plunge off boats or seaside cliffs but will free fall on board a NASA KC-135A jetliner — a military version of Boeing's 707 — flying half loops more than 30,000 feet above the Gulf. The plane is specially modified to create short weightless periods of up to 25 seconds.

Besides the obvious thrill of participating in such aerial acrobatics, the students will gain a valuable collection of scientific data, along with resume citations bound to impress prospective employers.

The four are juniors and seniors who rank in the top 10 percent academically in their engineering majors: Jose Carreon, Julie Schaefer, James Knight and Biljana Zdravevski.

High school student Casey Liang, a junior at the Illinois Math and Science Academy, was selected to participate and will travel with the UIC team to NASA's Johnson Space Center in Houston to help with ground activities.

The team leaves for Houston March 19 and returns to Chicago March 28. Two flights are booked on the NASA jetliner March 26 and 27.

The four UIC students will work in pairs on the flights, each lasting about two hours during which up to 50 microgravity-inducing, parabolic arcs are flown over the Gulf. During the weightless period, the plane dives about 15,000 feet at a 45-degree angle before again climbing for another run.

"We're hoping to get between five and 10 good sets of data, which is enough to answer questions posed in the research project," said Constantine Megaridis, professor and associate department head of mechanical and industrial engineering. He serves as the team's faculty adviser.

The team's research centers on fluid dynamics and how droplets behave when stretched.

The microgravity created in flight will allow the team to film the movement of suspended droplets of water mixed with varying

amounts of glycerin to alter viscosity, or resistance to flow. Data gathered will help answer questions posed in the team's NASA research proposal.

"The droplets deform when stretched and do things we can understand with the help of models and equations," said Megaridis.

"The findings can have implications for an assortment of practical applications, such as the formulation of pesticide and paint sprays, for example."

The project proposal, equipment design, planning and task assignment were done entirely by the students as part of a nine-month independent study course. Megaridis meets with the team once a week, but he otherwise takes a hands-off approach.

"The program is designed to train scientific discipline," he said.

"You are under pressure. The experiment in flight gives you two minutes to prepare each run and 20 seconds to make it work. If it doesn't, you have to troubleshoot and make it work the next time. It simulates the real pressures professional engineers often encounter on the job."

UIC's track record in the six-year-old NASA Reduced Gravity Student Flight Opportunities Program is enviable. This is the third consecutive year UIC student engineers have won NASA's approval to participate. UIC is the only Chicago-area school to fly in the program to date.

Five students from the two previous UIC teams have graduated. Megaridis says two were hired directly by aerospace engineering firms; the other three entered doctoral programs at top-ranked universities.

Megaridis offered one more impressive statistic.

"On average, one of three persons gets sick flying on the KC-135. But no UIC student has gotten sick," he said.

"So far."

Above: Chui Messman and Mark Perricone, members of the first team sent to Johnson Space Center in March 2000.

Photo: NASA

SICKOREZ, DONN G. (JSC-AH) (NASA)

From: SBenson [s.k.benson@student.tcu.edu]

Sent: Monday, December 10, 2001 7:19 PM

To: SICKOREZ, DONN G. (JSC-AH)

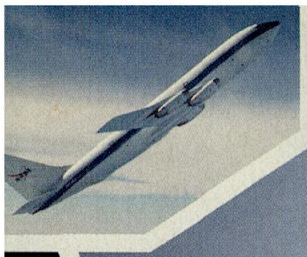
Subject: Job Opportunities

Dr. Sickorez,

My name is Scott Benson, I participated in the Texas Fly High Program in 2000. I am currently an Engineering Major at TCU in Fort Worth, I was just curious about possible job opportunities ranging from intern jobs to just simply volunteering. I would appreciate any advice that you might have in persuing a job at JSC at NASA. Thanks for your time.

THANKS,

SCOTT



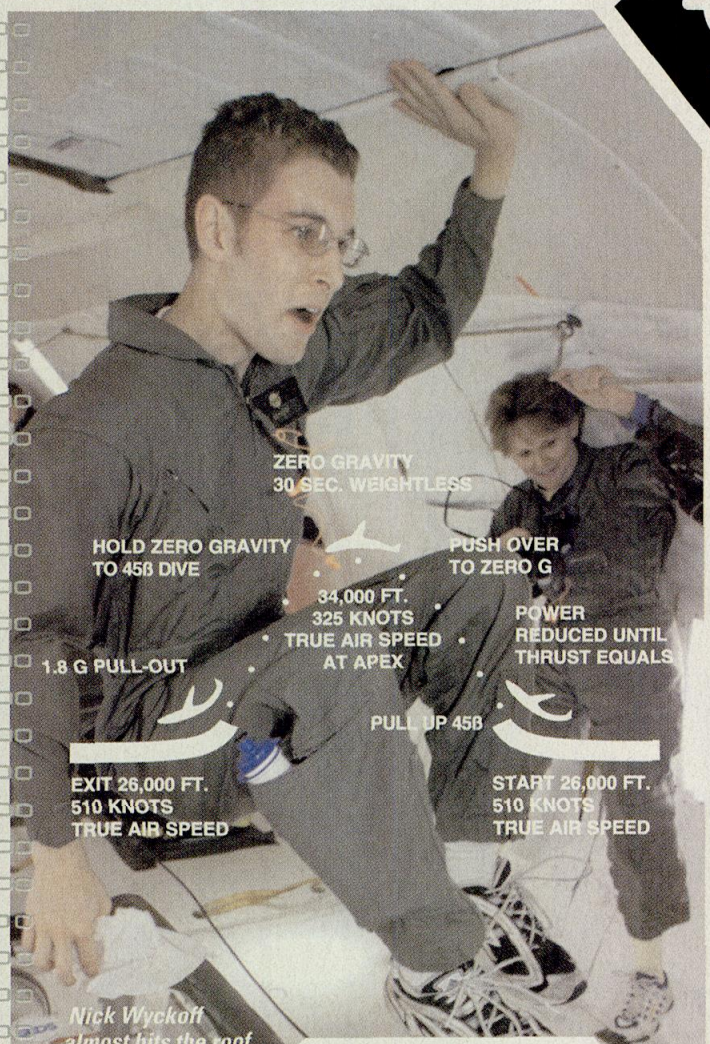
ID: KC-135

MISSION STATUS:

A RIDE ON NASA'S "VOMIT COMET" IS AN ADVENTURE IN WEIGHTLESSNESS.

RECOMMENDATION:

DON'T FORGET THE BARF BAG!



Nick Wyckoff almost hits the roof in a weightless moment. The chart shows the roller-coaster pattern of the KC-135.

WEIGHTLESS WONDER

Vomit Comet? NASA officials aren't nuts about this nickname for the KC-135. They prefer the term "Weightless Wonder."

Officials with the program say only about a third of participants get queasy. Most, they say, do just fine and are able to carry out their experiments without a problem.

FORGET EARTH-BOUND ROLLER COASTERS THE BEST THRILL RIDE IS ON NASA'S "VOMIT COMET."

This KC-135 jet is the National Aeronautics and Space Administration's zero-gravity astronaut trainer. It flies a pattern like a roller coaster—at 34,000 feet—and the ride lasts an hour and a half.

Like astronauts, teams of high school and college students can train on these reduced-gravity flights, as long as they come up with a NASA-approved gravity experiment to conduct onboard.

FOAM IN SPACE

Last year, the University of Alabama-Huntsville team came up with an experiment designed to prove that space stations could be built out of hardened foam.

"Weight is the key," said then-senior Nick Wyckoff of Gull Lake, Mich. "If something light is formed in space, then less fuel will be needed to get it up there."

GAS ATTACK!

Before taking off from the Johnson Space Center in Houston, Tex., the four team members had to undergo rigorous safety training in the altitude chamber, a small metal room with portholes and oxygen hoses that mimics altitude up to 25,000 feet.

Deflated balloons hung from the ceiling. During the chamber test, the balloons inflated when the pressure changed.

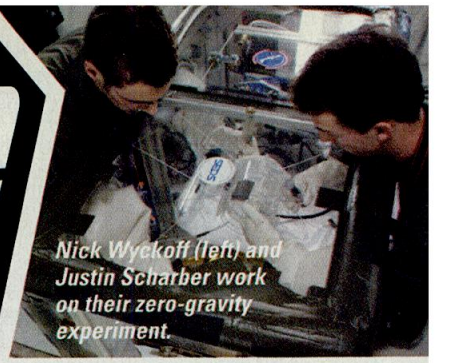
The balloons weren't the only things inflating on this "flight." Gasses in the team's bodies expanded, too, and you can imagine the results—from both ends. (Pardon me!)

At simulated 25,000 feet, the team members were told to take off their oxygen masks. Everyone could still breathe, but they were getting much less oxygen. Their lungs were

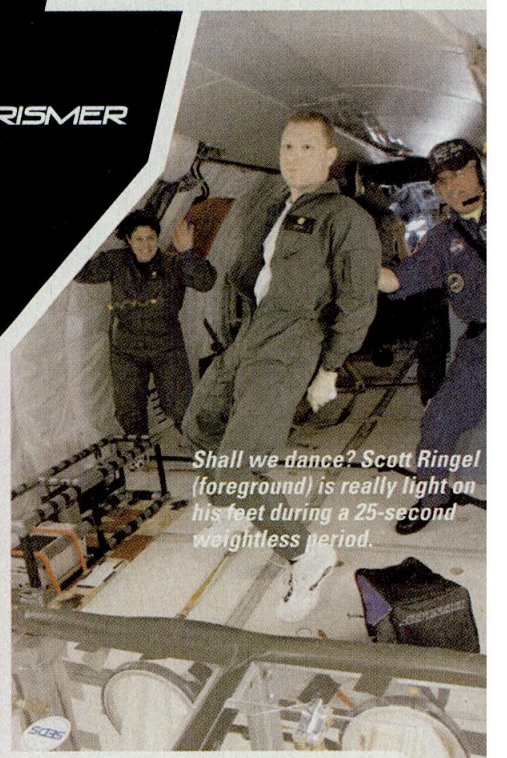
CODE NAME:

AS THE STOMACH TURNS

BY: MEL CHRISMER



Nick Wyckoff (left) and Justin Scharber work on their zero-gravity experiment.



Shall we dance? Scott Ringel (foreground) is really light on his feet during a 25-second weightless period.

working overtime. Less oxygen to the brain caused some to act silly.

NOW BOARDING

Early the next morning team members were given jumpsuits and a pre-flight briefing. NASA flight doctor Eric Santos offered a pill for the vomit reflex and handed out plenty of barf bags.

After takeoff, the team unbuckled and moved to the floor of the plane, next to a mini lab in which they'd conduct their experiment. At 25,000 feet the jet took a steep 45-degree angle up.

"Here we go!" yelled Nick Wyckoff over the roaring jets. Teammate Justin Scharber gave two thumbs up.

No one dared move his head. That can make you sick immediately. Dizzy for a second, everyone felt magnetized to the jet's walls.

Next the Vomit Comet was in another 45-degree angle—down!

Scary? "No, it's great!" said Craig Le Quire.

If something wasn't strapped down, it was weightless. People were doing somersaults in midair.

GRAVITY RETURNS

Then, "Feet down!" came the command from John Yaniec, lead KC-135 test director. That's the signal that 2 G's (twice the regular gravity) was coming back.

Each time, the floating lasted only about 25 seconds, but the plane flew the roller-coaster pattern 32 times. That was more than enough weightlessness for most of the team members.

Every weightless period, the students' experiment continued. The guys combined polyurethane compounds from double syringes and squeezed them through mixing nozzles into plastic curved tubes.

The experiment was a partial success. The mixture foamed and then hardened, but the foam leaked out of the nozzles when the gravity came back to the aircraft.

The process needs perfecting, said Justin Scharber. "Next time, we'll know what to expect."

QUEASY FEELINGS

So what about the vomit part? The people who moved their head during the "up" angles didn't do that more than once. The signals between the ears, eyes and stomach were strong.

Many got sick. The last thing to leave the jet was a trash bag full of used barf bags.

The Vomit Comet had lived up to its name.⚜

HOW TO GET AIRBORNE

Teams of high school, community college and university students can fly with science experiments. At this time high school opportunities are limited to Texas students. Check out the Texas Space Grant Consortium Web site at www.tsgc.utexas.edu/floatn/ or write to: NASA Reduced Gravity Student Flight Opportunities Program
Texas Space Grant Consortium
3925 West Braker Lane, Suite 200
Austin, TX 78759

A shaky return to terra firma.

Courtesy of NASA/JSC

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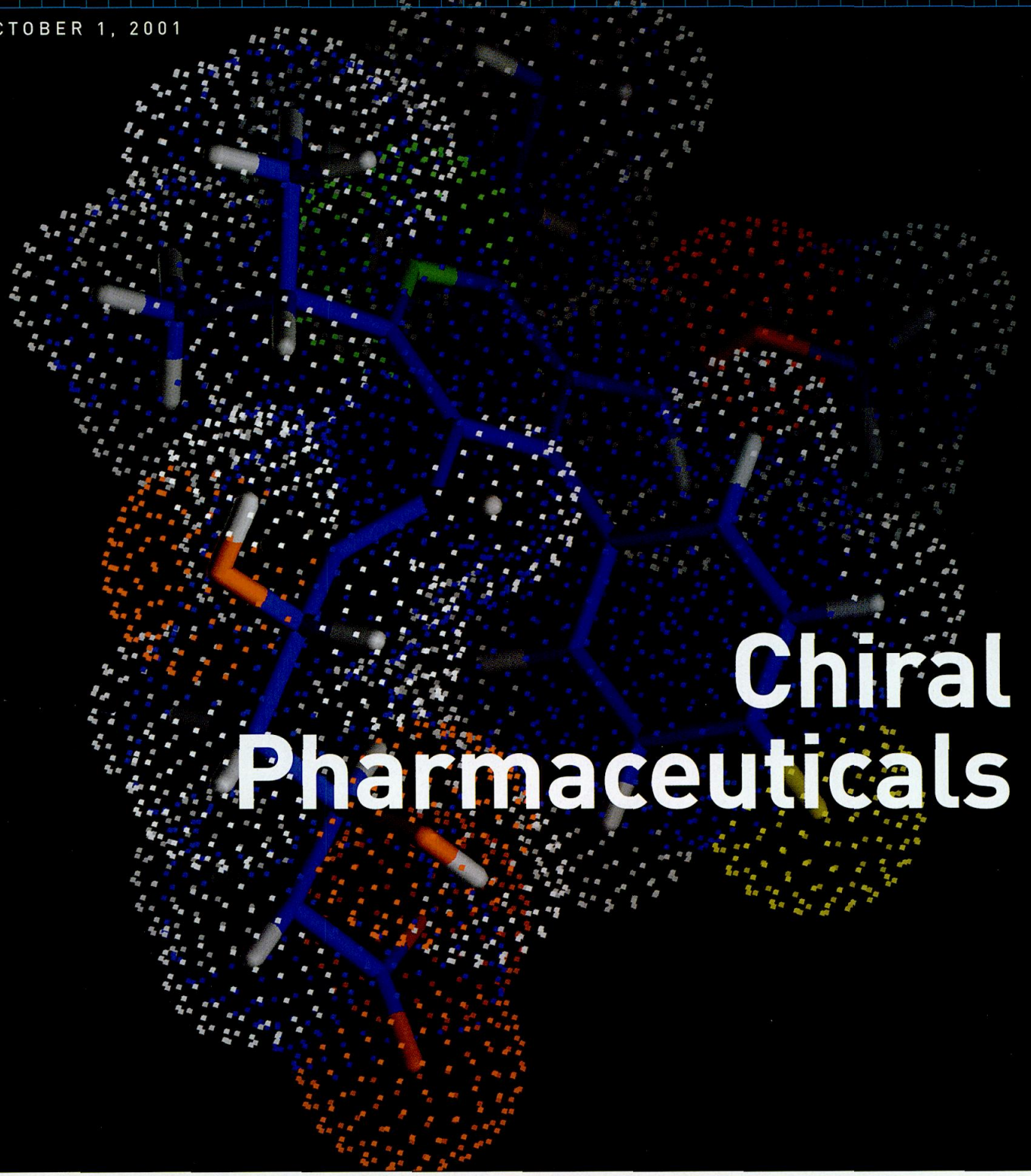

Chiral Pharmaceuticals

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THE NEWSMAGAZINE OF THE CHEMICAL WORLD

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CHIRAL DRUGS

Growth and development of these pharmaceuticals continue unabated.

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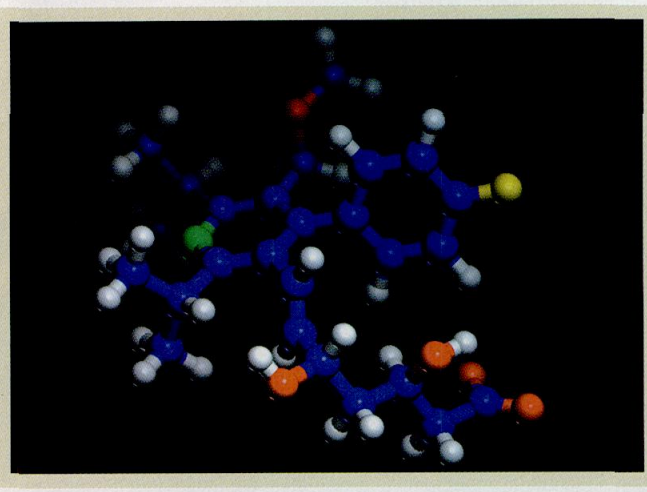

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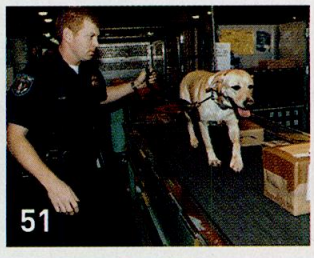

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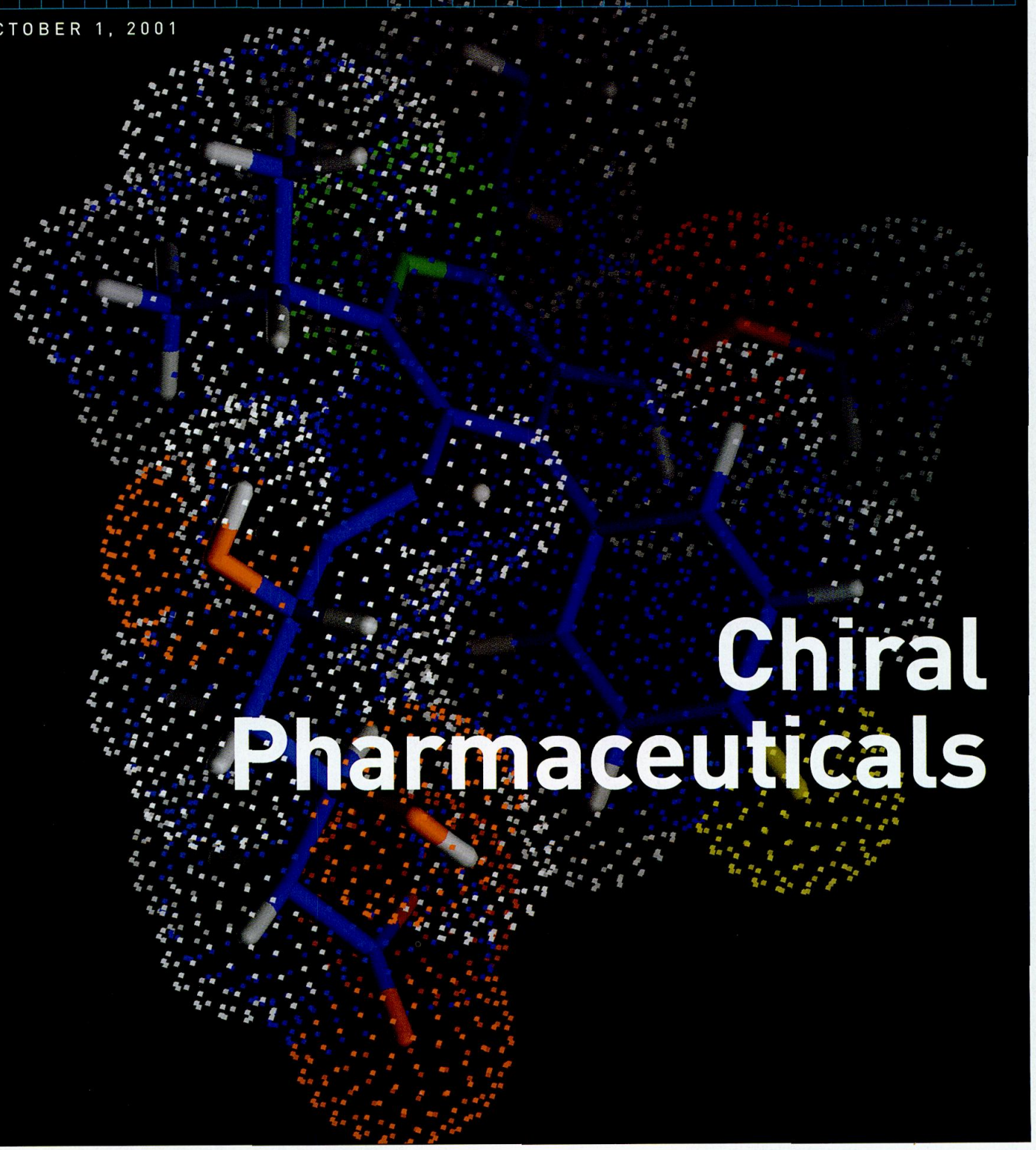

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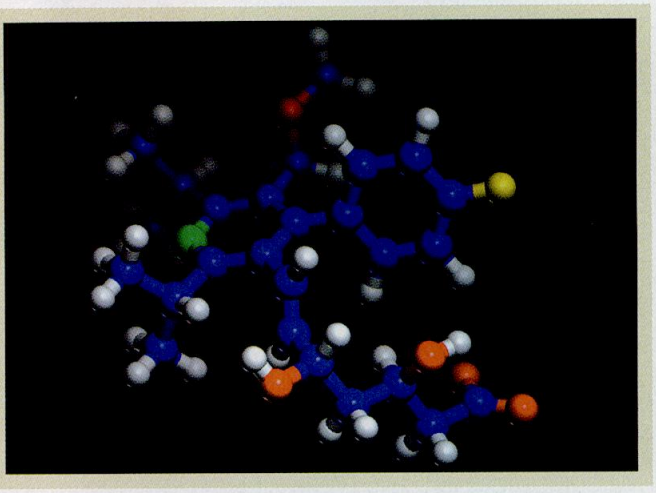

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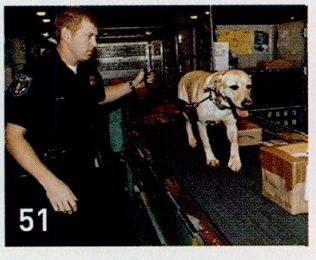

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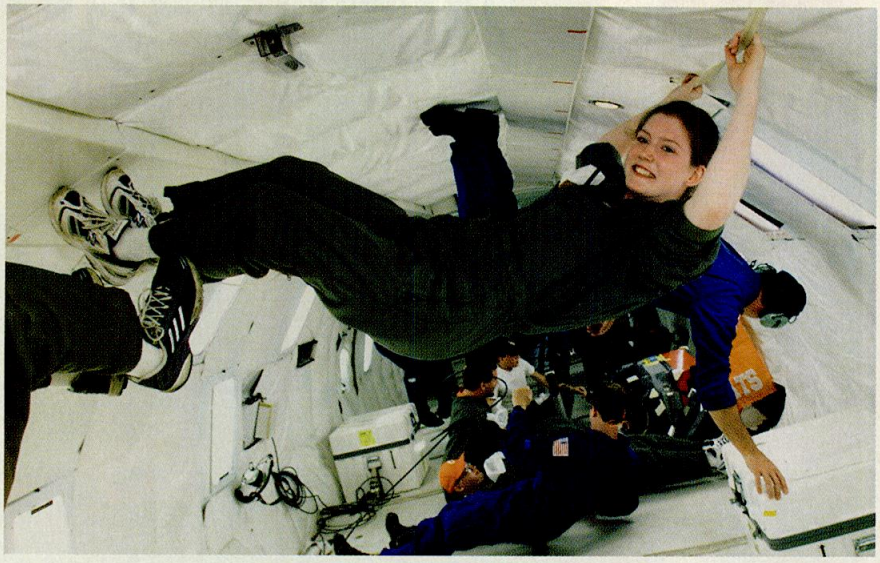
NASA PHOTO



WHAT'S UP? USM's Budzinski floats in NASA's "Weightless Wonder" jet.

HIGH-FLYING CHEMISTRY

Students lose weight, charge batteries as part of NASA's reduced-gravity program

KEVIN MACDERMOTT, C&EN WASHINGTON

THERE IS A LABORATORY IN Houston where the experimental equipment is strapped to the floor for fear that it may float away. The scientists there hover above the machines as they work, some standing on the ceiling and reaching down toward the floor to conduct their research. Even stranger is that this lab has wings and zips along at 350 knots.

What may sound like science fiction is business as usual for the crew of the National Aeronautics & Space Administration's "Weightless Wonder V," a KC-135A turbojet similar to a commercial Boeing 707. The aircraft is used to produce reduced-gravity environments for training astronauts, testing hardware and equipment bound for spaceflight, and evaluating medical protocols for use in space.

This flying laboratory is also used to train students to become scientists. NASA's Reduced-Gravity Student Flight Opportunities Program (RGSFOP), based in Houston at Johnson Space Center (JSC) and Ellington Field hangars, gives undergraduate science students the opportunity to conduct experiments of their own design in this special jet.

In early August, a team of chemistry students from the University of Southern Mississippi (USM), Hattiesburg, flew in the RGSFOP program and learned that being a chemist can sure be a lot of fun.

USM's chemistry experiment tested the effects of reduced gravity on the movement of plasma arcs produced by an inert gas discharge tube in a glass sphere. The team's hypothesis is that buoyancy-driven convection—fluid or gas flow caused by density gradients created by thermal or concentration gradients in a gravitational field—plays a significant role in the plasma's movement.

Team leader Brian Zoltowski, a chemistry major in his senior year at USM, says one application of the data they gain could be in the design of propulsion systems used in space. "By obtaining a general knowledge of plasma interactions," he says, "one can anticipate what complications may exist and how they differ in microgravity."

THE STUDENTS' TEST design is fairly straightforward: Take a novelty plasma ball, available inexpensively at any shopping mall, and place it in a sealed container with a videocamera to watch what happens to the plasma arcs. It's simple, it's safe, and that's exactly what NASA wants in its RGSFOP experiments. The research doesn't need to be Nobel-Prize quality, says Donn G. Sickorez, but it needs to be sound and it needs to be student-driven, not the work of their professor. Sickorez, JSC's university affairs officer, is a codirector of RGSFOP.

NASA's reduced-gravity program began in 1959, but the student flights began just five years ago. More than 100 different schools, representing nearly every state in the U.S., have participated so far, many coming back for repeat visits.

RGSFOP was designed to address the U.S.'s shrinking ranks of students graduating with degrees in science, technology, and engineering.

"What we're trying to do is help the next generation of scientists become scientists and engineers," Sickorez says. "It's not an easy road to travel, so we want to give them some incentive and show them that science can be interesting, it can be challenging, and it can be fun. We use the plane and its unique resources to help them along, to help motivate them."

THIS NEXT GENERATION of scientists needs to include representatives from many fields, and so the student flight program is open to any undergraduate team with an appropriate experiment. Most of the experiments have been based in engineering or physics, but there are the occasional materials science and chemistry experiments. This summer, there were only two from those disciplines: the USM team's and one from the University of Wisconsin, Madison, which tested the effect of reduced gravity on the clarity, pore structure, and density of aerogel produced through a rapid gelation process.

Although only an estimated one out of 10 proposals submitted to the RGSFOP office involves chemical analysis or a form of materials research involving chemistry, Sickorez believes the program is a good environment for chemical research.

"If the chemical reaction would be affected by zero *g*, then, of course, this is a good place for it," Sickorez says. "It's an excellent venue for materials research, some of which involves chemistry."

But whether their experiments are in chemistry or any other field, the participants leave with many benefits, according to Sickorez. "The students learn how to function in a team—and how to put that team together—how to write a proposal, how to wait for the acceptance, how to respond to comments, and how to physically build what was only an idea a few months before." They also learn to work under deadlines, a crucial part of teamwork, he adds.

"When you're in classes, you see parts and pieces. Here, it all flows. You see how it's all put together," Sickorez says.

William J. Ainsworth, a graduate chem-

MANY GROUPS SPONSOR DIVERSITY PANEL

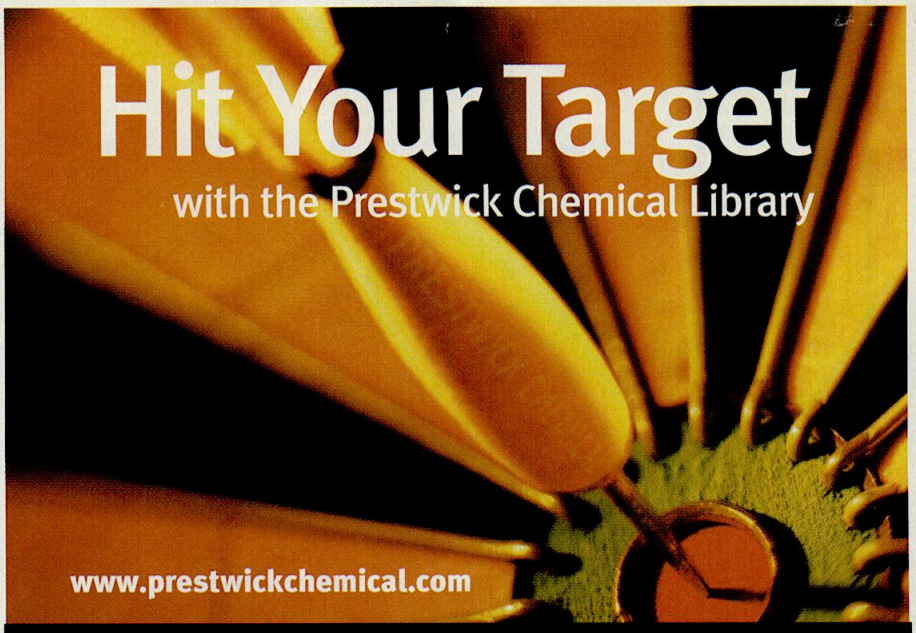
The special session at the ACS meeting in Chicago, "Diversity in the Top 50 Universities: The Challenge to Lead," was sponsored by the ACS Committee on Science. Cosponsoring organizations included the National Science Foundation; the American Institute of Chemical Engineers; the Council for Chemical Research; the ACS Division of Professional Relations; the ACS Committees on Minority Affairs, on Professional Training, and on Education; and the ACS Women Chemists and Younger Chemists Committees.

engineering Paula T. Hammond and Princeton University R. W. Moore Professor of Chemistry and chemistry department chairman George L. McLendon discussed the question "What factors are enabling some top 50 universities to grant a higher percentage of Ph.D.s to women?"

When a university conveys the message that it is ready, willing, and able to accept women and URMs, they come, Hammond said. "Women and URMs are looking for collaborative, interactive environments. Universities have personalities, and those that discourage collaborations are unsuccessful in getting women to come and stay. Successful universities have been able to package their programs to show their humanistic side." Hammond said that the questions women should ask when they think about going to a university for a Ph.D. are, "Is the science exciting?" and "Will I be valued?" When a person is "put down, they are discouraged from creating and innovating," she said.

McLendon noted that his lab is almost all women and minorities. He isn't sure what the reason is, but joked that "a crisis at Princeton is when you find out that Yale is doing something better." Princeton has a graduate research organization for women and has looked carefully at its seminar list to get more women as speakers. Women have gone from 10% of speakers to 30% in just the past few years. Princeton has abolished the tenure clock, which is more amenable to women who want to have children.

"Academic institutions are intrinsically monastic institutions that were created in the 13th century," he said wryly. "They might need a little fine-tuning." And with that understatement, the audience laughed. Time ran out during the question-and-answer period, but it was clear that this is a topic that continues to attract attention.■



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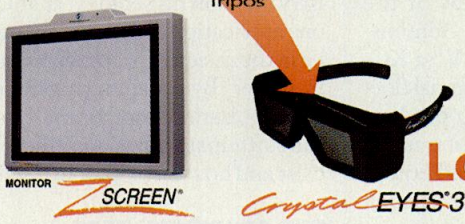

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istry student at USM who served as the team's ground crew, flew in 1999 as a USM undergraduate. He now flies with the team's faculty adviser, John A. Pojman, who has studied frontal polymerization and miscible fluids in the KC-135A turbojet as part of the original reduced-gravity program for professional researchers.

"This program helped me determine what to do with my life, really," Ainsworth tells C&EN. "It gave me a sense of direction as to where I wanted my career to go." Once indecisive over a career in industry or graduate studies, he's now sure of his choice to return to the classroom, where he's excited about his work and the opportunities that come with it.

Over RGSFOP's short existence, three separate programs have emerged to cover a wide range of students: the original undergraduate program; a separate program for community colleges; and "Fly High," which opened the flights to high school students throughout Texas. But due to budget cuts within NASA, the high school program is being dropped and the community college and university programs rolled into one. NASA absorbs the full cost of the flights, roughly $1,700 per flyer, and the students pay their transportation, lodging, and dining expenses.

During their week in Houston, the students operate from Ellington Field, where they share space in the hangar with the Weightless Wonder itself, an arrangement that gives participants a true behind-the-scenes look at NASA and its vehicles. During the USM students' session, a high-altitude test jet shared the hanger space. And only a week before, crew returning from a *Discovery* shuttle mission to the International Space Station spent some time in the hangar with the students.

RULES GO WITH the privilege of being at Ellington Field. The staff's matter-of-fact presentation usually includes scenarios and outcomes no one wants to encounter. Staying within the designated areas and accounting for all tools and small objects (they could wind up in the one of the jet's engines) are among the most serious.

But there's also the "18-inch rule": Students' test equipment must stay 18 inches off the floor because any leaking fuel fumes, which are heavier than air, collect on the floor. A spark or charge from the students' hardware could set the place ablaze. The building has a sophisticated firefighting system that can be triggered by a single spark, but even then, the place would fill with foam and water.

Preparations for the flight week take months. After a team's initial proposal has been accepted, the team must get to work on major projects such as raising the necessary funds and building the experimental equipment.

In USM's case, building the experimental hardware was fairly simple because some of the equipment had flown in the KC-135A with an earlier group. The largest piece was a stout, cast-aluminum cylinder that was once a stage of the body of a sounding rocket, the *Conquest I,* that was fired into space several years ago. Within this aluminum casing, the students fit a wooden rack that held the novelty plasma ball and a small video camera. One end of the casing was sealed and bolted; the other end was closed off in the same fashion except for a small utility hole cut in the aluminum baseplate, through which the students ran the power cords of the sphere and camera to a power strip. The video camera was then connected to a portable digital recorder with a small screen that shows a close-up view of the plasma ball and its arcs, which glow a brilliant pink-purple in the blackness of the cylinder.

The analysis and report that JSC requires for its safety preparations are surprisingly complex and thorough. The Test Equipment Data Package, or TEDP, covers everything from structural design elements to potential hazard identification. Every detail must be listed: the length of each bolt, the electrical circuitry's voltage, the gases found in the plasma ball, and the type of wood used in the frame. The TEDP is due to JSC six weeks before the team's scheduled flight week, allowing time for JSC test directors to review the experiment in depth and report any concerns or comments to the students.

The TEDP is the students' study guide. They need to know it and their experiment inside and out for the final Test Readiness Review (TRR), the final experiment check and the one that worried the students most. All groups in the hangar go through TRR at the same time. They sit nervously, waiting for the entourage of pilots, flight surgeons, safety representatives from JSC and Ellington Field, and JSC test directors to arrive at their table to judge the students' months of work.

Safety is the primary concern in the hangar, and the TRR reviewers, looking

NASA PHOTO

BACK ON EARTH **Students and journalists (green flight suits) pose with flight crew (blue flight suits) after their flight.**

The research doesn't need to be Nobel-Prize quality, but it needs to be sound and it needs to be student-driven, not the work of their professor.

for potential safety hazards, probe every angle. Groups that have prepared well get off easily, as the USM team did; others get a grilling. The questions can be quite specific, and an unsatisfactory response could prevent a team from flying.

Because the JSC staff will take the time—if time is available—to help the students fix problems, not many teams get grounded by failing the review.

"I've seen a couple hundred student experiments," explains Lead KC-135 Test Director and RGSFOP codirector John S. Yaniec. "But I've also seen two grounded." He leads the TRR reviewers through their rounds and also leads the safety operations surrounding the KC-135A.

With the hardware ready for flight, the students must then prepare themselves. Every flyer is required to pass a physical examination administered by a Federal Aviation Administration-certified physician. But there's also mental preparation to undertake, as they have all heard stories of this infamous jet.

NASA MAY HAVE dubbed the jet "Weightless Wonder V," but nearly everyone else calls it the "Vomit Comet," an unappealing name resulting from an unfortunate reality: Many flyers get motion sickness because of the jet's unique flight pattern, which looks like a sine curve and feels like a killer roller-coaster.

Not too long ago, the "kill ratio," as it's called by crew members, was quite high—more people became ill than not. "We've never had a 'no-kill' flight before this year," Yaniec says, "but we've also had some flights where there were 16 out of 18 sick." However, flyers now are better equipped for the flight as a result of extensive briefings on the causes and prevention of motion sickness. Most flyers and crew now take medication before flight as well, a precaution that has dramatically helped reduce the number of ill flyers.

However, according to Yaniec, "You can make yourself sick," he says. "You can also keep yourself from getting sick." It's a matter of expectation and precaution.

All participants attend an hourlong briefing on the mechanics of spatial disorientation, the cause of most cases of motion sickness and certainly the leading culprit on the Vomit Comet. They learn how spatial orientation is determined by the inner ear and tactile and visual cues, and that all of these come into conflict on the jet. The instructor uses demonstrations to make her point, asking volunteers to make multiple movements with their heads and arms as they spin in a chair. The volunteers get a bit loopy, but everyone learns what movements to avoid during their flight: Try to keep your head and body facing the same direction as if you were wearing a neck brace, and don't look out the windows.

Believe it or not, another way to help prevent illness on the flight is to eat before going up. An empty stomach is quicker to irritate than one with contents.

Motion sickness is only one of the medical concerns addressed by program staff. Because the KC-135A flies a dangerous line, there's always the possibility of an in-flight emergency. So the students are briefed on the host of maladies they could suffer in such situations, and they learn of the physical laws that explain these events. Most physiological problems involved with flight and altitude can be explained through gas laws such as Boyle's law of trapped gas expansion, Henry's law of evolved gases, Dalton's law of total and partial pressures, and the laws of gaseous diffusion.

The most likely emergency scenario would be a loss of cabin pressure. Like any commercial airliner, the KC-135A's cabin is pressurized to a level that a passenger's body needs to maintain a proper level of oxygen in the blood. The pressure is roughly the equivalent of breathing at 8,000 feet, slightly less than what most people are accustomed to on the ground.

THE HIGHER a jet flies, the more important the pressure inside the cabin becomes, because the pressure outside is decreasing with increasing altitude, making the air less dense and less breathable. If the jet's pressurized cabin were to spring a leak, hypoxia—a state of oxygen deficiency in the blood, tissues, and cells sufficient to cause an impairment of mental and body functions—would set in quickly. After a loss of cabin pressure, an individual in a jet flying at roughly 25,000 feet—the lower end of the KC-135A's flight range—has a time of useful consciousness of between three and five minutes. After that, the individual has lost the ability to function deliberately.

JSC shows the students what it's like to have hypoxia by giving it to them.

"You have to be aware of what's going to happen to your body," explains Javier Roque, a JSC medical officer. He gave the students a thorough explanation of what to expect and why they should expect it, listing more than a dozen symptoms such as dizziness, mental confusion, slurred speech, tunnel vision, blurred sight, cyanosis (a bluing of the lips and extremities), and hot and cold flashes. What they would probably notice most, he told them, was a feeling of euphoria—the experience sounds bad, but it doesn't feel so.

"One of the first things to go is your vision," he says. "But will you admit it? Probably not." The participants often don't recognize the many symptoms of hypoxia, and some are reluctant to acknowledge the ones they do notice.

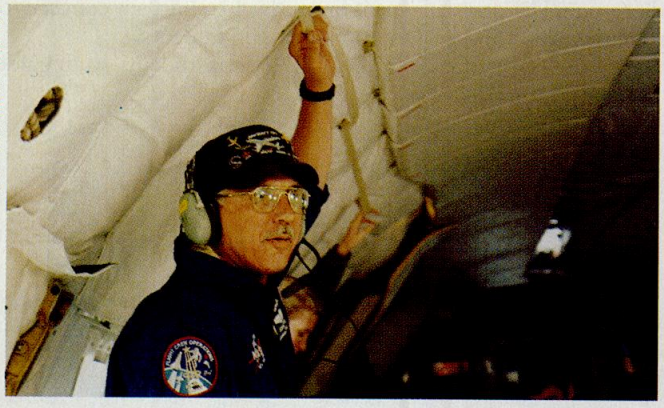
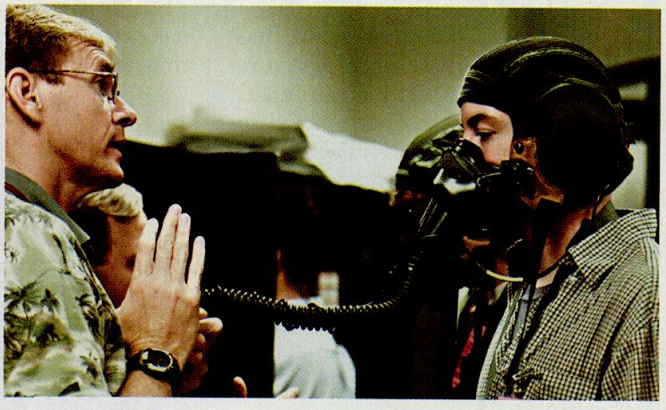


PHOTO BY KEVIN MACDERMOTT



NASA PHOTO

HERE TO HELP Zero-*g* veteran Yaniec keeps his eyes on floating flyers; a flight surgeon helps C&EN's Kevin MacDermott check the seal on his oxygen mask before a hyperbaric chamber "ride."

Under the strict supervision of flight surgeons and veteran Air Force pilots, all students in the RGSFOP program "take a ride" in a hyperbaric chamber at JSC's Neutral Buoyancy Laboratory, the same building that houses a four-story-deep swimming pool in which astronauts practice working in their spacesuits on submerged mock-ups of the space shuttle and space station modules. Once fitted with oxygen masks and headgear, a dozen undergraduates and two journalists follow Roque into the hyperbaric chamber, a metal box the size of a small room with several windows. They're joined by two former pilots who will watch over the students.

When everyone is in their seats and all masks and communications cords are plugged into place, the chamber occupants spend a half hour breathing pure oxygen to decrease the concentration of nitrogen in the body. Nitrogen makes up 78% of the air we breathe. Harmless in everyday breathing, it can cause trouble for anyone who changes elevation significantly because it forms bubbles in the bloodstream that will expand with the decrease in air pressure.

Operators then begin removing the air from the chamber, dropping the pressure at a rate that simulates a jet climbing at 5,000 feet per minute. At 10,000 feet, a mist forms in the chamber, and the students' eyes get big as they gauge each other's reactions. The cloud disappears quickly, as the chamber operators pump in a bit of ambient air to keep the temperature inside from dropping too fast. There's a bit of chatter through the microphones in the masks, but most of the students sit quietly and wait for instructions. A surgeon outside the chamber quizzes the students on gas laws and physiology definitions, but no one is quick to answer. The surgeon is not fazed by the silence: Most students are anxious, so he keeps talking to ease their nerves.

When the chamber reaches 25,000 feet, so to speak, half the students unclip their oxygen masks, breathing only the thinned air in the chamber. They're allowed to be "off air" for up to five minutes before putting the masks back on. Each student is given a clipboard, pencil, and an activity sheet full of math problems, trivia questions, and small puzzles. A box on the right side of the page is reserved for writing down symptoms, which the students are to document as soon as they appear.

Everyone reacts to hypoxia differently. One student becomes completely unresponsive, staring at the floor until a pilot replaces his mask and turns his air back on. Most of the students, however, either focus intently on the clipboard activities or ignore them completely, watching their peers with sleepy eyes and giggling—euphoria had set in. It's quite a show for those still wearing masks.

After five minutes, the three JSC staff in the chamber replace the masks of anyone who is still off air; then the second half of the group takes its turn.

FINALLY, IT'S FLIGHT TIME. "You're joining a unique club today," Yaniec tells the flyers. This final briefing is as much pep talk as it is informative. Dressed in flight suits and ready to go, the students get the details of their flight over the Gulf of Mexico: how far out they will be, how high, how many parabolas before a turnaround. They also get a review of motion sickness prevention tips and reassurance from Yaniec.

"When you're on this airplane, you're my family," he says. "We'll take care of you."

By "we," Yaniec means the large flight crew that will accompany the students: engineers, cameramen, and medical staff. There are almost as many crew members as noncrew on the flight.

Two flyers from each university team of four are flying this day. The remaining two will fly the next day, weather permitting. They walk out to the jet together, and everyone is so excited that they're indifferent to the Texas heat and the loud whirring of the Coast Guard helicopter by the next hangar.

Once on the jet, however, it's another story. The 12 flyers and eight crew file to the passenger seats at the back of the cabin. It's hot back there, and it's loud, too, during takeoff. Earplugs muffle but don't eliminate the hum of the KC-135A's four large engines. Anxious students chatter and sweat; the flight crew sits back and relaxes—they've all done this many times before. Yaniec, for example, has flown more than 19,000 parabolas, though they're not all from the student flight program.

But the crew's collective sense of humor isn't as reassuring. They take bets on the flight's kill ratio, several guesses hitting five out of 12.

Before placing his bet, Yaniec turns back to the seats and asks, "How many of you ate lunch today?" All hands go up. "Then I'll take 10," he says, grinning widely.

When the jet levels out at the appropriate altitude, the crew prepares for the parabolas and the students sit or lie on the floor near their experimental gear, which has been strapped down. Many flyers opt to be strapped to the floor as well, as they're advised to ride out the first two or three parabolas on the floor to get used to the feel. Several unzip their flight suits, even though the cabin is cooler now because of the altitude. They take the white "flight etiquette" bags they were issued during the motion sickness briefing and stick them

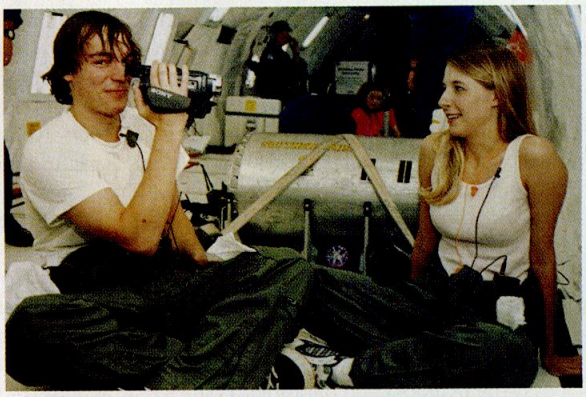


PHOTO BY KEVIN MACDERMOTT

WORTH A THOUSAND WORDS **USM flyers Zoltowski and Leard make a video to use in outreach to Mississippi students.**

NASA PHOTO

CHECK IT OUT **USM's Budzinski and Carter pose with their experiment during an in-flight break.**

HOW TO APPLY

Information on RGSFOP and deadlines for application will soon be available on the new program website, http://microgravityuniversity.jsc.nasa.gov. Readers can also contact Donn G. Sickorez, University Affairs Officer, Johnson Space Center, AH2, Houston, TX 77058; (281) 483-4724; fax (281) 483-9192.

in their suits' many pockets, leaving the ends hanging out for quick access.

The jet flies 32 parabolic arcs during its flight over the Gulf of Mexico. The path is a straight line determined that morning, and the pilots fly several parabolas in a row before turning around and flying the next set in the opposite direction. Each parabola consists of a climb, a peak, and a dive. The dives and climbs are done at angles between 45 and 60 degrees and altitudes between 26,000 and 34,000 feet, each averaging 8,000 feet. Flight speed is 350 knots.

At the peak of each parabola, as the jet levels off and begins to dive, there is roughly 20 seconds of zero *g*: weightlessness. But the 55-second pairs of dives and climbs reach 1.8 *g*, or almost twice the gravity on Earth, a force strong enough to pin you to the floor if you're not accustomed to it.

Though they were warned, some of the flyers get up off the floor for the second parabola, and the force of the movement rockets them to the ceiling. Padding protects flyers from impacts, but the flyers can still find other ways to injure themselves.

"Feet down, coming out!" When Yaniec yells this warning, flyers have roughly three seconds to orient themselves with their feet toward the floor. If they're too slow, they crash to the floor when the jet enters the 1.8-*g* period, falling like a rock. During 1.8 *g*, the best place to be is either sitting against the walls or lying on the floor, keeping your head and shoulders aligned and minimizing your movements.

By the third or fourth parabola, the students have gotten used to the concept of weightlessness and the idea of limiting movement and can enjoy the sensation.

ing the little VCR screen filled with dancing arcs.

The sight is surreal, as is everything in the jet's cabin during zero *g*. Like an Escher drawing, perspective is skewed. People are crawling along the ceiling, sitting high on the walls, standing normally on the floor, or hovering in the middle space.

After 30 normal parabolas, the pilots fly two more, and these simulate lunar *g* (one-sixth *g*) and martian *g* (one-third *g*). The flyers hop up and down from the floor, the jump time extended by the reduced gravity. There's a little more float time in the lunar *g*—it's more noticeable, at least.

Then the flight's over. It lasted 1.7 flight hours, although it felt like only a few minutes. Before the flight left the runway, Yaniec gave the students a last insight. "You are going to come out of this thinking,

PHOTOS BY KEVIN MACDERMOTT

WELL GROUNDED **Zoltowski, USM's team leader, fields reviewers' questions about his team's experiment; students from Texas' Orange High School work out a technical problem with classmates as their teacher watches.**

Five student teams are on board this flight, including a high school team from Orange, Texas, held over from the last high school flight week this spring because of technical difficulties with the jet. Other teams come from West Virginia University; a joint effort between the University of Alabama, Huntsville, and the California Institute of Technology; USM; and Montana State University.

Nearly all of the team members stay on the floor during the first parabola. Just as the jet hits a parabolic peak and enters zero *g*, a second set of interior lights come on, serving as a visual cue for those who can't hear the audible warnings over the engines. The lights come on, and the flyers' stomachs rise high in their abdomens, just like when a car crests a sharp hill too fast and then drops a bit on the other side. This may be the only time during the parabolas that one can feel the jet's orientation in the sky. There are a few small windows, but no one wants to look out for fear of creating spatial disorientation and thus a need for their white bags.

"Floating is unlike anything that I've ever felt before, and so far, I have found it very difficult to describe," Kayce Leard says. A senior and a biochemistry major at USM, Leard flew with Zoltowski during USM's first flight day.

"The closest sensation to floating," she says, "would have to be swimming underwater. However, in microgravity, your body feels no resistance, as it does underwater."

LEARD'S HAIR FLOATS over her head as she and Zoltowski check on their experiment to make sure the camera is recording and the plasma arcs are acting as predicted. They watch the activity in the plasma ball during the both the zero-*g* and 1.8-*g* periods. After a few minutes, the JSC videographer swings by to record the experiment. Videocamera rolling on his shoulder, he leans over the aluminum casing almost as though he's preparing to do a somersault over it, but when his feet come up over his head, he plants them on the ceiling, and there he stands, completely inverted, filming the little VCR screen filled with dancing arcs.

'Gravity stinks.' " And for the first few moments back on the runway, he was right. Several students later told C&EN that their first thoughts upon landing were, How do I top an experience like that?

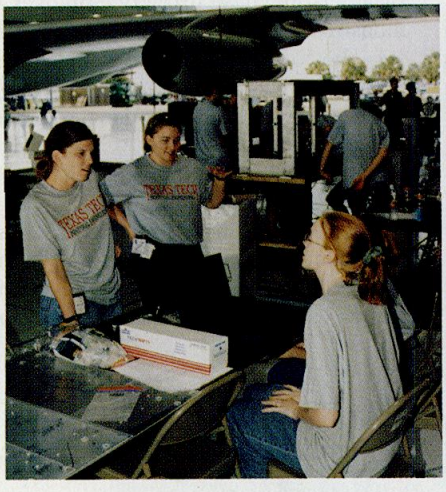
On the second flight day, the second set of students fly. Now is their chance to see what their teammates who flew the day before raved about. The remaining USM flyers—Nicholas Carter, a senior, and Kristi Budzinski, a junior, both chemistry majors—aren't as nervous as the first two, having seen them return unharmed.

When the second flight has left the runway, those on the ground return to the RGS-FOP briefing room, where they watch the action in the jet's cabin by live-feed video. The students on the ground can communicate with those in the air by a telephone link once the airborne students have put on microphones and headsets, a necessity because of the roar in the KC-135A's cabin. Some use the link for fun; others use it to conduct work. The Orange High School group, for example, had trouble with their

onboard machinery—a computer-driven lathe that shaped brass ingots to shapes determined by the high school students—and they were able to work it out by talking to their colleagues on the ground.

The USM students used the connection time to confirm the experimental data. While floating above the aluminum casing, Carter announces, "I can't really tell what's happening with the sphere." A few seconds later, during a 1.8-*g* pullout, he notices a change in the plasma arcs' behavior: "Whoa! Now they're going crazy down there!"

THESE TWO STUDENTS had an equally tough time describing their encounter with weightlessness. "It's almost impossible to describe," Budzinski confirmed. "My whole body just felt light. I had no restrictions in my movements. It was like floating on water, only without the water."



PHOTOS BY KEVIN MACDERMOTT

HANGING OUT Students work on their experiments in the hangar they shared with the reduced-gravity jet.

Carter says, "It was just like being Superman for a short time. You can do just about anything imaginable that you can only dream of on Earth." Both Carter and Budzinski, and Zoltowski and Leard before them, got to try some of these unimaginable movements, such as multiple front flips and propelling themselves across the cabin, arms stretched out in front of them—just like Superman.

When the flights were over, the USM students retrieved their experiment and made the long drive back to Hattiesburg. They said goodbye to new friends, many of whom were in the second batch of flyers and had yet to go up.

There was lots to do upon arrival at USM. The students ran their video data through specialized software that gave them numerical values for the plasma arcs' movement. Then they had to submit a follow-up report to RGSFOP, explaining the results of the experiment and justifying the research.

The fifth member of the flight group, alternate flyer and biology major Chrisina Watters, now has an additional project to complete. Although she didn't get to fly, she was also energized by the experience. In the weeks following the flight, she and some fellow biology students were working on a proposal they planned to submit, Watters tells C&EN.

"We're thinking about something with jellyfish or brine shrimp and their ability to determine their orientation and move in a reduced-gravity environment," she says.

It wouldn't be the first biology experiment. For example, the University of Wyoming flew a team this summer that tested the effect of zero *g* on short-term binding of *Pseudomonas aeruginosa* to beef and to catheter tubing.

"If they write a proposal, and it's good, sound science, they have an excellent chance of being selected," Sickorez says. "We'll take them, and we'll do what they want because our goal is to develop and motivate scientists."

THE CURRENT ACCEPTANCE rate for proposals is close to 80%. However, RGSFOP plans to cut back the number of student flights next year, Sickorez says. There are currently 11 flight weeks each year, with roughly 120 student groups flying. That's 480 student flyers.

"We can't support that with the current budget shortfalls," Sickorez explains. "So we're trying for six flight weeks—four in the spring and two in the summer, supporting between 60 and 70 teams."

Teams have a much stronger chance of acceptance to the program if they propose a good outreach program to carry out after the flight. RGSFOP requires those who participate in their program to tell others about it. The proposals are weighted 30 points out of 100 for the proposed outreach plan; the remainder of the points are for safety and scientific merit.

USM's plans for outreach include a program they've named SURGE, an acronym for Students Understanding Reduced-Gravity Environments. SURGE is a full-day demonstration, to which the USM students will invite local middle and high school students.

"We are hoping to perform some simple drop experiments with the kids to demonstrate microgravity and to give them a hands-on experience with it," Budzinski says. They also plan to show their flight videos, which JSC supplies to each team.

Watters tells C&EN that the team is also discussing a possible trip to her hometown of Mobile, Ala., where they would make a presentation to high school students. This is RGSFOP's best advertising.

"This program revealed to us the level of intensity needed to participate in the scientific workforce," Budzinski says. "We learned the difficulty of writing a proposal, the importance of deadlines, and the difficulty of making the transition from proposal to actual experiment," she adds.

On a personal note, Budzinski adds: "I worry so much about my grade-point average, financial aid, grad school, and so many other things that I sometimes forget why I ever wanted to study chemistry. The NASA program made me remember how much I enjoy experimentation, theory, and the scientific pursuit of knowledge."

"The opportunity to meet students from other parts of the country and to learn how things are done differently is also interesting," Watters notes.

Leard tells C&EN: "I think the entire team developed a real sense for why we're in the field that we're in. Personally, I have become more enthusiastic about my major since we returned from the trip. Knowing that science and technology made an experience like this possible is real encouragement for those of us who are trying to make a career out of it."

"I would participate in the program again—absolutely," Carter says. "It is definitely a once-in-a-lifetime opportunity and probably the most interesting thing I've ever done." ■

FROM THE ACS MEETING

BOARD, COUNCIL ACT IN CHICAGO

Governance groups hear reports on society finances, other issues

LINDA R. RABER, C&EN WASHINGTON

AT THE FALL ACS NATIONAL meeting in Chicago, the society's council and board met to hear reports on the activities of the society's committees, to act on petitions, and to select candidates for certain committees.

Financially, this has been a difficult year for ACS, as it has been for the global economy as a whole. One year ago, the picture was rosier, and the board funded $9 million in new initiatives (C&EN, Sept. 18, 2000, page 71). This year, the report of the Society Committee on Budget & Finance was considerably more somber. The committee noted that the core programs of the society are projected to end 2001 with a net contribution of $220,000. With the inclusion of projected net program expenses from the Member Insurance Program of $2.6 million, and the society's board appropriations of $5.6 million (which cover the ACS Scholars Program, the ACS Matching Gift Fund, and information technology development projects), the society's overall general operations are projected to end 2001 with a net deficit of $8 million.

The projected net contribution from core operations is $222,000 unfavorable to the approved budget, but it is less than 1% of the projected expenditures for ACS Core Programs of $331 million.

The financial performance is primarily attributable to unfavorable performance in the society's investment program. The shortfall in revenue in the investment program is largely a result of the interest rate cuts initiated by the Federal Reserve Board in an effort to bolster a weakening U.S. economy.

These losses were cushioned by favorable performances from Chemical Abstracts Service (CAS) and the society's indirect cost centers. The strong performance in CAS is the result of better-than-expected revenues from SciFinder. Several factors contribute to the favorable variance in the indirect cost centers, including the resolution of a legal issue with a publisher of educational materials.

There has been some belt-tightening, and capital expenditures are projected to total $29.1 million in 2001, which is $925,000 better than the approved budget.

THE BOARD and council also heard a report on ACS President Attila E. Pavlath's recent electronic survey of ACS members. The survey was intended to gauge member satisfaction with the society and its products and services.

While a substantial majority of ACS members are satisfied with their ACS memberships, there is still room for improvement. The survey indicates that younger members are somewhat less knowledgeable and/or satisfied with their memberships than older members and that the primary draw of ACS membership is society publications. A more detailed discussion of this survey will be published in a future issue of C&EN.

The Committee on Grants & Awards recommended and the board approved that the ACS Award in Applied Polymer Chemistry and the ACS Award in Industrial Chemistry be supported by the society for the 2003 award term unless a sponsor is found.

Under delegated authority, the committee also voted to amend the purpose and eligibility for the ACS Award in Industrial Chemistry so that neither commercialization nor patents are required, as expressed in the current language. The new language states that the work must be done by a person whose primary employer is industrial and who is based in North America. The committee also accepted a proposal from Procter & Gamble to change the name of the ACS Award in Colloid or Surface Chemistry to the ACS Award in Colloid Chemistry and to amend its scope accordingly.

On the recommendation of the Committee on Professional & Member Relations (P&MR), the board voted to cosponsor the 2005 International Congress of

Seated

Makeup of elected council committees for 2002

During their meeting, councilors elected seven members to the Committee on Committees, five to the Council Policy Committee, and four to the Committee on Nominations & Elections. For 2002, the membership of the committees will be as follows:

COMMITTEE ON COMMITTEES[a]	COUNCIL POLICY COMMITTEE[b]	COMMITTEE ON NOMINATIONS & ELECTIONS
ELECTED IN CHICAGO	**ELECTED IN CHICAGO**	**ELECTED IN CHICAGO**
William H. Breazeale Jr.	Warren V. Bush	Rita R. Boggs
Peter K. Dorhout	Dean W. Cooke	Michael P. Doyle
Carol A. Duane	Merle I. Eiss	Kathleen M. Schulz
Lydia E. M. Hines	Thomas J. Kucera	Peter J. Stang
Mary V. Orna	Kent J. Voorhees	
Eleanor D. Siebert		
Herbert B. Silber		
CONTINUING MEMBERS	**CONTINUING MEMBERS**	**CONTINUING MEMBERS**
Ronald D. Archer	Bonnie A. Charpentier	Jeannette E. Brown
Janan M. Hayes	Ann H. Hunt	Peter A. Christie
Joe W. Hightower	Paul R. Jones	Donald D. Clarke
Neil D. Jespersen	Ted J. Logan	Richard L. Deming
Dorothy J. Phillips	Howard M. Peters	Thomas W. Gilbert
Wanda W. Rauscher	Charles F. Rowell	Valerie J. Kuck
Barbara A. Sawrey	Kathleen D. Trahanovsky	Bonnie Lawlor
Isiah M. Warner		Mamie W. Moy
		Barbara J. Peterson
		Robert A. Pett
		H. David Wohlers

a The president-elect is a member (ex officio) of this committee. **b** The president, president-elect, immediate past-president, and executive director are members (ex officio) of this committee.

NASA PHOTO

WHAT'S UP? USM's Budzinski floats in NASA's "Weightless Wonder" jet.

HIGH-FLYING CHEMISTRY

Students lose weight, charge batteries as part of NASA's reduced-gravity program

KEVIN MACDERMOTT, C&EN WASHINGTON

THERE IS A LABORATORY IN Houston where the experimental equipment is strapped to the floor for fear that it may float away. The scientists there hover above the machines as they work, some standing on the ceiling and reaching down toward the floor to conduct their research. Even stranger is that this lab has wings and zips along at 350 knots.

What may sound like science fiction is business as usual for the crew of the National Aeronautics & Space Administration's "Weightless Wonder V," a KC-135A turbojet similar to a commercial Boeing 707. The aircraft is used to produce reduced-gravity environments for training astronauts, testing hardware and equipment bound for spaceflight, and evaluating medical protocols for use in space.

This flying laboratory is also used to train students to become scientists. NASA's Reduced-Gravity Student Flight Opportunities Program (RGSFOP), based in Houston at Johnson Space Center (JSC) and Ellington Field hangars, gives undergraduate science students the opportunity to conduct experiments of their own design in this special jet.

In early August, a team of chemistry students from the University of Southern Mississippi (USM), Hattiesburg, flew in the RGSFOP program and learned that being a chemist can sure be a lot of fun.

USM's chemistry experiment tested the effects of reduced gravity on the movement of plasma arcs produced by an inert gas discharge tube in a glass sphere. The team's hypothesis is that buoyancy-driven convection—fluid or gas flow caused by density gradients created by thermal or concentration gradients in a gravitational field—plays a significant role in the plasma's movement.

Team leader Brian Zoltowski, a chemistry major in his senior year at USM, says one application of the data they gain could be in the design of propulsion systems used in space. "By obtaining a general knowledge of plasma interactions," he says, "one can anticipate what complications may exist and how they differ in microgravity."

THE STUDENTS' TEST design is fairly straightforward: Take a novelty plasma ball, available inexpensively at any shopping mall, and place it in a sealed container with a videocamera to watch what happens to the plasma arcs. It's simple, it's safe, and that's exactly what NASA wants in its RGSFOP experiments. The research doesn't need to be Nobel-Prize quality, says Donn G. Sickorez, but it needs to be sound and it needs to be student-driven, not the work of their professor. Sickorez, JSC's university affairs officer, is a codirector of RGSFOP.

NASA's reduced-gravity program began in 1959, but the student flights began just five years ago. More than 100 different schools, representing nearly every state in the U.S., have participated so far, many coming back for repeat visits.

RGSFOP was designed to address the U.S.'s shrinking ranks of students graduating with degrees in science, technology, and engineering.

"What we're trying to do is help the next generation of scientists become scientists and engineers," Sickorez says. "It's not an easy road to travel, so we want to give them some incentive and show them that science can be interesting, it can be challenging, and it can be fun. We use the plane and its unique resources to help them along, to help motivate them."

THIS NEXT GENERATION of scientists needs to include representatives from many fields, and so the student flight program is open to any undergraduate team with an appropriate experiment. Most of the experiments have been based in engineering or physics, but there are the occasional materials science and chemistry experiments. This summer, there were only two from those disciplines: the USM team's and one from the University of Wisconsin, Madison, which tested the effect of reduced gravity on the clarity, pore structure, and density of aerogel produced through a rapid gelation process.

Although only an estimated one out of 10 proposals submitted to the RGSFOP office involves chemical analysis or a form of materials research involving chemistry, Sickorez believes the program is a good environment for chemical research.

"If the chemical reaction would be affected by zero *g*, then, of course, this is a good place for it," Sickorez says. "It's an excellent venue for materials research, some of which involves chemistry."

But whether their experiments are in chemistry or any other field, the participants leave with many benefits, according to Sickorez. "The students learn how to function in a team—and how to put that team together—how to write a proposal, how to wait for the acceptance, how to respond to comments, and how to physically build what was only an idea a few months before." They also learn to work under deadlines, a crucial part of teamwork, he adds.

"When you're in classes, you see parts and pieces. Here, it all flows. You see how it's all put together," Sickorez says.

William J. Ainsworth, a graduate chem-

istry student at USM who served as the team's ground crew, flew in 1999 as a USM undergraduate. He now flies with the team's faculty adviser, John A. Pojman, who has studied frontal polymerization and miscible fluids in the KC-135A turbojet as part of the original reduced-gravity program for professional researchers.

"This program helped me determine what to do with my life, really," Ainsworth tells C&EN. "It gave me a sense of direction as to where I wanted my career to go." Once indecisive over a career in industry or graduate studies, he's now sure of his choice to return to the classroom, where he's excited about his work and the opportunities that come with it.

Over RGSFOP's short existence, three separate programs have emerged to cover a wide range of students: the original undergraduate program; a separate program for community colleges; and "Fly High," which opened the flights to high school students throughout Texas. But due to budget cuts within NASA, the high school program is being dropped and the community college and university programs rolled into one. NASA absorbs the full cost of the flights, roughly $1,700 per flyer, and the students pay their transportation, lodging, and dining expenses.

During their week in Houston, the students operate from Ellington Field, where they share space in the hangar with the Weightless Wonder itself, an arrangement that gives participants a true behind-the-scenes look at NASA and its vehicles. During the USM students' session, a high-altitude test jet shared the hanger space. And only a week before, crew returning from a *Discovery* shuttle mission to the International Space Station spent some time in the hangar with the students.

RULES GO WITH the privilege of being at Ellington Field. The staff's matter-of-fact presentation usually includes scenarios and outcomes no one wants to encounter. Staying within the designated areas and accounting for all tools and small objects (they could wind up in the one of the jet's engines) are among the most serious.

But there's also the "18-inch rule": Students' test equipment must stay 18 inches off the floor because any leaking fuel fumes, which are heavier than air, collect on the floor. A spark or charge from the students' hardware could set the place ablaze. The building has a sophisticated firefighting system that can be triggered by a single spark, but even then, the place would fill with foam and water.

Preparations for the flight week take months. After a team's initial proposal has been accepted, the team must get to work on major projects such as raising the necessary funds and building the experimental equipment.

In USM's case, building the experimental hardware was fairly simple because some of the equipment had flown in the KC-135A with an earlier group. The largest piece was a stout, cast-aluminum cylinder that was once a stage of the body of a sounding rocket, the *Conquest I,* that was fired into space several years ago. Within this aluminum casing, the students fit a wooden rack that held the novelty plasma ball and a small video camera. One end of the casing was sealed and bolted; the other end was closed off in the same fashion except for a small utility hole cut in the aluminum baseplate, through which the students ran the power cords of the sphere and camera to a power strip. The video camera was then connected to a portable digital recorder with a small screen that shows a close-up view of the plasma ball and its arcs, which glow a brilliant pink-purple in the blackness of the cylinder.

The analysis and report that JSC requires for its safety preparations are surprisingly complex and thorough. The Test Equipment Data Package, or TEDP, covers everything from structural design elements to potential hazard identification. Every detail must be listed: the length of each bolt, the electrical circuitry's voltage, the gases found in the plasma ball, and the type of wood used in the frame. The TEDP is due to JSC six weeks before the team's scheduled flight week, allowing time for JSC test directors to review the experiment in depth and report any concerns or comments to the students.

The TEDP is the students' study guide. They need to know it and their experiment inside and out for the final Test Readiness Review (TRR), the final experiment check and the one that worried the students most. All groups in the hangar go through TRR at the same time. They sit nervously, waiting for the entourage of pilots, flight surgeons, safety representatives from JSC and Ellington Field, and JSC test directors to arrive at their table to judge the students' months of work.

Safety is the primary concern in the hangar, and the TRR reviewers, looking

NASA PHOTO

BACK ON EARTH Students and journalists (green flight suits) pose with flight crew (blue flight suits) after their flight.

The research doesn't need to be Nobel-Prize quality, but it needs to be sound and it needs to be student-driven, not the work of their professor.

for potential safety hazards, probe every angle. Groups that have prepared well get off easily, as the USM team did; others get a grilling. The questions can be quite specific, and an unsatisfactory response could prevent a team from flying.

Because the JSC staff will take the time—if time is available—to help the students fix problems, not many teams get grounded by failing the review.

"I've seen a couple hundred student experiments," explains Lead KC-135 Test Director and RGSFOP codirector John S. Yaniec. "But I've also seen two grounded." He leads the TRR reviewers through their rounds and also leads the safety operations surrounding the KC-135A.

With the hardware ready for flight, the students must then prepare themselves. Every flyer is required to pass a physical examination administered by a Federal Aviation Administration-certified physician. But there's also mental preparation to undertake, as they have all heard stories of this infamous jet.

NASA MAY HAVE dubbed the jet "Weightless Wonder V," but nearly everyone else calls it the "Vomit Comet," an unappealing name resulting from an unfortunate reality: Many flyers get motion sickness because of the jet's unique flight pattern, which looks like a sine curve and feels like a killer roller-coaster.

Not too long ago, the "kill ratio," as it's called by crew members, was quite high—more people became ill than not. "We've never had a 'no-kill' flight before this year," Yaniec says, "but we've also had some flights where there were 16 out of 18 sick." However, flyers now are better equipped for the flight as a result of extensive briefings on the causes and prevention of motion sickness. Most flyers and crew now take medication before flight as well, a precaution that has dramatically helped reduce the number of ill flyers.

However, according to Yaniec, "You can make yourself sick," he says. "You can also keep yourself from getting sick." It's a matter of expectation and precaution.

All participants attend an hourlong briefing on the mechanics of spatial disorientation, the cause of most cases of motion sickness and certainly the leading culprit on the Vomit Comet. They learn how spatial orientation is determined by the inner ear and tactile and visual cues, and that all of these come into conflict on the jet. The instructor uses demonstrations to make her point, asking volunteers to make multiple movements with their heads and arms as they spin in a chair. The volunteers get a bit loopy, but everyone learns what movements to avoid during their flight: Try to keep your head and body facing the same direction as if you were wearing a neck brace, and don't look out the windows.

Believe it or not, another way to help prevent illness on the flight is to eat before going up. An empty stomach is quicker to irritate than one with contents.

Motion sickness is only one of the medical concerns addressed by program staff. Because the KC-135A flies a dangerous line, there's always the possibility of an in-flight emergency. So the students are briefed on the host of maladies they could suffer in such situations, and they learn of the physical laws that explain these events. Most physiological problems involved with flight and altitude can be explained through gas laws such as Boyle's law of trapped gas expansion, Henry's law of evolved gases, Dalton's law of total and partial pressures, and the laws of gaseous diffusion.

The most likely emergency scenario would be a loss of cabin pressure. Like any commercial airliner, the KC-135A's cabin is pressurized to a level that a passenger's body needs to maintain a proper level of oxygen in the blood. The pressure is roughly the equivalent of breathing at 8,000 feet, slightly less than what most people are accustomed to on the ground.

THE HIGHER a jet flies, the more important the pressure inside the cabin becomes, because the pressure outside is decreasing with increasing altitude, making the air less dense and less breathable. If the jet's pressurized cabin were to spring a leak, hypoxia—a state of oxygen deficiency in the blood, tissues, and cells sufficient to cause an impairment of mental and body functions—would set in quickly. After a loss of cabin pressure, an individual in a jet flying at roughly 25,000 feet—the lower end of the KC-135A's flight range—has a time of useful consciousness of between three and five minutes. After that, the individual has lost the ability to function deliberately.

JSC shows the students what it's like to have hypoxia by giving it to them.

"You have to be aware of what's going to happen to your body," explains Javier Roque, a JSC medical officer. He gave the students a thorough explanation of what to expect and why they should expect it, listing more than a dozen symptoms such as dizziness, mental confusion, slurred speech, tunnel vision, blurred sight, cyanosis (a bluing of the lips and extremities), and hot and cold flashes. What they would probably notice most, he told them, was a feeling of euphoria—the experience sounds bad, but it doesn't feel so.

"One of the first things to go is your vision," he says. "But will you admit it? Probably not." The participants often don't recognize the many symptoms of hypoxia, and some are reluctant to acknowledge the ones they do notice.

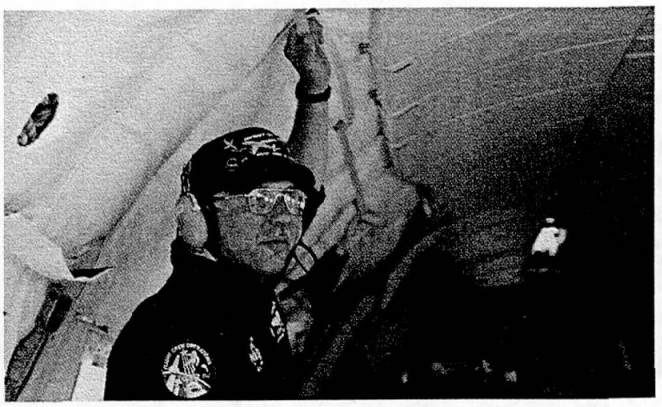


PHOTO BY KEVIN MACDERMOTT

NASA PHOTO

HERE TO HELP Zero-*g* veteran Yaniec keeps his eyes on floating flyers; a flight surgeon helps C&EN's Kevin MacDermott check the seal on his oxygen mask before a hyperbaric chamber "ride."

Under the strict supervision of flight surgeons and veteran Air Force pilots, all students in the RGSFOP program "take a ride" in a hyperbaric chamber at JSC's Neutral Buoyancy Laboratory, the same building that houses a four-story-deep swimming pool in which astronauts practice working in their spacesuits on submerged mock-ups of the space shuttle and space station modules. Once fitted with oxygen masks and headgear, a dozen undergraduates and two journalists follow Roque into the hyperbaric chamber, a metal box the size of a small room with several windows. They're joined by two former pilots who will watch over the students.

When everyone is in their seats and all masks and communications cords are plugged into place, the chamber occupants spend a half hour breathing pure oxygen to decrease the concentration of nitrogen in the body. Nitrogen makes up 78% of the air we breathe. Harmless in everyday breathing, it can cause trouble for anyone who changes elevation significantly because it forms bubbles in the bloodstream that will expand with the decrease in air pressure.

Operators then begin removing the air from the chamber, dropping the pressure at a rate that simulates a jet climbing at 5,000 feet per minute. At 10,000 feet, a mist forms in the chamber, and the students' eyes get big as they gauge each other's reactions. The cloud disappears quickly, as the chamber operators pump in a bit of ambient air to keep the temperature inside from dropping too fast. There's a bit of chatter through the microphones in the masks, but most of the students sit quietly and wait for instructions. A surgeon outside the chamber quizzes the students on gas laws and physiology definitions, but no one is quick to answer. The surgeon is not fazed by the silence: Most students are anxious, so he keeps talking to ease their nerves.

When the chamber reaches 25,000 feet, so to speak, half the students unclip their oxygen masks, breathing only the thinned air in the chamber. They're allowed to be "off air" for up to five minutes before putting the masks back on. Each student is given a clipboard, pencil, and an activity sheet full of math problems, trivia questions, and small puzzles. A box on the right side of the page is reserved for writing down symptoms, which the students are to document as soon as they appear.

Everyone reacts to hypoxia differently. One student becomes completely unresponsive, staring at the floor until a pilot replaces his mask and turns his air back on. Most of the students, however, either focus intently on the clipboard activities or ignore them completely, watching their peers with sleepy eyes and giggling—euphoria had set in. It's quite a show for those still wearing masks.

After five minutes, the three JSC staff in the chamber replace the masks of anyone who is still off air; then the second half of the group takes its turn.

PHOTO BY KEVIN MACDERMOTT

WORTH A THOUSAND WORDS USM flyers Zoltowski and Leard make a video to use in outreach to Mississippi students.

NASA PHOTO

CHECK IT OUT USM's Budzinski and Carter pose with their experiment during an in-flight break.

FINALLY, IT'S FLIGHT TIME. "You're joining a unique club today," Yaniec tells the flyers. This final briefing is as much pep talk as it is informative. Dressed in flight suits and ready to go, the students get the details of their flight over the Gulf of Mexico: how far out they will be, how high, how many parabolas before a turnaround. They also get a review of motion sickness prevention tips and reassurance from Yaniec.

"When you're on this airplane, you're my family," he says. "We'll take care of you."

By "we," Yaniec means the large flight crew that will accompany the students: engineers, cameramen, and medical staff. There are almost as many crew members as noncrew on the flight.

Two flyers from each university team of four are flying this day. The remaining two will fly the next day, weather permitting. They walk out to the jet together, and everyone is so excited that they're indifferent to the Texas heat and the loud whirring of the Coast Guard helicopter by the next hangar.

Once on the jet, however, it's another story. The 12 flyers and eight crew file to the passenger seats at the back of the cabin. It's hot back there, and it's loud, too, during takeoff. Earplugs muffle but don't eliminate the hum of the KC-135A's four large engines. Anxious students chatter and sweat; the flight crew sits back and relaxes—they've all done this many times before. Yaniec, for example, has flown more than 19,000 parabolas, though they're not all from the student flight program.

But the crew's collective sense of humor isn't as reassuring. They take bets on the flight's kill ratio, several guesses hitting five out of 12.

Before placing his bet, Yaniec turns back to the seats and asks, "How many of you ate lunch today?" All hands go up. "Then I'll take 10," he says, grinning widely.

When the jet levels out at the appropriate altitude, the crew prepares for the parabolas and the students sit or lie on the floor near their experimental gear, which has been strapped down. Many flyers opt to be strapped to the floor as well, as they're advised to ride out the first two or three parabolas on the floor to get used to the feel. Several unzip their flight suits, even though the cabin is cooler now because of the altitude. They take the white "flight etiquette" bags they were issued during the motion sickness briefing and stick them

HOW TO APPLY

Information on RGSFOP and deadlines for application will soon be available on the new program website, http://microgravityuniversity.jsc.nasa.gov. Readers can also contact Donn G. Sickorez, University Affairs Officer, Johnson Space Center, AH2, Houston, TX 77058; (281) 483-4724; fax (281) 483-9192.

in their suits' many pockets, leaving the ends hanging out for quick access.

The jet flies 32 parabolic arcs during its flight over the Gulf of Mexico. The path is a straight line determined that morning, and the pilots fly several parabolas in a row before turning around and flying the next set in the opposite direction. Each parabola consists of a climb, a peak, and a dive. The dives and climbs are done at angles between 45 and 60 degrees and altitudes between 26,000 and 34,000 feet, each averaging 8,000 feet. Flight speed is 350 knots.

At the peak of each parabola, as the jet levels off and begins to dive, there is roughly 20 seconds of zero *g*: weightlessness. But the 55-second pairs of dives and climbs reach 1.8 *g*, or almost twice the gravity on Earth, a force strong enough to pin you to the floor if you're not accustomed to it.

Though they were warned, some of the flyers get up off the floor for the second parabola, and the force of the movement rockets them to the ceiling. Padding protects flyers from impacts, but the flyers can still find other ways to injure themselves.

"Feet down, coming out!" When Yaniec yells this warning, flyers have roughly three seconds to orient themselves with their feet toward the floor. If they're too slow, they crash to the floor when the jet enters the 1.8-*g* period, falling like a rock. During 1.8 *g*, the best place to be is either sitting against the walls or lying on the floor, keeping your head and shoulders aligned and minimizing your movements.

By the third or fourth parabola, the students have gotten used to the concept of weightlessness and the idea of limiting movement and can enjoy the sensation.

ing the little VCR screen filled with dancing arcs.

The sight is surreal, as is everything in the jet's cabin during zero *g*. Like an Escher drawing, perspective is skewed. People are crawling along the ceiling, sitting high on the walls, standing normally on the floor, or hovering in the middle space.

After 30 normal parabolas, the pilots fly two more, and these simulate lunar *g* (one-sixth *g*) and martian *g* (one-third *g*). The flyers hop up and down from the floor, the jump time extended by the reduced gravity. There's a little more float time in the lunar *g*—it's more noticeable, at least.

Then the flight's over. It lasted 1.7 flight hours, although it felt like only a few minutes. Before the flight left the runway, Yaniec gave the students a last insight. "You are going to come out of this thinking,

PHOTOS BY KEVIN MACDERMOTT

WELL GROUNDED Zoltowski, USM's team leader, fields reviewers' questions about his team's experiment; students from Texas' Orange High School work out a technical problem with classmates as their teacher watches.

Five student teams are on board this flight, including a high school team from Orange, Texas, held over from the last high school flight week this spring because of technical difficulties with the jet. Other teams come from West Virginia University; a joint effort between the University of Alabama, Huntsville, and the California Institute of Technology; USM; and Montana State University.

Nearly all of the team members stay on the floor during the first parabola. Just as the jet hits a parabolic peak and enters zero *g*, a second set of interior lights come on, serving as a visual cue for those who can't hear the audible warnings over the engines. The lights come on, and the flyers' stomachs rise high in their abdomens, just like when a car crests a sharp hill too fast and then drops a bit on the other side. This may be the only time during the parabolas that one can feel the jet's orientation in the sky. There are a few small windows, but no one wants to look out for fear of creating spatial disorientation and thus a need for their white bags.

"Floating is unlike anything that I've ever felt before, and so far, I have found it very difficult to describe," Kayce Leard says. A senior and a biochemistry major at USM, Leard flew with Zoltowski during USM's first flight day.

"The closest sensation to floating," she says, "would have to be swimming underwater. However, in microgravity, your body feels no resistance, as it does underwater."

LEARD'S HAIR FLOATS over her head as she and Zoltowski check on their experiment to make sure the camera is recording and the plasma arcs are acting as predicted. They watch the activity in the plasma ball during the both the zero-*g* and 1.8-*g* periods. After a few minutes, the JSC videographer swings by to record the experiment. Videocamera rolling on his shoulder, he leans over the aluminum casing almost as though he's preparing to do a somersault over it, but when his feet come up over his head, he plants them on the ceiling, and there he stands, completely inverted, filming the little VCR screen filled with dancing arcs.

'Gravity stinks.' " And for the first few moments back on the runway, he was right. Several students later told C&EN that their first thoughts upon landing were, How do I top an experience like that?

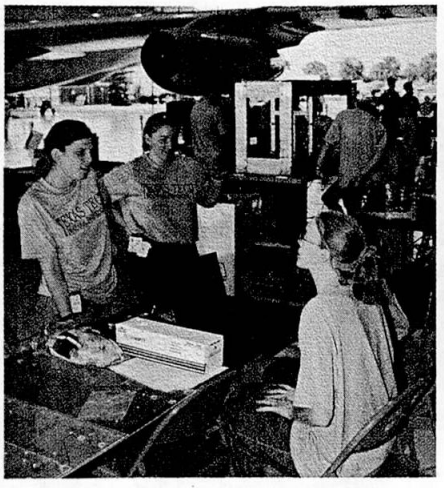
On the second flight day, the second set of students fly. Now is their chance to see what their teammates who flew the day before raved about. The remaining USM flyers—Nicholas Carter, a senior, and Kristi Budzinski, a junior, both chemistry majors—aren't as nervous as the first two, having seen them return unharmed.

When the second flight has left the runway, those on the ground return to the RGS-FOP briefing room, where they watch the action in the jet's cabin by live-feed video. The students on the ground can communicate with those in the air by a telephone link once the airborne students have put on microphones and headsets, a necessity because of the roar in the KC-135A's cabin. Some use the link for fun; others use it to conduct work. The Orange High School group, for example, had trouble with their

onboard machinery—a computer-driven lathe that shaped brass ingots to shapes determined by the high school students—and they were able to work it out by talking to their colleagues on the ground.

The USM students used the connection time to confirm the experimental data. While floating above the aluminum casing, Carter announces, "I can't really tell what's happening with the sphere." A few seconds later, during a 1.8-*g* pullout, he notices a change in the plasma arcs' behavior: "Whoa! Now they're going crazy down there!"

THESE TWO STUDENTS had an equally tough time describing their encounter with weightlessness. "It's almost impossible to describe," Budzinski confirmed. "My whole body just felt light. I had no restrictions in my movements. It was like floating on water, only without the water."



PHOTOS BY KEVIN MACDERMOTT

HANGING OUT Students work on their experiments in the hangar they shared with the reduced-gravity jet.

Carter says, "It was just like being Superman for a short time. You can do just about anything imaginable that you can only dream of on Earth." Both Carter and Budzinski, and Zoltowski and Leard before them, got to try some of these unimaginable movements, such as multiple front flips and propelling themselves across the cabin, arms stretched out in front of them—just like Superman.

When the flights were over, the USM students retrieved their experiment and made the long drive back to Hattiesburg. They said goodbye to new friends, many of whom were in the second batch of flyers and had yet to go up.

There was lots to do upon arrival at USM. The students ran their video data through specialized software that gave them numerical values for the plasma arcs' movement. Then they had to submit a follow-up report to RGSFOP, explaining the results of the experiment and justifying the research.

The fifth member of the flight group, alternate flyer and biology major Chrisina Watters, now has an additional project to complete. Although she didn't get to fly, she was also energized by the experience. In the weeks following the flight, she and some fellow biology students were working on a proposal they planned to submit, Watters tells C&EN.

"We're thinking about something with jellyfish or brine shrimp and their ability to determine their orientation and move in a reduced-gravity environment," she says.

It wouldn't be the first biology experiment. For example, the University of Wyoming flew a team this summer that tested the effect of zero *g* on short-term binding of *Pseudomonas aeruginosa* to beef and to catheter tubing.

"If they write a proposal, and it's good, sound science, they have an excellent chance of being selected," Sickorez says. "We'll take them, and we'll do what they want because our goal is to develop and motivate scientists."

THE CURRENT ACCEPTANCE rate for proposals is close to 80%. However, RGSFOP plans to cut back the number of student flights next year, Sickorez says. There are currently 11 flight weeks each year, with roughly 120 student groups flying. That's 480 student flyers.

"We can't support that with the current budget shortfalls," Sickorez explains. "So we're trying for six flight weeks—four in the spring and two in the summer, supporting between 60 and 70 teams."

Teams have a much stronger chance of acceptance to the program if they propose a good outreach program to carry out after the flight. RGSFOP requires those who participate in their program to tell others about it. The proposals are weighted 30 points out of 100 for the proposed outreach plan; the remainder of the points are for safety and scientific merit.

USM's plans for outreach include a program they've named SURGE, an acronym for Students Understanding Reduced-Gravity Environments. SURGE is a full-day demonstration, to which the USM students will invite local middle and high school students.

"We are hoping to perform some simple drop experiments with the kids to demonstrate microgravity and to give them a hands-on experience with it," Budzinski says. They also plan to show their flight videos, which JSC supplies to each team.

Watters tells C&EN that the team is also discussing a possible trip to her hometown of Mobile, Ala., where they would make a presentation to high school students. This is RGSFOP's best advertising.

"This program revealed to us the level of intensity needed to participate in the scientific workforce," Budzinski says. "We learned the difficulty of writing a proposal, the importance of deadlines, and the difficulty of making the transition from proposal to actual experiment," she adds.

On a personal note, Budzinski adds: "I worry so much about my grade-point average, financial aid, grad school, and so many other things that I sometimes forget why I ever wanted to study chemistry. The NASA program made me remember how much I enjoy experimentation, theory, and the scientific pursuit of knowledge."

"The opportunity to meet students from other parts of the country and to learn how things are done differently is also interesting," Watters notes.

Leard tells C&EN: "I think the entire team developed a real sense for why we're in the field that we're in. Personally, I have become more enthusiastic about my major since we returned from the trip. Knowing that science and technology made an experience like this possible is real encouragement for those of us who are trying to make a career out of it."

"I would participate in the program again—absolutely," Carter says. "It is definitely a once-in-a-lifetime opportunity and probably the most interesting thing I've ever done." ■

FROM THE ACS MEETING

BOARD, COUNCIL ACT IN CHICAGO

Governance groups hear reports on society finances, other issues

LINDA R. RABER, C&EN WASHINGTON

AT THE FALL ACS NATIONAL meeting in Chicago, the society's council and board met to hear reports on the activities of the society's committees, to act on petitions, and to select candidates for certain committees.

Financially, this has been a difficult year for ACS, as it has been for the global economy as a whole. One year ago, the picture was rosier, and the board funded $9 million in new initiatives (C&EN, Sept. 18, 2000, page 71). This year, the report of the Society Committee on Budget & Finance was considerably more somber. The committee noted that the core programs of the society are projected to end 2001 with a net contribution of $220,000. With the inclusion of projected net program expenses from the Member Insurance Program of $2.6 million, and the society's board appropriations of $5.6 million (which cover the ACS Scholars Program, the ACS Matching Gift Fund, and information technology development projects), the society's overall general operations are projected to end 2001 with a net deficit of $8 million.

The projected net contribution from core operations is $222,000 unfavorable to the approved budget, but it is less than 1% of the projected expenditures for ACS Core Programs of $331 million.

The financial performance is primarily attributable to unfavorable performance in the society's investment program. The shortfall in revenue in the investment program is largely a result of the interest rate cuts initiated by the Federal Reserve Board in an effort to bolster a weakening U.S. economy.

These losses were cushioned by favorable performances from Chemical Abstracts Service (CAS) and the society's indirect cost centers. The strong performance in CAS is the result of better-than-expected revenues from SciFinder. Several factors contribute to the favorable variance in the indirect cost centers, including the resolution of a legal issue with a publisher of educational materials.

There has been some belt-tightening, and capital expenditures are projected to total $29.1 million in 2001, which is $925,000 better than the approved budget.

THE BOARD and council also heard a report on ACS President Attila E. Pavlath's recent electronic survey of ACS members. The survey was intended to gauge member satisfaction with the society and its products and services.

While a substantial majority of ACS members are satisfied with their ACS memberships, there is still room for improvement. The survey indicates that younger members are somewhat less knowledgeable and/or satisfied with their memberships than older members and that the primary draw of ACS membership is society publications. A more detailed discussion of this survey will be published in a future issue of C&EN.

The Committee on Grants & Awards recommended and the board approved that the ACS Award in Applied Polymer Chemistry and the ACS Award in Industrial Chemistry be supported by the society for the 2003 award term unless a sponsor is found.

Under delegated authority, the committee also voted to amend the purpose and eligibility for the ACS Award in Industrial Chemistry so that neither commercialization nor patents are required, as expressed in the current language. The new language states that the work must be done by a person whose primary employer is industrial and who is based in North America. The committee also accepted a proposal from Procter & Gamble to change the name of the ACS Award in Colloid or Surface Chemistry to the ACS Award in Colloid Chemistry and to amend its scope accordingly.

On the recommendation of the Committee on Professional & Member Relations (P&MR), the board voted to cosponsor the 2005 International Congress of

Seated

Makeup of elected council committees for 2002

During their meeting, councilors elected seven members to the Committee on Committees, five to the Council Policy Committee, and four to the Committee on Nominations & Elections. For 2002, the membership of the committees will be as follows:

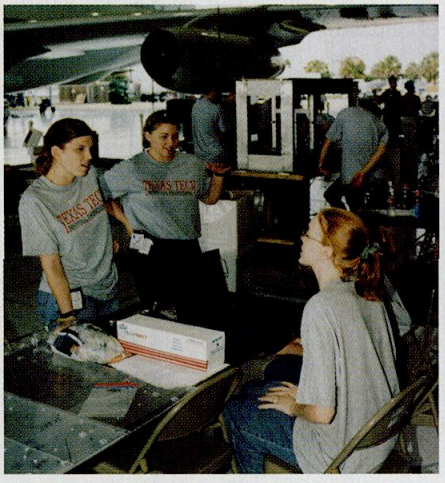
COMMITTEE ON COMMITTEES[a]	COUNCIL POLICY COMMITTEE[b]	COMMITTEE ON NOMINATIONS & ELECTIONS
ELECTED IN CHICAGO	**ELECTED IN CHICAGO**	**ELECTED IN CHICAGO**
William H. Breazeale Jr.	Warren V. Bush	Rita R. Boggs
Peter K. Dorhout	Dean W. Cooke	Michael P. Doyle
Carol A. Duane	Merle I. Eiss	Kathleen M. Schulz
Lydia E. M. Hines	Thomas J. Kucera	Peter J. Stang
Mary V. Orna	Kent J. Voorhees	
Eleanor D. Siebert		
Herbert B. Silber		
CONTINUING MEMBERS	**CONTINUING MEMBERS**	**CONTINUING MEMBERS**
Ronald D. Archer	Bonnie A. Charpentier	Jeannette E. Brown
Janan M. Hayes	Ann H. Hunt	Peter A. Christie
Joe W. Hightower	Paul R. Jones	Donald D. Clarke
Neil D. Jespersen	Ted J. Logan	Richard L. Deming
Dorothy J. Phillips	Howard M. Peters	Thomas W. Gilbert
Wanda W. Rauscher	Charles F. Rowell	Valerie J. Kuck
Barbara A. Sawrey	Kathleen D. Trahanovsky	Bonnie Lawlor
Isiah M. Warner		Mamie W. Moy
		Barbara J. Peterson
		Robert A. Pett
		H. David Wohlers

a The president-elect is a member (ex officio) of this committee. **b** The president, president-elect, immediate past-president, and executive director are members (ex officio) of this committee.

onboard machinery—a computer-driven lathe that shaped brass ingots to shapes determined by the high school students—and they were able to work it out by talking to their colleagues on the ground.

The USM students used the connection time to confirm the experimental data. While floating above the aluminum casing, Carter announces, "I can't really tell what's happening with the sphere." A few seconds later, during a 1.8-*g* pullout, he notices a change in the plasma arcs' behavior: "Whoa! Now they're going crazy down there!"

THESE TWO STUDENTS had an equally tough time describing their encounter with weightlessness. "It's almost impossible to describe," Budzinski confirmed. "My whole body just felt light. I had no restrictions in my movements. It was like floating on water, only without the water."



PHOTOS BY KEVIN MACDERMOTT

HANGING OUT **Students work on their experiments in the hangar they shared with the reduced-gravity jet.**

Carter says, "It was just like being Superman for a short time. You can do just about anything imaginable that you can only dream of on Earth." Both Carter and Budzinski, and Zoltowski and Leard before them, got to try some of these unimaginable movements, such as multiple front flips and propelling themselves across the cabin, arms stretched out in front of them—just like Superman.

When the flights were over, the USM students retrieved their experiment and made the long drive back to Hattiesburg. They said goodbye to new friends, many of whom were in the second batch of flyers and had yet to go up.

There was lots to do upon arrival at USM. The students ran their video data through specialized software that gave them numerical values for the plasma arcs' movement. Then they had to submit a follow-up report to RGSFOP, explaining the results of the experiment and justifying the research.

The fifth member of the flight group, alternate flyer and biology major Chrisina Watters, now has an additional project to complete. Although she didn't get to fly, she was also energized by the experience. In the weeks following the flight, she and some fellow biology students were working on a proposal they planned to submit, Watters tells C&EN.

"We're thinking about something with jellyfish or brine shrimp and their ability to determine their orientation and move in a reduced-gravity environment," she says.

It wouldn't be the first biology experiment. For example, the University of Wyoming flew a team this summer that tested the effect of zero *g* on short-term binding of *Pseudomonas aeruginosa* to beef and to catheter tubing.

"If they write a proposal, and it's good, sound science, they have an excellent chance of being selected," Sickorez says. "We'll take them, and we'll do what they want because our goal is to develop and motivate scientists."

THE CURRENT ACCEPTANCE rate for proposals is close to 80%. However, RGSFOP plans to cut back the number of student flights next year, Sickorez says. There are currently 11 flight weeks each year, with roughly 120 student groups flying. That's 480 student flyers.

"We can't support that with the current budget shortfalls," Sickorez explains. "So we're trying for six flight weeks—four in the spring and two in the summer, supporting between 60 and 70 teams."

Teams have a much stronger chance of acceptance to the program if they propose a good outreach program to carry out after the flight. RGSFOP requires those who participate in their program to tell others about it. The proposals are weighted 30 points out of 100 for the proposed outreach plan; the remainder of the points are for safety and scientific merit.

USM's plans for outreach include a program they've named SURGE, an acronym for Students Understanding Reduced-Gravity Environments. SURGE is a full-day demonstration, to which the USM students will invite local middle and high school students.

"We are hoping to perform some simple drop experiments with the kids to demonstrate microgravity and to give them a hands-on experience with it," Budzinski says. They also plan to show their flight videos, which JSC supplies to each team.

Watters tells C&EN that the team is also discussing a possible trip to her hometown of Mobile, Ala., where they would make a presentation to high school students. This is RGSFOP's best advertising.

"This program revealed to us the level of intensity needed to participate in the scientific workforce," Budzinski says. "We learned the difficulty of writing a proposal, the importance of deadlines, and the difficulty of making the transition from proposal to actual experiment," she adds.

On a personal note, Budzinski adds: "I worry so much about my grade-point average, financial aid, grad school, and so many other things that I sometimes forget why I ever wanted to study chemistry. The NASA program made me remember how much I enjoy experimentation, theory, and the scientific pursuit of knowledge."

"The opportunity to meet students from other parts of the country and to learn how things are done differently is also interesting," Watters notes.

Leard tells C&EN: "I think the entire team developed a real sense for why we're in the field that we're in. Personally, I have become more enthusiastic about my major since we returned from the trip. Knowing that science and technology made an experience like this possible is real encouragement for those of us who are trying to make a career out of it."

"I would participate in the program again—absolutely," Carter says. "It is definitely a once-in-a-lifetime opportunity and probably the most interesting thing I've ever done." ■

in their suits' many pockets, leaving the ends hanging out for quick access.

The jet flies 32 parabolic arcs during its flight over the Gulf of Mexico. The path is a straight line determined that morning, and the pilots fly several parabolas in a row before turning around and flying the next set in the opposite direction. Each parabola consists of a climb, a peak, and a dive. The dives and climbs are done at angles between 45 and 60 degrees and altitudes between 26,000 and 34,000 feet, each averaging 8,000 feet. Flight speed is 350 knots.

At the peak of each parabola, as the jet levels off and begins to dive, there is roughly 20 seconds of zero *g*: weightlessness. But the 55-second pairs of dives and climbs reach 1.8 *g*, or almost twice the gravity on Earth, a force strong enough to pin you to the floor if you're not accustomed to it.

Though they were warned, some of the flyers get up off the floor for the second parabola, and the force of the movement rockets them to the ceiling. Padding protects flyers from impacts, but the flyers can still find other ways to injure themselves.

"Feet down, coming out!" When Yaniec yells this warning, flyers have roughly three seconds to orient themselves with their feet toward the floor. If they're too slow, they crash to the floor when the jet enters the 1.8-*g* period, falling like a rock. During 1.8 *g*, the best place to be is either sitting against the walls or lying on the floor, keeping your head and shoulders aligned and minimizing your movements.

By the third or fourth parabola, the students have gotten used to the concept of weightlessness and the idea of limiting movement and can enjoy the sensation.

ing the little VCR screen filled with dancing arcs.

The sight is surreal, as is everything in the jet's cabin during zero *g*. Like an Escher drawing, perspective is skewed. People are crawling along the ceiling, sitting high on the walls, standing normally on the floor, or hovering in the middle space.

After 30 normal parabolas, the pilots fly two more, and these simulate lunar *g* (one-sixth *g*) and martian *g* (one-third *g*). The flyers hop up and down from the floor, the jump time extended by the reduced gravity. There's a little more float time in the lunar *g*—it's more noticeable, at least.

Then the flight's over. It lasted 1.7 flight hours, although it felt like only a few minutes. Before the flight left the runway, Yaniec gave the students a last insight. "You are going to come out of this thinking,

PHOTOS BY KEVIN MACDERMOTT

WELL GROUNDED Zoltowski, USM's team leader, fields reviewers' questions about his team's experiment; students from Texas' Orange High School work out a technical problem with classmates as their teacher watches.

Five student teams are on board this flight, including a high school team from Orange, Texas, held over from the last high school flight week this spring because of technical difficulties with the jet. Other teams come from West Virginia University; a joint effort between the University of Alabama, Huntsville, and the California Institute of Technology; USM; and Montana State University.

Nearly all of the team members stay on the floor during the first parabola. Just as the jet hits a parabolic peak and enters zero *g*, a second set of interior lights come on, serving as a visual cue for those who can't hear the audible warnings over the engines. The lights come on, and the flyers' stomachs rise high in their abdomens, just like when a car crests a sharp hill too fast and then drops a bit on the other side. This may be the only time during the parabolas that one can feel the jet's orientation in the sky. There are a few small windows, but no one wants to look out for fear of creating spatial disorientation and thus a need for their white bags.

"Floating is unlike anything that I've ever felt before, and so far, I have found it very difficult to describe," Kayce Leard says. A senior and a biochemistry major at USM, Leard flew with Zoltowski during USM's first flight day.

"The closest sensation to floating," she says, "would have to be swimming underwater. However, in microgravity, your body feels no resistance, as it does underwater."

LEARD'S HAIR FLOATS over her head as she and Zoltowski check on their experiment to make sure the camera is recording and the plasma arcs are acting as predicted. They watch the activity in the plasma ball during the both the zero-*g* and 1.8-*g* periods. After a few minutes, the JSC videographer swings by to record the experiment. Videocamera rolling on his shoulder, he leans over the aluminum casing almost as though he's preparing to do a somersault over it, but when his feet come up over his head, he plants them on the ceiling, and there he stands, completely inverted, filming

'Gravity stinks.' " And for the first few moments back on the runway, he was right. Several students later told C&EN that their first thoughts upon landing were, How do I top an experience like that?

On the second flight day, the second set of students fly. Now is their chance to see what their teammates who flew the day before raved about. The remaining USM flyers—Nicholas Carter, a senior, and Kristi Budzinski, a junior, both chemistry majors—aren't as nervous as the first two, having seen them return unharmed.

When the second flight has left the runway, those on the ground return to the RGS-FOP briefing room, where they watch the action in the jet's cabin by live-feed video. The students on the ground can communicate with those in the air by a telephone link once the airborne students have put on microphones and headsets, a necessity because of the roar in the KC-135A's cabin. Some use the link for fun; others use it to conduct work. The Orange High School group, for example, had trouble with their

Under the strict supervision of flight surgeons and veteran Air Force pilots, all students in the RGSFOP program "take a ride" in a hyperbaric chamber at JSC's Neutral Buoyancy Laboratory, the same building that houses a four-story-deep swimming pool in which astronauts practice working in their spacesuits on submerged mock-ups of the space shuttle and space station modules. Once fitted with oxygen masks and headgear, a dozen undergraduates and two journalists follow Roque into the hyperbaric chamber, a metal box the size of a small room with several windows. They're joined by two former pilots who will watch over the students.

When everyone is in their seats and all masks and communications cords are plugged into place, the chamber occupants spend a half hour breathing pure oxygen to decrease the concentration of nitrogen in the body. Nitrogen makes up 78% of the air we breathe. Harmless in everyday breathing, it can cause trouble for anyone who changes elevation significantly because it forms bubbles in the bloodstream that will expand with the decrease in air pressure.

Operators then begin removing the air from the chamber, dropping the pressure at a rate that simulates a jet climbing at 5,000 feet per minute. At 10,000 feet, a mist forms in the chamber, and the students' eyes get big as they gauge each other's reactions. The cloud disappears quickly, as the chamber operators pump in a bit of ambient air to keep the temperature inside from dropping too fast. There's a bit of chatter through the microphones in the masks, but most of the students sit quietly and wait for instructions. A surgeon outside the chamber quizzes the students on gas laws and physiology definitions, but no one is quick to answer. The surgeon is not fazed by the silence: Most students are anxious, so he keeps talking to ease their nerves.

When the chamber reaches 25,000 feet, so to speak, half the students unclip their oxygen masks, breathing only the thinned air in the chamber. They're allowed to be "off air" for up to five minutes before putting the masks back on. Each student is given a clipboard, pencil, and an activity sheet full of math problems, trivia questions, and small puzzles. A box on the right side of the page is reserved for writing down symptoms, which the students are to document as soon as they appear.

Everyone reacts to hypoxia differently. One student becomes completely unresponsive, staring at the floor until a pilot replaces his mask and turns his air back on. Most of the students, however, either focus intently on the clipboard activities or ignore them completely, watching their peers with sleepy eyes and giggling—euphoria had set in. It's quite a show for those still wearing masks.

After five minutes, the three JSC staff in the chamber replace the masks of anyone who is still off air; then the second half of the group takes its turn.

FINALLY, IT'S FLIGHT TIME. "You're joining a unique club today," Yaniec tells the flyers. This final briefing is as much pep talk as it is informative. Dressed in flight suits and ready to go, the students get the details of their flight over the Gulf of Mexico: how far out they will be, how high, how many parabolas before a turnaround. They also get a review of motion sickness prevention tips and reassurance from Yaniec.

"When you're on this airplane, you're my family," he says. "We'll take care of you."

By "we," Yaniec means the large flight crew that will accompany the students: engineers, cameramen, and medical staff. There are almost as many crew members as noncrew on the flight.

Two flyers from each university team of four are flying this day. The remaining two will fly the next day, weather permitting. They walk out to the jet together, and everyone is so excited that they're indifferent to the Texas heat and the loud whirring of the Coast Guard helicopter by the next hangar.

Once on the jet, however, it's another story. The 12 flyers and eight crew file to the passenger seats at the back of the cabin. It's hot back there, and it's loud, too, during takeoff. Earplugs muffle but don't eliminate the hum of the KC-135A's four large engines. Anxious students chatter and sweat; the flight crew sits back and relaxes—they've all done this many times before. Yaniec, for example, has flown more than 19,000 parabolas, though they're not all from the student flight program.

But the crew's collective sense of humor isn't as reassuring. They take bets on the flight's kill ratio, several guesses hitting five out of 12.

Before placing his bet, Yaniec turns back to the seats and asks, "How many of you ate lunch today?" All hands go up. "Then I'll take 10," he says, grinning widely.

When the jet levels out at the appropriate altitude, the crew prepares for the parabolas and the students sit or lie on the floor near their experimental gear, which has been strapped down. Many flyers opt to be strapped to the floor as well, as they're advised to ride out the first two or three parabolas on the floor to get used to the feel. Several unzip their flight suits, even though the cabin is cooler now because of the altitude. They take the white "flight etiquette" bags they were issued during the motion sickness briefing and stick them

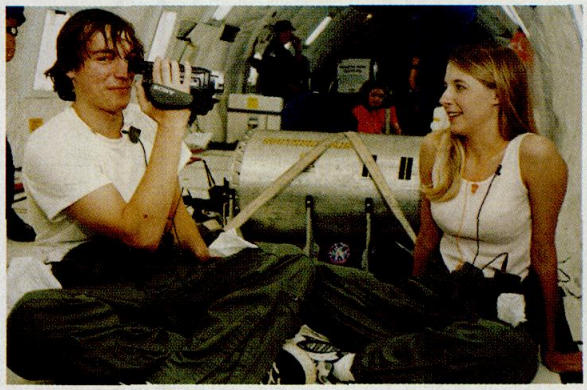


PHOTO BY KEVIN MACDERMOTT

WORTH A THOUSAND WORDS **USM flyers Zoltowski and Leard make a video to use in outreach to Mississippi students.**

NASA PHOTO

CHECK IT OUT **USM's Budzinski and Carter pose with their experiment during an in-flight break.**

HOW TO APPLY

Information on RGSFOP and deadlines for application will soon be available on the new program website, http://microgravityuniversity.jsc.nasa.gov. Readers can also contact Donn G. Sickorez, University Affairs Officer, Johnson Space Center, AH2, Houston, TX 77058; (281) 483-4724; fax (281) 483-9192.

for potential safety hazards, probe every angle. Groups that have prepared well get off easily, as the USM team did; others get a grilling. The questions can be quite specific, and an unsatisfactory response could prevent a team from flying.

Because the JSC staff will take the time—if time is available—to help the students fix problems, not many teams get grounded by failing the review.

"I've seen a couple hundred student experiments," explains Lead KC-135 Test Director and RGSFOP codirector John S. Yaniec. "But I've also seen two grounded." He leads the TRR reviewers through their rounds and also leads the safety operations surrounding the KC-135A.

With the hardware ready for flight, the students must then prepare themselves. Every flyer is required to pass a physical examination administered by a Federal Aviation Administration-certified physician. But there's also mental preparation to undertake, as they have all heard stories of this infamous jet.

NASA MAY HAVE dubbed the jet "Weightless Wonder V," but nearly everyone else calls it the "Vomit Comet," an unappealing name resulting from an unfortunate reality: Many flyers get motion sickness because of the jet's unique flight pattern, which looks like a sine curve and feels like a killer roller-coaster.

Not too long ago, the "kill ratio," as it's called by crew members, was quite high—more people became ill than not. "We've never had a 'no-kill' flight before this year," Yaniec says, "but we've also had some flights where there were 16 out of 18 sick." However, flyers now are better equipped for the flight as a result of extensive briefings on the causes and prevention of motion sickness. Most flyers and crew now take medication before flight as well, a precaution that has dramatically helped reduce the number of ill flyers.

However, according to Yaniec, "You can make yourself sick," he says. "You can also keep yourself from getting sick." It's a matter of expectation and precaution.

All participants attend an hourlong briefing on the mechanics of spatial disorientation, the cause of most cases of motion sickness and certainly the leading culprit on the Vomit Comet. They learn how spatial orientation is determined by the inner ear and tactile and visual cues, and that all of these come into conflict on the jet. The instructor uses demonstrations to make her point, asking volunteers to make multiple movements with their heads and arms as they spin in a chair. The volunteers get a bit loopy, but everyone learns what movements to avoid during their flight: Try to keep your head and body facing the same direction as if you were wearing a neck brace, and don't look out the windows.

Believe it or not, another way to help prevent illness on the flight is to eat before going up. An empty stomach is quicker to irritate than one with contents.

Motion sickness is only one of the medical concerns addressed by program staff. Because the KC-135A flies a dangerous line, there's always the possibility of an in-flight emergency. So the students are briefed on the host of maladies they could suffer in such situations, and they learn of the physical laws that explain these events. Most physiological problems involved with flight and altitude can be explained through gas laws such as Boyle's law of trapped gas expansion, Henry's law of evolved gases, Dalton's law of total and partial pressures, and the laws of gaseous diffusion.

The most likely emergency scenario would be a loss of cabin pressure. Like any commercial airliner, the KC-135A's cabin is pressurized to a level that a passenger's body needs to maintain a proper level of oxygen in the blood. The pressure is roughly the equivalent of breathing at 8,000 feet, slightly less than what most people are accustomed to on the ground.

THE HIGHER a jet flies, the more important the pressure inside the cabin becomes, because the pressure outside is decreasing with increasing altitude, making the air less dense and less breathable. If the jet's pressurized cabin were to spring a leak, hypoxia—a state of oxygen deficiency in the blood, tissues, and cells sufficient to cause an impairment of mental and body functions—would set in quickly. After a loss of cabin pressure, an individual in a jet flying at roughly 25,000 feet—the lower end of the KC-135A's flight range—has a time of useful consciousness of between three and five minutes. After that, the individual has lost the ability to function deliberately.

JSC shows the students what it's like to have hypoxia by giving it to them.

"You have to be aware of what's going to happen to your body," explains Javier Roque, a JSC medical officer. He gave the students a thorough explanation of what to expect and why they should expect it, listing more than a dozen symptoms such as dizziness, mental confusion, slurred speech, tunnel vision, blurred sight, cyanosis (a bluing of the lips and extremities), and hot and cold flashes. What they would probably notice most, he told them, was a feeling of euphoria—the experience sounds bad, but it doesn't feel so.

"One of the first things to go is your vision," he says. "But will you admit it? Probably not." The participants often don't recognize the many symptoms of hypoxia, and some are reluctant to acknowledge the ones they do notice.

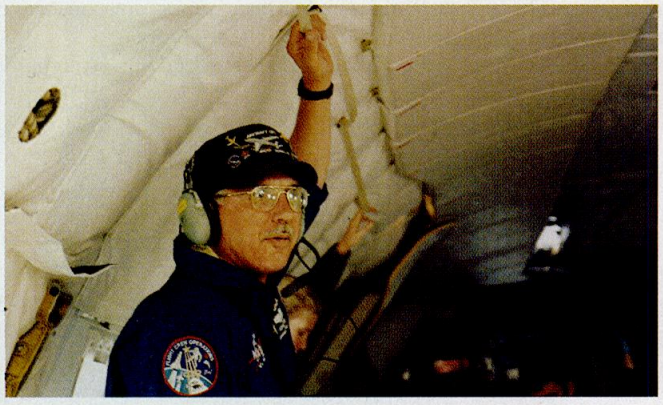


PHOTO BY KEVIN MACDERMOTT

NASA PHOTO

HERE TO HELP **Zero-*g* veteran Yaniec keeps his eyes on floating flyers; a flight surgeon helps C&EN's Kevin MacDermott check the seal on his oxygen mask before a hyperbaric chamber "ride."**

istry student at USM who served as the team's ground crew, flew in 1999 as a USM undergraduate. He now flies with the team's faculty adviser, John A. Pojman, who has studied frontal polymerization and miscible fluids in the KC-135A turbojet as part of the original reduced-gravity program for professional researchers.

"This program helped me determine what to do with my life, really," Ainsworth tells C&EN. "It gave me a sense of direction as to where I wanted my career to go." Once indecisive over a career in industry or graduate studies, he's now sure of his choice to return to the classroom, where he's excited about his work and the opportunities that come with it.

Over RGSFOP's short existence, three separate programs have emerged to cover a wide range of students: the original undergraduate program; a separate program for community colleges; and "Fly High," which opened the flights to high school students throughout Texas. But due to budget cuts within NASA, the high school program is being dropped and the community college and university programs rolled into one. NASA absorbs the full cost of the flights, roughly $1,700 per flyer, and the students pay their transportation, lodging, and dining expenses.

During their week in Houston, the students operate from Ellington Field, where they share space in the hangar with the Weightless Wonder itself, an arrangement that gives participants a true behind-the-scenes look at NASA and its vehicles. During the USM students' session, a high-altitude test jet shared the hanger space. And only a week before, crew returning from a *Discovery* shuttle mission to the International Space Station spent some time in the hangar with the students.

RULES GO WITH the privilege of being at Ellington Field. The staff's matter-of-fact presentation usually includes scenarios and outcomes no one wants to encounter. Staying within the designated areas and accounting for all tools and small objects (they could wind up in the one of the jet's engines) are among the most serious.

But there's also the "18-inch rule": Students' test equipment must stay 18 inches off the floor because any leaking fuel fumes, which are heavier than air, collect on the floor. A spark or charge from the students' hardware could set the place ablaze. The building has a sophisticated firefighting system that can be triggered by a single spark, but even then, the place would fill with foam and water.

Preparations for the flight week take months. After a team's initial proposal has been accepted, the team must get to work on major projects such as raising the necessary funds and building the experimental equipment.

In USM's case, building the experimental hardware was fairly simple because some of the equipment had flown in the KC-135A with an earlier group. The largest piece was a stout, cast-aluminum cylinder that was once a stage of the body of a sounding rocket, the *Conquest I,* that was fired into space several years ago. Within this aluminum casing, the students fit a wooden rack that held the novelty plasma ball and a small video camera. One end of the casing was sealed and bolted; the other end was closed off in the same fashion except for a small utility hole cut in the aluminum baseplate, through which the students ran the power cords of the sphere and camera to a power strip. The video camera was then connected to a portable digital recorder with a small screen that shows a close-up view of the plasma ball and its arcs, which glow a brilliant pink-purple in the blackness of the cylinder.

The analysis and report that JSC requires for its safety preparations are surprisingly complex and thorough. The Test Equipment Data Package, or TEDP, covers everything from structural design elements to potential hazard identification. Every detail must be listed: the length of each bolt, the electrical circuitry's voltage, the gases found in the plasma ball, and the type of wood used in the frame. The TEDP is due to JSC six weeks before the team's scheduled flight week, allowing time for JSC test directors to review the experiment in depth and report any concerns or comments to the students.

The TEDP is the students' study guide. They need to know it and their experiment inside and out for the final Test Readiness Review (TRR), the final experiment check and the one that worried the students most. All groups in the hangar go through TRR at the same time. They sit nervously, waiting for the entourage of pilots, flight surgeons, safety representatives from JSC and Ellington Field, and JSC test directors to arrive at their table to judge the students' months of work.

Safety is the primary concern in the hangar, and the TRR reviewers, looking

NASA PHOTO

BACK ON EARTH **Students and journalists (green flight suits) pose with flight crew (blue flight suits) after their flight.**

The research doesn't need to be Nobel-Prize quality, but it needs to be sound and it needs to be student-driven, not the work of their professor.

MANY GROUPS SPONSOR DIVERSITY PANEL

The special session at the ACS meeting in Chicago, "Diversity in the Top 50 Universities: The Challenge to Lead," was sponsored by the ACS Committee on Science. Cosponsoring organizations included the National Science Foundation; the American Institute of Chemical Engineers; the Council for Chemical Research; the ACS Division of Professional Relations; the ACS Committees on Minority Affairs, on Professional Training, and on Education; and the ACS Women Chemists and Younger Chemists Committees.

engineering Paula T. Hammond and Princeton University R. W. Moore Professor of Chemistry and chemistry department chairman George L. McLendon discussed the question "What factors are enabling some top 50 universities to grant a higher percentage of Ph.D.s to women?"

When a university conveys the message that it is ready, willing, and able to accept women and URMs, they come, Hammond said. "Women and URMs are looking for collaborative, interactive environments. Universities have personalities, and those that discourage collaborations are unsuccessful in getting women to come and stay. Successful universities have been able to package their programs to show their humanistic side." Hammond said that the questions women should ask when they think about going to a university for a Ph.D. are, "Is the science exciting?" and "Will I be valued?" When a person is "put down, they are discouraged from creating and innovating," she said.

McLendon noted that his lab is almost all women and minorities. He isn't sure what the reason is, but joked that "a crisis at Princeton is when you find out that Yale is doing something better." Princeton has a graduate research organization for women and has looked carefully at its seminar list to get more women as speakers. Women have gone from 10% of speakers to 30% in just the past few years. Princeton has abolished the tenure clock, which is more amenable to women who want to have children.

"Academic institutions are intrinsically monastic institutions that were created in the 13th century," he said wryly. "They might need a little fine-tuning." And with that understatement, the audience laughed. Time ran out during the question-and-answer period, but it was clear that this is a topic that continues to attract attention.■

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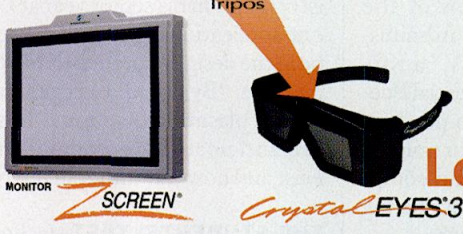

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NASA PHOTO

WHAT'S UP? USM's Budzinski floats in NASA's "Weightless Wonder" jet.

HIGH-FLYING CHEMISTRY

Students lose weight, charge batteries as part of NASA's reduced-gravity program

KEVIN MACDERMOTT, C&EN WASHINGTON

THERE IS A LABORATORY IN Houston where the experimental equipment is strapped to the floor for fear that it may float away. The scientists there hover above the machines as they work, some standing on the ceiling and reaching down toward the floor to conduct their research. Even stranger is that this lab has wings and zips along at 350 knots.

What may sound like science fiction is business as usual for the crew of the National Aeronautics & Space Administration's "Weightless Wonder V," a KC-135A turbojet similar to a commercial Boeing 707. The aircraft is used to produce reduced-gravity environments for training astronauts, testing hardware and equipment bound for spaceflight, and evaluating medical protocols for use in space.

This flying laboratory is also used to train students to become scientists. NASA's Reduced-Gravity Student Flight Opportunities Program (RGSFOP), based in Houston at Johnson Space Center (JSC) and Ellington Field hangars, gives undergraduate science students the opportunity to conduct experiments of their own design in this special jet.

In early August, a team of chemistry students from the University of Southern Mississippi (USM), Hattiesburg, flew in the RGSFOP program and learned that being a chemist can sure be a lot of fun.

USM's chemistry experiment tested the effects of reduced gravity on the movement of plasma arcs produced by an inert gas discharge tube in a glass sphere. The team's hypothesis is that buoyancy-driven convection—fluid or gas flow caused by density gradients created by thermal or concentration gradients in a gravitational field—plays a significant role in the plasma's movement.

Team leader Brian Zoltowski, a chemistry major in his senior year at USM, says one application of the data they gain could be in the design of propulsion systems used in space. "By obtaining a general knowledge of plasma interactions," he says, "one can anticipate what complications may exist and how they differ in microgravity."

THE STUDENTS' TEST design is fairly straightforward: Take a novelty plasma ball, available inexpensively at any shopping mall, and place it in a sealed container with a videocamera to watch what happens to the plasma arcs. It's simple, it's safe, and that's exactly what NASA wants in its RGSFOP experiments. The research doesn't need to be Nobel-Prize quality, says Donn G. Sickorez, but it needs to be sound and it needs to be student-driven, not the work of their professor. Sickorez, JSC's university affairs officer, is a codirector of RGSFOP.

NASA's reduced-gravity program began in 1959, but the student flights began just five years ago. More than 100 different schools, representing nearly every state in the U.S., have participated so far, many coming back for repeat visits.

RGSFOP was designed to address the U.S.'s shrinking ranks of students graduating with degrees in science, technology, and engineering.

"What we're trying to do is help the next generation of scientists become scientists and engineers," Sickorez says. "It's not an easy road to travel, so we want to give them some incentive and show them that science can be interesting, it can be challenging, and it can be fun. We use the plane and its unique resources to help them along, to help motivate them."

THIS NEXT GENERATION of scientists needs to include representatives from many fields, and so the student flight program is open to any undergraduate team with an appropriate experiment. Most of the experiments have been based in engineering or physics, but there are the occasional materials science and chemistry experiments. This summer, there were only two from those disciplines: the USM team's and one from the University of Wisconsin, Madison, which tested the effect of reduced gravity on the clarity, pore structure, and density of aerogel produced through a rapid gelation process.

Although only an estimated one out of 10 proposals submitted to the RGSFOP office involves chemical analysis or a form of materials research involving chemistry, Sickorez believes the program is a good environment for chemical research.

"If the chemical reaction would be affected by zero *g*, then, of course, this is a good place for it," Sickorez says. "It's an excellent venue for materials research, some of which involves chemistry."

But whether their experiments are in chemistry or any other field, the participants leave with many benefits, according to Sickorez. "The students learn how to function in a team—and how to put that team together—how to write a proposal, how to wait for the acceptance, how to respond to comments, and how to physically build what was only an idea a few months before." They also learn to work under deadlines, a crucial part of teamwork, he adds.

"When you're in classes, you see parts and pieces. Here, it all flows. You see how it's all put together," Sickorez says.

William J. Ainsworth, a graduate chem-

CHEMICAL & Engineering News

THE NEWSMAGAZINE OF THE CHEMICAL WORLD

VOLUME 79, NUMBER 40 • OCTOBER 1, 2001 HTTP://PUBS.ACS.ORG/CEN

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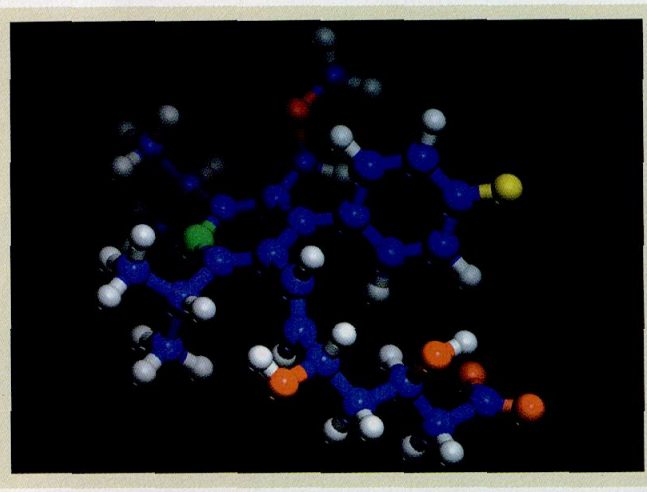

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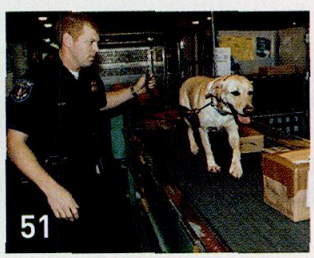

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QUOTE OF THE WEEK

"Buying [drugs] online from overseas websites is like playing Russian roulette."

KEVIN BELL, Customs Service spokesman **PAGE 51**

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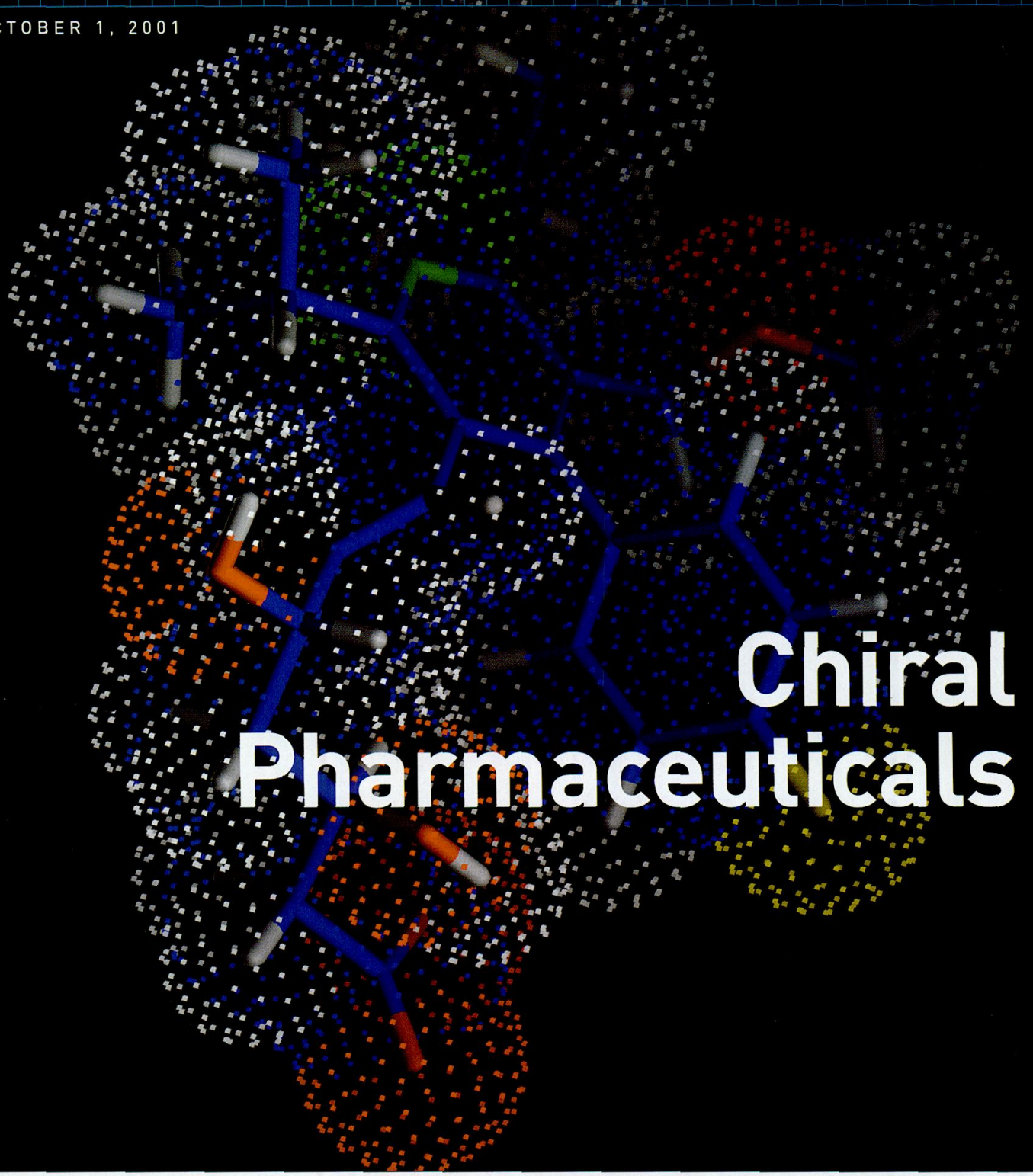
EDUCATION: STUDENTS' EXPERIMENTS FLY HIGH WITH NASA

CHEMICAL & Engineering News

OCTOBER 1, 2001



Chiral Pharmaceuticals

This is the Sunday magazine of Colombia's largest daily, El Tiempo, also one of the largest in Latin America

DOMINICALES
ISSN 0121-9790
9 DE SEPTIEMBRE DE 2001

Experto ayuda a Angela Posada durante 25 segundos de gravedad cero.

EN ENTRENAMIENTO DE LA NASA

Colombiana en gravedad cero

ANGELA POSADA-SWAFFORD

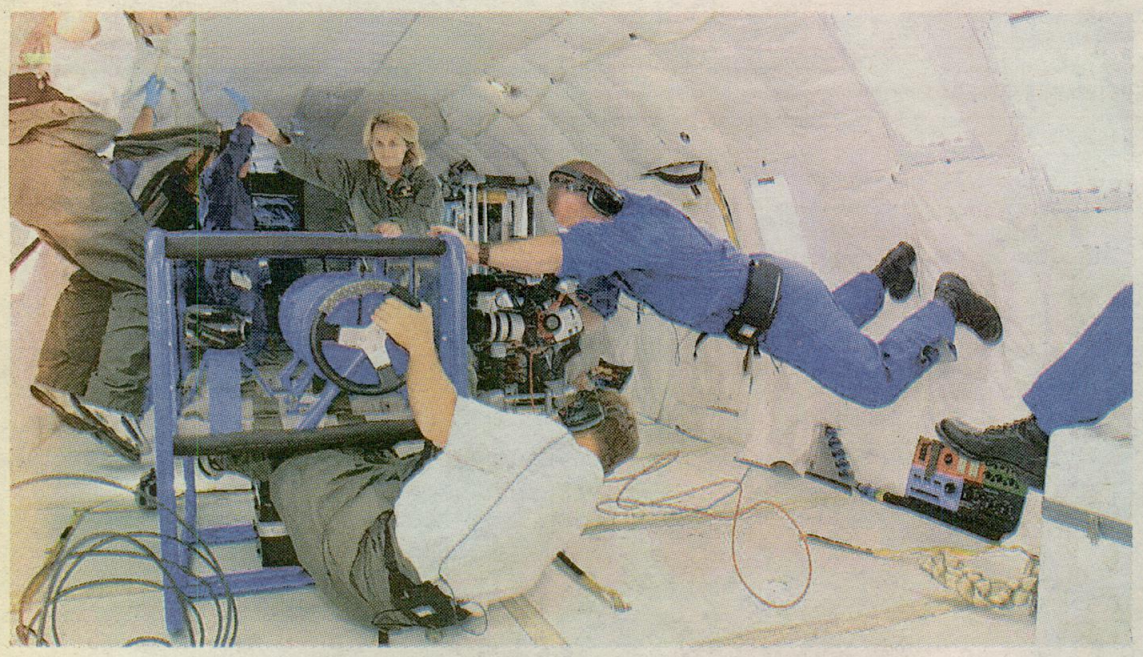
Segunda parte de la crónica de un compatriota admitida a experiencias para astronautas.

HOUSTON

Hace un calor húmedo y el grueso traje de aviación verde oliva se pega a la espalda. Sentados en la parte trasera del KC-135A, el avión de entrenamiento en microgravedad de la NASA, un grupo de 18 estudiantes y dos periodistas observamos con una mezcla de nerviosismo y curiosidad a diez tripulantes vestidos con el uniforme azul de la agencia espacial estadounidense. Mientras inspeccionan la cabina, del que es básicamente una versión militar del Boeing 707 –pero sin ventanas ni asientos de pasajeros y un interior totalmente recubierto de mullidas capas de espuma blanca- los directores de vuelo hacen las consabidas apuestas: "Diez", dice el veterano John Yaniec mirándonos de reojo bajo su sombrero azul lleno de escudos de misiones espaciales. "Yo diría que ocho", apunta Dominic del Rosso con cara de seriedad. "Ustedes no están en nada", dice el médico Eric Santos. "Mi número es catorce. Y vayan enfriándome esa cerveza".

Las apuestas, se refieren a la cantidad de pasajeros que van a marearse durante el vuelo de esta mañana, en el que el KC-135A, también conocido como 'el Cometa del Vómito', dibujará una serie de 32 arcos o parábolas en el cielo con el fin de obtener, en la curva de cada parábola, unos 18 a 25 segundos de ingravidez. Es la única forma de experimentar la falta de gravedad sin salir del planeta, y lo más cercano que cualquiera puede llegar a ser astronauta. NASA ha volado más de 80,000 parábolas de apoyo a las misiones Mercury, Gemini, Apollo, Skylab, Transbordador Espacial y Estación Espacial. Aunque se le conoce más por su papel en entrenamiento de astronautas, el 80 por ciento de los vuelos del KC-135A están destinados a experimentos en ingeniería aeroespacial, pues es la única forma en que la NASA puede estudiar el comportamiento de materiales, objetos, aparatos electrónicos y hasta plantas y animales destinados al espacio. Además, la agencia se asegura que cada año grupos de estudiantes tengan la oportunidad de sus propios experimentos en microgravedad. Estos estudiantes serán los astronautas e ingenieros del futuro.

TIME
El general Powell pierde poder en la Casa Blanca.



Un camarógrafo capta un experimento con langostas en un tanque.

Grupo de MIT; delante la colombiana Posada.

Al mi lado, Tamra Haby y Jennifer Long, dos de las cuatro brillantes integrantes del equipo del Massachusetts Institute of Technology al que acompaño hoy (la universidad que más astronautas ha producido) se muestran calmadas y muy alegres, en contraste con algunos de los estudiantes de frentes sudorosas y caras de concentración. MIT quiere este año observar el comportamiento de varios trozos de material que potencialmente podrían ser usados en una gran vela solar que impulsaría satélites y telescopios utilizando la radiación de las partículas de luz, de la misma manera que una vela recoge el viento para hacer navegar a un velero.

La puerta del Boeing se cierra y quedamos metidos en un mundo extraño de ciencia ficción, completamente aislados del exterior. La cabina blanca iluminada con brillantes luces queda desocupada, salvo por las cajas con los experimentos de los estudiantes, atornilladas al piso. Alguien comenta que fue aquí donde se filmaron las escenas en microgravedad de Apollo 13 y Armageddon. "¿Todo el mundo listo? ¡Nos fuimos!", grita Yaniec por el micrófono a medida que el avión inicia su carrera por la pista.

Seis meses de expectativa, varios exámenes médicos, una larga lista de credenciales periodísticas y una semana de clases y entrenamientos en el Centro Espacial Johnson están a punto de cristalizar en las siguientes dos horas. Porque antes de poner pie en el KC-135A, tuvimos que pasar exámenes de corazón, pulmones, visión y estado físico y mental y asistir a largas pero interesantes sesiones cubriendo las diversas leyes que afectan a los gases bajo presión, abundantes detalles sobre ciencias atmosféricas, los principios del equilibrio y todo lo concerniente a la fisiología del mareo, todos temas con los cuales ya estaba familiarizada gracias a mi certificación de buceo SCUBA. Lo que estábamos a punto de hacer gobierna tanto a buzos como a pilotos.

CAMARA HIPOBARICA

Sin duda, el momento culminante del entrenamiento fue la sesión en la cámara hipobárica de NASA. Tras una extensa explicación acerca de sistemas de emergencia en aviones, nos invitaron a entrar al gigantesco Neutral Buoyancy Lab, o NBL, donde está la cámara hipobárica. El NBL es uno de esos edificios míticos dentro del Centro Espacial, cuyo acceso es altamente restringido, ya que alberga la enorme piscina que contiene las réplicas a escala del Transbordador y la Estación Espacial. Es aquí donde los astronautas entrenan hasta poder hacer los procedimientos con los ojos cerrados en un ambiente lo más similarmente posible al espacio. El NBL también alberga las cámaras hiperbáricas que necesita el regimiento de buzos que acompaña a cada astronauta durante sus prácticas. Respirando mezclas de gases, los buzos deben permanecer varias horas sumergidos en la piscina más grande y honda del mundo, pendientes de la más mínima necesidad del astronauta. Nosotros habríamos de entrar, no en la cámara hiperbárica, que aumenta la presión simulando una inmersión, sino en la cámara hipobárica, que hace todo lo contrario: reduce la presión atmosférica, imitando un vuelo a 25,000 pies.

> ¡Nadando en el aire! No es posible describirlo en una palabra.

El objetivo de un 'vuelo' de entrenamiento en la cámara hipobárica, en la que caben 15 personas y dos entrenadores de NASA con grados en fisiología aeroespacial, es simular lo que sucedería en caso de una rápida despresurización a 25,000 pies (7,620 metros) la misma a la que volaríamos en el KC-135A. La idea es familiarizar a los estudiantes con los síntomas de hipoxia, o falta de oxígeno abrupta que sobrevendrían en caso de una pérdida de presión en la cabina, para hacerlos entender cuándo deben reaccionar poniéndose máscara de oxígeno. Los médicos necesitan saber cuál es el umbral de tolerancia de cada uno.

El grupo entra en la cámara, básicamente una gran caja de metal con cuatro ventanas y se sienta frente a frente en bancas largas con consolas individuales llenas de suiches para controlar el flujo de aire. Tras 30 minutos de aprender a respirar oxígeno puro fluyendo a alta presión por entre las mismas máscaras que utilizan pilotos militares, los técnicos bajan la presión, mientras que el altímetro indica el ascenso. Entre 5,000 y 10,000 pies, un velo de neblina invade la cámara, indicando la condensación del aire ocasionada por la rápida transición entre el húmedo clima de Houston y el seco aire de la altura. A los 25,000 pies, nos hacen quitar las máscaras y nos dan unas hojas de papel con algunos ejercicios que se van haciendo cada vez más complicados a medida que mi cerebro comienza a protestar por la escasez de oxígeno. El primero consiste en deletrear mi nombre al revés. Luego, hay que sumar y restar y anotar nombres de varios presidentes estadounidenses en orden.

Han pasado dos minutos. En una esquina de la hoja debemos anotar lo que vamos sintiendo cada vez que los técnicos anuncian el pasar de cada minuto. Mis anotaciones son "algo de vértigo, borrachera". A los tres minutos, comienzo a conectar los puntos de un dibujo que obviamente es Mickey Mouse. Mis síntomas son los mismos, pero mucho más pronunciados y dolor de cabeza. Algunos de los estudiantes comienzan a dar señales de comportamientos extraños: uno ríe a carcajadas y trata de esquivar el brazo del médico con la máscara. Otro se queja de calor. A los cuatro minutos comienzo a perder visión periférica, pero me siento calmada mientras escribo lentamente los significados de siglas mundialmente famosas. A los cuatro y medio minutos el especialista Javier Roque comenta acerca del tono azulado de mis labios.

Cuando sólo quedamos cuatro personas trabajando aún sin la máscara, los técnicos comentan que haber nacido en Bogotá a casi 3,000 metros, bien podría estarme ayudando. Cuando llego a los cinco minutos, mi visión comienza a concentrarse en un túnel, como mirando por el lado equivocado de unos binóculos, me invade un sueño delicioso y por una fracción de segundo siento que la conciencia se me va desvaneciendo como un ladrón en la noche. Roque me ayuda a colocarme la máscara y un agudo estado de sobriedad regresa galopando a mi cabeza, mientras "bajamos" a nivel del mar, descendiendo suavemente en diez minutos. ¡Uff! Miro a mis compañeras de MIT con mucho alivio: logramos pasar la prueba sin quitarnos la ropa, bailar el Jarabe Tapatío o cualquiera de los absurdos comportamientos que se han visto en este lugar.

Durante las clases, el tema del vómito surge una y otra vez. El apodo del avión tiene su razón: "De tres pasajeros que suben por primera vez, uno se marea

DIRECTOR Roberto Posada García-Peña • **COORDINADOR** Jorge Restrepo • **DISEÑO EDITORIAL** EL TIEMPO **CARÁTULA** FOTOS: NASA
PUBLICADO POR Multirrevistas Editores S.A. • **CIRCULA CON EL TIEMPO** ISNN 0121-9790

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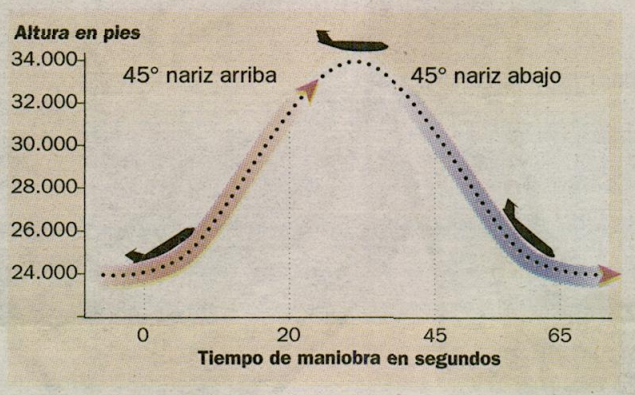
violentamente, uno se marea moderadamente, y otro no se marea para nada", explica Yaniec, quien desde 1994 ha acumulado cientos de vuelos. La tripulación ha coleccionado una rica epistemología del mareo. "Si creen que porque nunca se marea le va a ir bien con nosotros, está equivocado", dice el médico Santos. "El mareo espacial, el que se experimenta en vuelos parabólicos, está relacionado con falta de gravedad e hipergravedad durante la fase en que el avión asciende hacia la curva de la parábola. También tiene que ver con el conflicto que hay entre los ojos y los movimientos de aceleración angular en el oído interno pues ambos perciben cosas diferentes y envían al cerebro señales que lo confunden". "Todo el mundo es distinto. Hay personas que son envidiablemente inmunes con o sin la pastilla del mareo", dice Dominic del Rosso, uno de los veteranos directores de vuelo. "Conozco astronautas que no se montan a una montaña rusa y que se sienten muy bien en el KC-135A", pero también hay astronautas que preferirían no tener que entrenar nunca en el KC, porque siempre les va mal". "Si alguien se enferma", dice del Rosso el día antes del vuelo, "aléjense. Si han estado conteniéndose, todo saldrá en una explosión. En gravedad cero, eso no es agradable". Nadie ríe. Tras una explicación sobre la manera correcta de usar las bolsas para el mareo que todos debemos llevar en el pecho del uniforme, salimos del hangar especulando acerca de qué debemos desayunar mañana. Los consejos van desde bananas hasta duraznos. Pero la realidad se reduce a tener sentido común y evitar alcohol, trasnochada, cafeína y gaseosas. Algo que cualquier buzo sabe.

El día del vuelo nos despiertan de madrugada con los preparativos, que incluyen la entrega de uniformes, documentos legales para firmar y una última sesión donde nos dan el Scop-Dex para el mareo. Esta potente combinación de escopolamina y Dexedrin, que la NASA aconseja tomar pero que no obliga, no tiene muchos efectos secundarios salvo algo de hiperactividad y ha demostrado funcionar. Salimos del edificio para embarcarnos en el KC-135A, estacionado a unas cuantas yardas. Entre aplausos, fotos y filmaciones, caras sonrientes de los mecánicos, gritos de vitoreo de los compañeros, escolta de nuestros directores de vuelo y fluir de la adrenalina, me siento como se debió sentir John Glenn antes de abordar el Mercury Redstone para el primer vuelo orbitalguardadas proporciones.

MICROGRAVEDAD

A 24,000 pies sobre el Golfo de México, Yaniec nos ordena sentarnos con los pies extendidos cerca de nuestros experimentos. "Dentro de cinco minutos iniciaremos la primera parábola", dice. "Subiremos 10,000 pies en un ángulo de 45 grados, a 450 millas por hora, hasta llegar a 34,000 pies. Esta fase se llama el pullout en alta gravedad. Durará 18 a 21 segundos y ustedes experimentarán dos gravedades, o sea, todo les pesará el doble de lo normal. Después entraremos en una transición a la microgravedad, que durará entre tres y cinco segundos, a medida que el avión se aproxima a la curva máxima. Enseguida vendrá la microgravedad total, que durará unos 18 a 25 segundos. Luego vendrá la transición a la gravedad normal y me escucharán gritar ¡pies en el suelo, saliendo de la parábola! Desde ese momento, tendrán entre tres y cinco segundos para sentarse nuevamente con los pies extendidos frente a ustedes. No quiero a nadie flotando durante la transición, o correrá el peligro de partirse una costilla al aterrizar abruptamente contra el suelo, o peor, contra sus propios experimentos cuando el avión inicie el descenso, clavando la nariz 45 grados hasta descender 10,000 pies." "Inmediatamente tras la primera parábola iniciaremos la segunda y así hasta continuar con las primeras diez. No pararemos si alguien se marea. Si se enferman, muévanse hacia las sillas de atrás y no se paren por ningún motivo, a menos que se sientan mejor. Estaremos pendientes de cada uno. Después del primer grupo de parábolas tendremos tres minutos de descanso mientras el avión hace una curva para regresar en la dirección contraria. Al final del tercer grupo de parábolas, haremos una que imite la gravedad de Marte, la cual durará entre uno y dos minutos, oportunidad de experimentar 0.38 G' s, o sea 3/8 de la gravedad de la Tierra y finalmente una parábola de gravedad lunar, que simulará la fuerza gravitacional de la Luna, 0.17 Gs". "¡Un minuto!" grita. El rugido ensordecedor de las turbinas a pleno pulmón desaparece abruptamente, y entramos en microgravedad. Repentinamente, cinco millones de años de evolución desaparecen de cada una de mis células y me encuentro en el mayor estado de confusión y emoción que jamás haya experimentado. Flotando sin el menor control de mi cuerpo, como un simio perdiendo el equilibrio en la rama de un árbol, cada uno de mis sentidos entra en shock. Durante un segundo mi cerebro registra pánico, queriéndome decir que me voy a estrellar. Momentos después, se convence de que está flotando, y el pánico se convierte en una euforia irracional. ¡Estoy flotando! ¡Nadando en el aire! No es posible hacerle justicia a esa sensación en unas frases. Por mi boca salen aullidos de júbilo y palabras incoherentes en una mezcla de idiomas. En el resto de la cabina, los gritos sugieren que no soy la única en percibir esta sobrecarga eléctrica que parece estar a punto de fundir mis neuronas. "¡Pies en el suelo!" grita Yaniec y siento que varias manos me bajan hasta ayudarme a encontrar el piso. Levantando la mirada veo a Del Rosso dándome la señal de OK con una sonrisa. Siento que el avión inicia el empinado ascenso y que la cámara fotográfica me pesa como un ladrillo en el bolsillo de la pierna. La cabeza parece hundirse en el tronco. Es el momento en que debo tener la cabeza quieta para no marearme, evitando que los fluidos del sistema vestibular, alojados en lo más profundo del oído interno, se muevan locamente. Para la quinta parábola estoy completamente acostumbrada a las sensaciones. No tengo el menor indicio de mareo y me permito el lujo de dejarme ir a donde el cuerpo quiera, sin agarrarme a los sostenes especiales. Para la octava parábola, el avión ha cobrado sus primeras seis víctimas, que son trasladadas a las sillas traseras, mientras Santos les da agua y salvavidas de cereza. En la parábola 15, el grupo de MIT sigue sus observaciones, ya que el material se despliega dentro de su caja como se esperaba en ausencia de gravedad: quizás éstas serán las velas solares del mañana. Ninguna de las mujeres que conformamos el equipo de MIT ha sentido mareo. A la altura de la parábola 24, noto que la cabina está extrañamente silenciosa y que la caja que contiene el experimento de MIT está rodeada de uniformes azules: casi todos los tripulantes de NASA han convergido en nosotras ya que el 75 por ciento de los demás está mareado.

Con el avión de prueba, nuevos miembros del club de gravedad cero.



Maniobra para lograr ingravidez.

Incluso las langostas que hacían parte del experimento han muerto. "No tenemos a quién más cuidar, así que vamos a darles unas buenas volteretas", dice Del Rosso. "El doctor de abordo siempre tiene razón en sus predicciones: catorce de veinte se marearon Este ha sido un vuelo con muchas víctimas. Encójanse en un ovillo y vamos a dar vueltas!" Mientras giro dando chillidos, pierdo totalmente la noción de dónde estoy, comprendiendo lo que siente un astronauta cuando debe penetrar por un nódulo que comunica una parte de la estación con la otra: en el espacio no hay arriba ni abajo, ni izquierda o derecha. "¡Podría vivir así toda la vida!", les grito a las demás. Pero ya se aproxima el final de la ultima parábola y con ella, el momento de poner los pies en la tierra. ¡Ahora puedo decir que tengo diez minutos y medio de vuelo en microgravedad!

Después de semejante experiencia, se me ocurre pensar que gran parte del éxito se debe al asombroso profesionalismo de las personas de la NASA involucradas. Aquí no sólo los astronautas tienen la buena madera, como bien escribiera Tom Wolfe. Sólo hay una cosa que aún me molesta: ¡nadie en NASA me ha querido decir qué hizo Bruce Willis durante su vuelo en el KC-135A!

Angela Posada-Swafford es colombiana nacionalizada en E.U.; colabora en ciencia para Discover, Astronomy, Muy Interesante, The Miami Herald, National Public Radio y Discovery Channel Latinoamérica/Iberia.

El día que lloró el Corsario Negro

DANIEL SAMPER PIZANO

Hace muchos más años de los que estaría dispuesto a reconocer devoré con pasión los libros de aventuras de Emilio Salgari. Casi todos me encantaban. Pero hubo uno, entre todos, que me dejó perplejo, y fue el del Corsario Negro. Recuerdo vagamente que sus primeros capítulos me parecieron muy interesantes, repletos de aventuras y de duelos. Pero que después se desataba una aburridísima historia de dolor y amor que dio el traste con mi interés infantil y me condujo a buscar lecturas más animadas. Hace poco encontré en una librería de viejo un tomo ajado de *El Corsario Negro* y, empujado por la nostalgia, me lancé sobre él. Quería saber si podía conmoverme con las peripecias de este personaje tanto como en otros tiempos.

La experiencia, como casi todo lo que se ensaya en busca del tiempo perdido, fue extrañísima: esta vez la parte de aventuras me pareció convencional y floja, y en cambio descubrí unos capítulos extraordinarios cuando el Corsario Negro queda, como Antonio Machado, al fin solo con su corazón y el mar. No digo que las aventuras fueran del todo desdeñables. Hay en particular una larga secuencia en que el Corsario y sus amigos sufren sitio en una casa de Maracaibo, que me hizo evocar la claustrofobia que padecen los personajes de Alvaro Mutis en sus novelas (donde alguna sombra del autor de Sandokán flota). Algún día habrá que escribir sobre la claustrofobia en Mutis y Salgari.

Pero lo realmente interesante era aquella parte que me aburrió tanto cuando estudiaba primaria. *El Cosario Negro* es un realidad un noble italiano, don Emilio de Roccabruna, señor de Valpenta y Ventimiglia, que, por cosas de la vida, termina llevando vida de pirata. Lo mismo ocurre con dos de sus hermanos, que se hacen a la mar como el Corsario Verde y el Corsario Rojo y mueren ambos asesinados por el cruel gobernador de Maracaibo, el miserable flamenco Wan Guld. El Corsario Negro se presenta en el puerto ansioso de rescatar el cadáver de uno de sus hermanos. Logra hacerlo, no sin arriesgar la vida, y zarpa con él en su buque, *El Rayo*, rumbo a las islas Tortugas, sede de los filibusteros. En el camino derrota a una nave española y recoge a una hermosa muchacha holandesa que va a bordo y de la cual queda enamorado: "la única mujer a la que he querido de verdad".

Este viaje de regreso, que me hizo bostezar de niño, me parece ahora una pieza estupenda de literatura romántica. Salgari pinta al Corsario como un personaje atormentado por la pena y el luto, en quien no se sabe qué sobresale más: si el valor o la tristeza. Su hazaña no ha consistido en salvar la vida de sus hermanos, sino en bajarlos de la horca y entregarlos al océano. Poca cosa. Es un juntacadáveres.

Todo en el Corsario concita pesadumbre y estremecimiento. "*El Rayo* avanzaba con la rapidez de una gaviota, hendiendo el agua fulgurante con su agudo espolón. Tan negro como era, parecía el fantasma del legendario y maldito holandés, o el barco féretro navegando por un mar de fuego". Lo del agua fulgurante es porque Salgari pone a *El Rayo* a surcar un mar donde "las crestas de las olas parecían despedir chispas, y la espuma [formando como una franja, proyectaba magníficas fosforescencias". Es un mar que se ilumina de repente por la luz verdosa de los peces. Pero esto sólo ocurre porque se apresta para recibir el cadáver del Corsario Rojo.

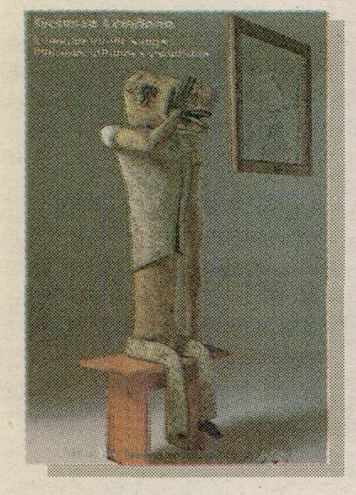
La escena es majetuosa y pone los pelos de punta. Al despuntar el alba, un alba cuyo color "se asemejaba al gris del hierro", El Corsario imparte la orden de arrojar al agua al querido fiambre. El contramaestra y tres marineros lo envuelven en una hamaca lastrada con balas de cañón y lo dejan caer por la borda. "El fúnebre bulto se precipitó entre las olas, levantando un gran salto de espumas que semejaba una llama. Todos los filibusteros estaban inclinados sobre las amuras. A través de las fosforescentes aguas se veía cómo el cadáver descendía al fondo de los misteriosos abismos del mar describiendo grandes ondulaciones". Es una descripción casi cinematográfica hecha por un escritor que se suicidó en 1911.

Minutos antes, frente a su hermano ahorcado, el Corsario convocó a la tripulación y "rompió el fúnebre silencio que reinaba a bordo del buque" para proferir un terrible juramento. "¡Hombres de mar! -grita-. ¡Juro por mi honor, por estas ondas, nuestras fieles compañeras, y por mi alma, que no gozaré de bien alguno sobre la tierra hasta que haya vengado a mis hermanos, si no mato a Wan Guld y extermino a toda su famili, así como él ha exterminado a la mía!" La lealtad a este juramento la habrá de traer varios dolores de cabeza al inconsolable filibustero. En el segundo tomo de la novela ocupa, con enorme despilfarro de vidas, a Maracaibo y Gibraltar (Venezuela), pero se le escapa el gobernador Wan Guld. Y lo peor es que se entera de que esa blanca pálida y adorable que le ha arrebatado el corazón es hija del odiado personaje. Momento poco envidiable: si ha de ser fiel a su juramento de venganza, debe dar muerte a esta mujer que lleva la sangre del maldito; pero ello significa el *sacrificio irremediable de su corazón*.

Al terminar el libro, el Corsario cumple su palabra y ordena abandonar a la muchacha en una chalupa en alta mar y en medio de una tempestad feroz para que se la traguen las olas. Frase final, pronunciada por un ríspido pirata a otro:

-Mira hacia arriba: el Corsario Negro llora.

Para el lector que soy ahora, este final es hermoso y suficiente. Pero sospecho que la historia continúa en otro libro. Hace muchos años debí de haberla leído y disfrutado, pero ahora no recuerdo nada. ¡Voto a Belcebú que la aventura ha vuelto a emocionarme! ¿No habrá un alma caritativa que me diga dónde prosigue, o, por lo menos, cómo termina la biografía de este italiano improbable que peleaba mucho y lloraba poco?



Un artista frente a la violencia

EDUARDO RAMIREZ VILLAMIZAR

Actualmente hay una peligrosa libertad para bien y para mal en los jóvenes artistas, pero no para aquellos que entendieron el llamado que Aracy Amaral hizo desde Brazil en los años 30. servicio Militar obligatorio debe ser la geometría

Cundo contemplamos una escultura de Germán Londoño vemos primero una sabia relación de formas o colores, como una armónica y bella adivinanza controlada por la geometría, pero el artista ha puesto un título y este abre caminos imprevistos a nuestra imaginación, por tanto la solución de esta adivinanza puede ser poética, histórica como en las esculturas que nos mostró en su exposición *Africa* hace pocos años o como estas últimas esculturas, tremenda y aterradora.

Tenemos aquí, otro artista colombiano que con osadía se enfrenta al más peligrosa tema: la violencia. Su obra es un retrato aterrador de la autodestrucción y masacre en que está Colombia con la secreta complacencia de los que obtienen ganancias con este desastre. Para dar la pelea Londoño tiene como armas una gran cultura y un particular dominio del color y la geometría. Formas que parecerían incoherentes se organizan debido al sabio dominio del artista.

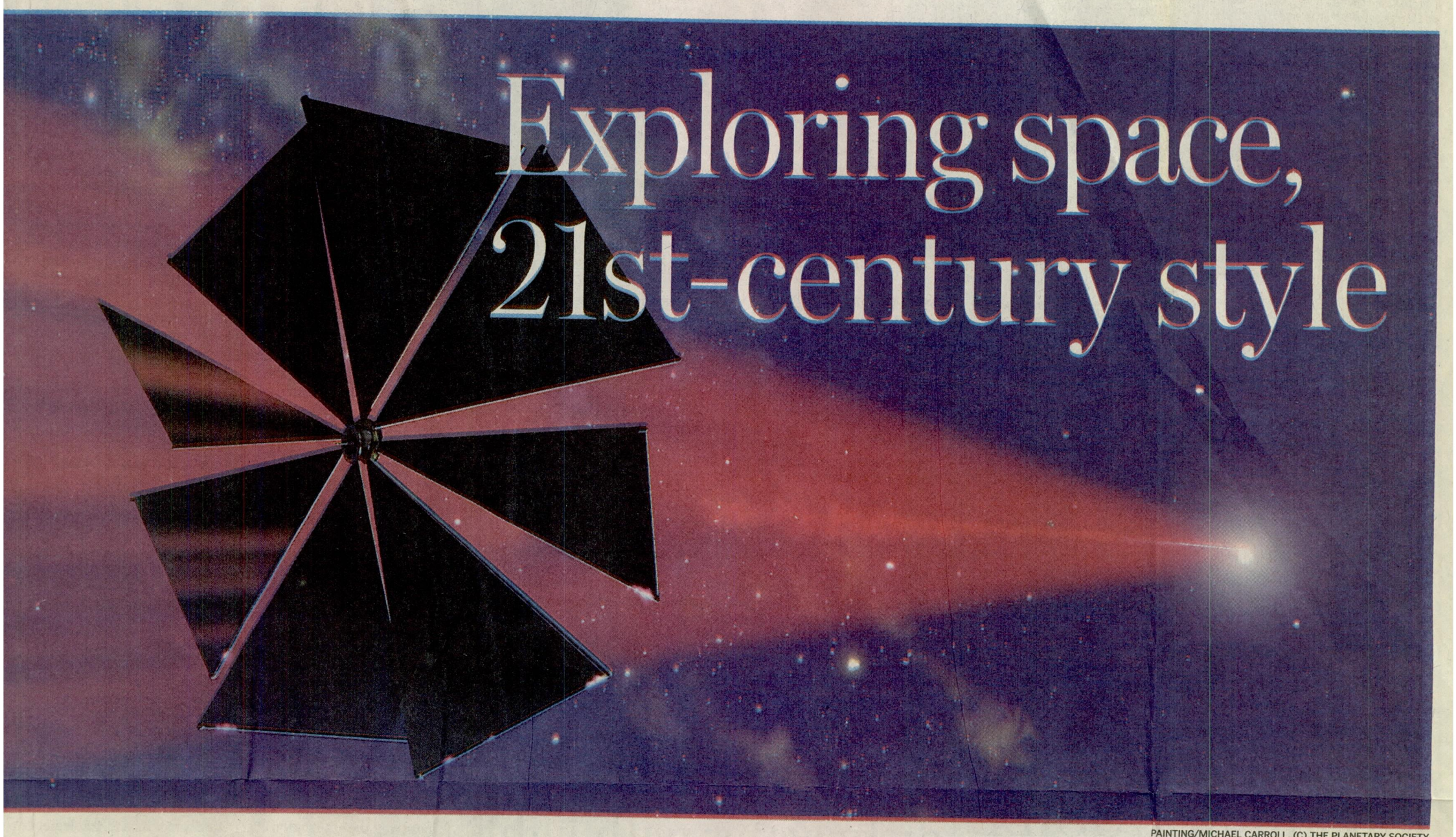
Así, la obra trasciende, pasa al campo del arte, sin caer en la trampa en que han caido algunos de los más dotados y más famosos artistas nuestros.

Londoño se atreve a caminar por el filo de de la navaja. Su talento y su juvenil entusiasmo lo salvaron y lo salvarán mañana. Solo resta saludarlo y continuar admirando sus obras.

Health | Science

THE BOSTON GLOBE TUESDAY, SEPTEMBER 4, 2001

Exploring space, 21st-century style



PAINTING/MICHAEL CARROLL, (C) THE PLANETARY SOCIETY

Enormous "solar sails" propelled by rays of light may one day carry unmanned spacecraft far beyond the solar system. Here, a solar-powered space laser moves a sail.

Using the sun to visit the stars

By Angela Swafford
GLOBE CORRESPONDENT

The future of space travel flutters in a small plastic box bolted to the floor of a plane affectionately known as "the Vomit Comet" for the effect it often has on its passengers.

As the NASA jet flies 32,000 feet above the Gulf of Mexico on a training mission that gives passengers intervals of weightlessness, two MIT aerospace engineering students peer into the box, straining to keep their knees under the harnesses. Tamra Haby and Jennifer Long carefully videotape the behavior of small sheets of carbon fiber material coated with shiny Mylar.

While the windowless aircraft repeatedly dives and climbs 10,000 feet like a roller coaster with 32 precipitous dips, they examine their carefully folded samples, hoping one will unfurl flawlessly in weightless conditions, without a single wrinkle.

Their quest: To find a fabric that will present a smooth surface for the sun's rays to push in the same way that the wind pushes a sailboat. Though the pressure exerted by sunlight is imperceptible on Earth, light rays are potent in the frictionless vacuum of space: They are the reason that the tails of comets always point away from the sun.

Solar sails eventually could serve as a propulsion system that requires no fuel, saving NASA money, and allowing space probes to get farther and faster than ever before.

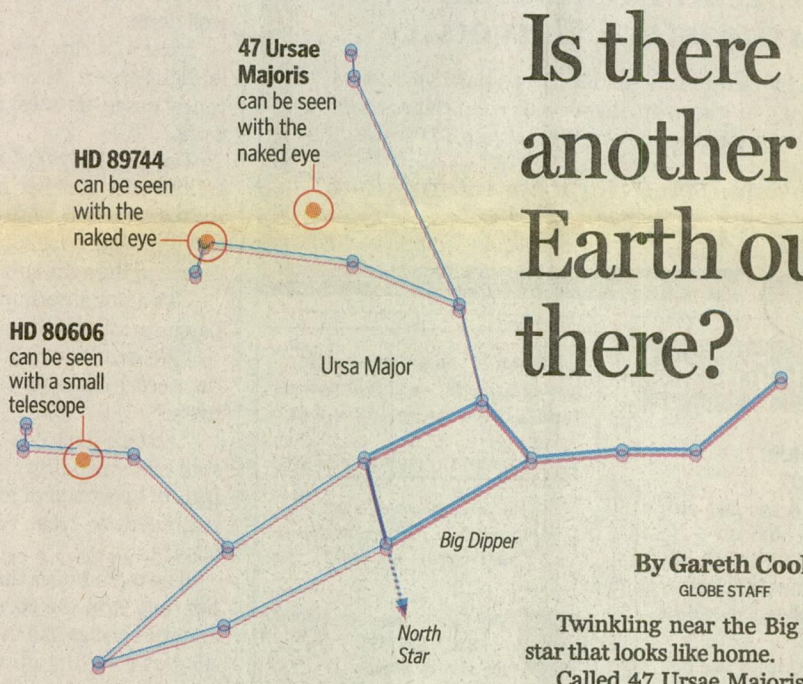
Although conventional chemical-powered rockets would still be needed to

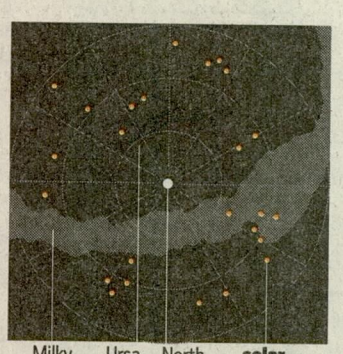
SOLAR SAIL, Page C3

PHOTO/LOUIS FRIEDMAN, (C) THE PLANETARY SOCIETY

Engineers examine a sail from Cosmos 1 (above), scheduled to become the first solar sail in space. MIT aerospace engineer Jennifer Long (below) conducts a solar sail experiment aboard NASA's KC-135A plane, which simulates zero gravity.

PHOTO/ANGELA SWAFFORD





We are not alone

Since 1995, astronomers have identified roughly 70 stars with planets orbiting them but researchers know nothing about their geography or climate except that most of them are enormous and unlike Earth. At least three of the newly discovered solar systems – HD 80606, HD 89744 and 47 Ursae Majoris – are visible to the naked eye or through a small telescope. NASA's Terrestrial Planet Finder satellite may be able to describe their landscape and weather.

GLOBE STAFF GRAPHIC/SEAN McNAUGHTON

Is there another Earth out there?

By Gareth Cook
GLOBE STAFF

Twinkling near the Big Dipper is a star that looks like home.

Called 47 Ursae Majoris, this member of the Great Bear constellation is similar in size and chemical composition to Earth's life-giving sun. And, astronomers found last month, the star has two planets sweeping around it, in orbits that are close to perfect circles, just as the Earth moves around the sun.

The finding was important because, until now, most newly identified solar systems feature planets traveling in highly skewed orbits, coming within scorching proximity of their stars and then rocketing great, icy distances away from them — conditions hardly conducive to life. But the objects revolving around 47 Ursae Majoris, or in other similar systems, could be rocky planets, too small to detect with current technology, very much like our own blue planet.

But the finding of a new solar system was also significant for how unremarkable it was — just another solar system to add to the list. For decades, astronomers hoped to find just a single solar system organized like our own, with a star at the center and planets revolving around. Now, since the first extrasolar planet was found in 1995, astronomers

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Using solar sails, scientists hope to see other worlds

▶ **SOLAR SAIL**
Continued from Page C1

get vessels into orbit, solar sails could be invaluable in space for adjusting position and trajectory.

"Solar sails give a very low thrust, but they can work continuously, pushing spacecraft faster and faster," explained Charles Garner, a senior engineer at the Advanced Propulsion Technology group at NASA's Jet Propulsion Laboratory in Pasadena, Calif. Ultimately, he said, a solar sail can move the spacecraft even faster than a chemical rocket.

Garner was formerly part of NASA's New Millennium Program, which is designed to identify, develop and flight-validate advanced technologies that can lower the costs of future science missions. The program has played an important role in renewing interest in solar sails, which were first thought of in 1886 by two French science-fiction writers. Then, in 1924, Russian scientist Konstantin Tsiolkovsky proposed that large spacecraft could be propelled through space using the pressure from light particles. In the same year, other European researchers proposed that the sails be constructed of metalized plastic film, the same material being used in prototypes today.

Just as a sailing vessel uses the wind to push against the surface of its sail, satellites and small robotic spacecraft will use the light particles from the sun — or from other sources of electromagnetic radiation such as an infrared laser — to exert pressure over a surface area, thus pushing it forward.

Getting closer to the sun — in order to receive a bigger push from the photons — is the key for accomplishing things like getting to Pluto in three years instead of the 12 to 15 years that a rocket with chemical propulsion would take, Garner said.

The continuous pressure from sunlight would ultimately accelerate the craft to speeds about five times faster than possible with conventional rockets, without requiring any fuel, he said. At 90 kilometers per second, a solar sail could cover the distance from New York to Los Angeles in less than a minute.

Because the momentum of the photons is so tiny, the sail must be huge and exceedingly light, yet strong; it should be flexible, yet able to maintain its rigidity. Most critically, it must be deployed from a small package without so much disturbance that it knocks the craft off course. Ideally, the sail would be self-deploying to eliminate the need for bulky deployment equipment.

That is precisely what the material — flown for the first time in microgravity by the MIT students — is like. Developed by Energy Science Laboratories Inc. in San Diego, the fabric is a delicate mesh composed of a network of carbon fibers so thin that one hundred of them would make up a strand the size of a human hair.

"Imagine a very tiny jungle gym made up of carbon fiber bars," said Energy Science's president, Tim Knowles. "The whole thing is very flexible and, since it is mostly air, you can squeeze it a lot without breaking or creasing it. It is 50 times lighter than a sheet of paper yet rigid enough that you can pick up a piece at one corner and the sheet will not bend."

The material is coated with a shiny, heat-resistant material, allowing it to withstand temperatures of up to 4,500 degrees Fahrenheit and allow it to get relatively close to the sun, Knowles said.

Other groups are also working to develop solar sails.

The Planetary Society, created by the late astronomer Carl Sagan, in conjunction with the Russian Space Research Institute, is developing a large sail made up of eight triangular blades, with a total area of 1,800 square feet and a radius of about 45 feet.

In mid-July, the society attempted to launch its Cosmos I sail for a sub-orbital test flight, but the Volna rocket failed to send the final command to separate the spacecraft from the upper stage, and the contraption crashed in the Kamchatka Peninsula in Russia.

The Planetary Society has announced that it intends to try again toward the end of the year.

In another attempt at building a solar sail, the German Aerospace Center, working with NASA, is studying the feasibility of a low-cost solar sail demonstration mission to be known as Odissee.

And colleges like MIT, breeding grounds for future aerospace engineers, are also involved in this "solar regatta."

"It is important to study any propulsion system that promises to advance our exploration of space," said Peter Young, senior lecturer in the Aero-Astro Department at MIT. A retired Air Force Colonel, Young's longstanding relationship with NASA's Reduced Gravity Program has given several students the opportunity to fly the fabled "Weightless Wonder," the kinder nickname for the Vomit Comet.

As the KC-135A lands, MIT's Beth Dewell and Lisa Dang rush to greet the flying party. Their turn on board will be tomorrow, and their job will be to test again the ability of their proposed solar sail material to deploy in zero gravity.

"Of course the ideal would have been to do this experiment in the vacuum, but the complexities were enormous," Dewell said.

NASA's Marshall Space Flight Center is picking up the torch where MIT has left it. Next spring, the KC-135A will carry more elaborate samples of the sail in a vacuum, tests that will bring closer the dream of building a spacecraft that can be literally blown by the sun.

NASA's New Millennium Program is setting tentative dates for flight validation programs for three solar sail concepts, Garner said. In the meantime, author Arthur C. Clarke and a private consortium in Virginia are launching a program called Team Encounter 2001 with more definite plans. According to their Web pages, the team is building a 75- by 75-meter solar sail that will carry, in the years to come, a payload consisting of messages, drawings, photographs, and DNA signatures (hair strands) of 3 to 5 million human participants who pay a modest fee and write a poem.

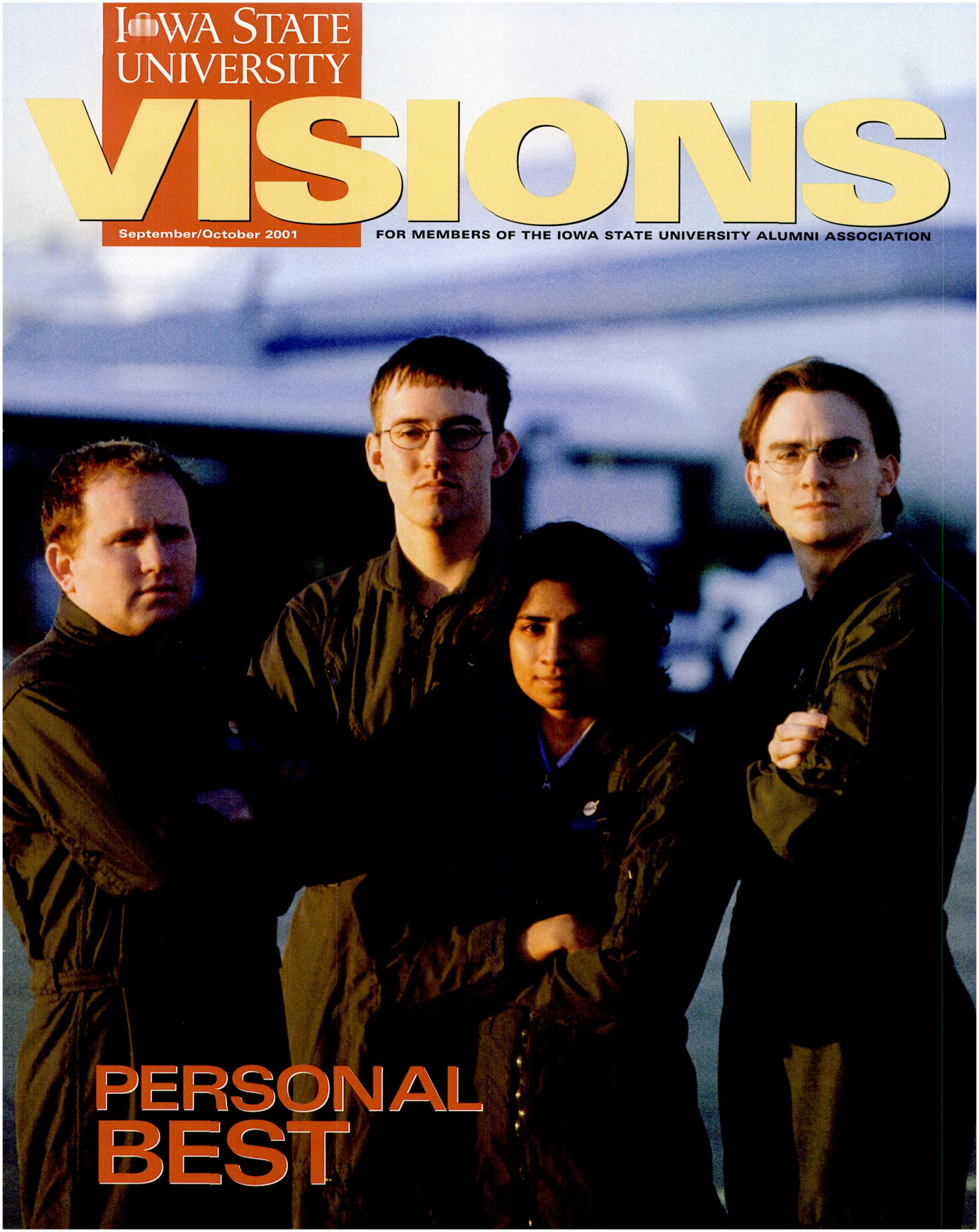
"It has been said that solar sails are the technology of the future," Garner said. "But . . . not long ago people were skeptical of chemical propulsion. Today, we are looking forward to creating a propulsion system that does not use propellant. Now that NASA is onto more challenging missions, we need to unfurl a giant sheet of plastic and make [solar sails] a reality."

IOWA STATE UNIVERSITY

VISIONS

September/October 2001

FOR MEMBERS OF THE IOWA STATE UNIVERSITY ALUMNI ASSOCIATION



PERSONAL BEST

by Carole Gieseke

Ups and downs

"You might have heard of this plane," my friend Joe was telling me. "They call it the vomit comet."

I had NOT heard of a plane called the vomit comet. If I had ever heard of it, I was sure I would have remembered.

"You know that plane," Joe insisted. "Remember the floating scenes in Apollo 13, that movie with Tom Hanks?"

I did. "That's the plane they filmed those scenes in."

Right! I did know that plane. I just didn't know it had such a disgusting nickname.

Well, it turns out that Joe and three of his super-smart engineering pals had the opportunity to fly in that plane – officially the KC-135A – as part of this highly selective reduced-gravity student opportunity program, and they wanted me to tag along and write a story about it. It would be during spring break, he said. In Houston. At Johnson Space Center. You know, NASA and all that. Wouldn't that be cool?

Hmmm. Maybe. It was certainly worth a look. So I typed in the Web address Joe gave me (www.tossyourcookieswiththeastronauts.com) and found this information for "professional journalists" on the Texas Space Grant Consortium's Web page:

"Go to Houston and be a part of the team's 'once in a lifetime' effort to test an experiment of their own design… As a 'team member,' you will also be able to 'mingle' with other teams of students selected to participate, attend social events and experience 'astronaut encounters.'"

Ooh! Mingling AND astronaut encounters. I called Joe back and told him I was in. He said he'd come over the next morning and give me the scoop. Meanwhile, he said, I should look at the Web site again.

OK, Joe, whatever you say. So I'm clicking through the different sections: About the Program, Competition, Teams, Timeline. Oh, here's an interesting one. There's a graphic of an airplane flying zero-gravity parabolas. Over and over and over. Up, down, up, down, up, down. And I'm literally getting nauseous looking at the screen.

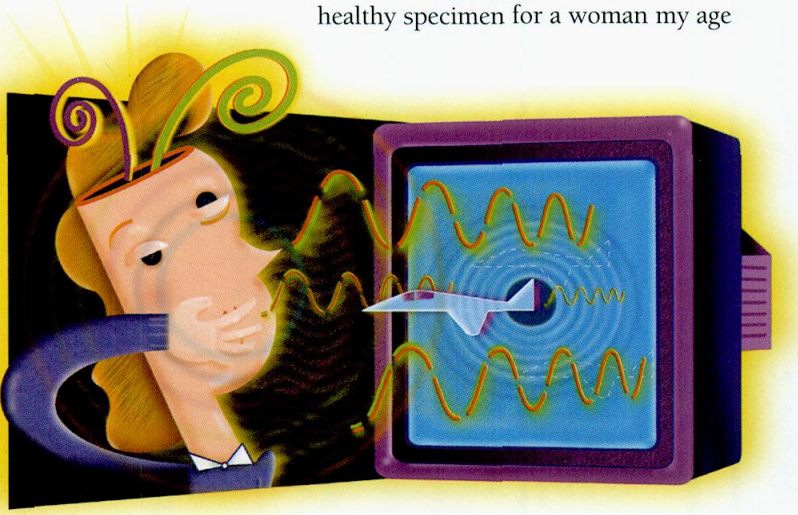
Next morning I tell Joe about this experience. "Carole," he says seriously, "you're not supposed to get sick just looking at it on the Web. Are you sure you want to go through with this?"

I did. I talked VISIONS photographer Jim Heemstra into going with me. I got my official FAA Class III flight physical, which included an EEG and the most elaborate vision exam I'd ever had in my life. (I couldn't figure that out. I wasn't going to fly the plane, just barf in it.) I cleared my press credentials with Johnson Space Center. I cleared my calendar.

As the time to go to Houston got nearer, I started receiving helpful "communiques" about security badges and physiological training and designating my next of kin. Communique #5, my favorite, described how the anti-nausea medication "Scop-Dex" would control "the vomit reflex" triggered by the "roller-coaster-like trajectory" flown by the "K-Bird" (AKA the vomit comet, which we were specifically told not to call it but which everyone calls it anyway.)

By golly, this was going to be exciting!

So we go to Houston and meet up with these four students who are all very bright and academically focused and rumpled and sleep deprived from driving from Ames to Texas. Then I get a phone call from the NASA doctor who wants to know what's the deal with me having asthma. I assure him that my regular doctor who gave me the official FAA Class III flight physical said I was a fine, healthy specimen for a woman my age and that I was absolutely fine to fly, vomit, whatever. The team doc disagreed. No way was he putting me up in that "zero-G bird" with a "chronic respiratory ailment." I was grounded.



So that was the end of my astronaut career.

In retrospect, I think the team doctor was wrong. As I sat in the hangar at Ellington Field, watching the downlink video feed of Joe and the other students bravely conducting their experiment on that bucking horse of an airplane, I had a pretty good idea what would have happened if I had flown with them. I think my asthma would have been fine. I think my sinus condition would have made my head explode, either before, during, or after I tossed everything I'd ever eaten in my entire life into a giant, official, Hefty-bag-sized, NASA-issued barf bag on about the third parabola.

I was so grateful to that team doctor that I wanted to give him a hug. ■

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IOWA STATE UNIVERSITY
VISIONS
FOR MEMBERS OF THE IOWA STATE UNIVERSITY ALUMNI ASSOCIATION

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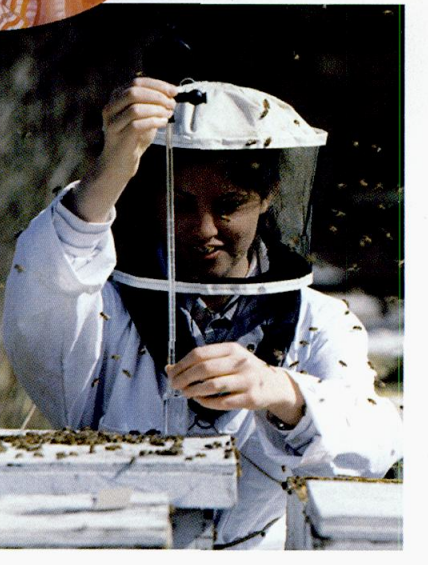

Cover Story

Personal best

Iowa State students are embarking on a lifetime of becoming their best.

by Karol Crosbie and Carole Gieseke

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Getting things done on Capitol Hill

Three successful Iowa Staters share their strategies.

by Karol Crosbie

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Editor: Carole Gieseke
Associate Editor: Karol Crosbie
Photography: Jim Heemstra
Design: Mauck+Associates
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VISIONS is published in January, March, July, and September for members of the Iowa State University Alumni Association. Visit the Association Web site at www.isualum.org. Send address changes to ISU Alumni Association, Alumni Suite, Memorial Union, 2229 Lincoln Way, Ames, Iowa 50014-7164 or e-mail alumni@ iastate.edu. Advertisers: For ad rates please call 515-294-6515.
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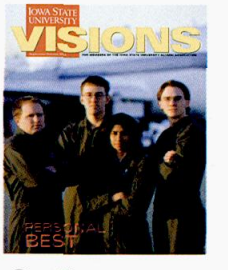

On the cover:
Last March, four engineering students participated in NASA's Reduced Gravity Student Flight Opportunities Program at Johnson Space Center in Houston. Photo by Jim Heemstra

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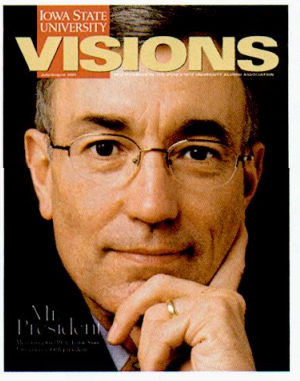
letters



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Camp Marston revisited

Being a Marston Gold Medal awardee in 1992, I read with a great deal of interest your recent article ("Camp Marston: An Iowa State Treasure in Minnesota's Backwoods, *July/August 2001*). Does anybody at ISU know about Camp Dodge 1946 and ISU Freshman Engineering? I was one of this group. We lived in barracks, ate in the mess hall, and went to classes in connected barracks at the National Guard Camp Dodge just north of Des Moines for one year. As I recall, we were about 700 freshmen in engineering off campus at Camp Dodge. How many graduated four years later? I did. I don't suppose there are many of us left.

— Allen Acheson, '50
Kansas City, Missouri

"I have never forgotten Rainy Lake and that campsite. It will always hold special memories for me."

Although the letter from H.A. Leermakers on page 20 is interesting, I highly doubt that the Asian Tiger Mosquito pictured with the letter (an exotic species, recently imported into the southern United States) was there to welcome him. Perhaps an indigenous species such as the treehole mosquito (Aedes triseriatus) was the cause of his discomfort.

To an entomologist, it's like picturing black bears in the arctic instead of polar bears.

I know, I know ... no one noticed but me.

— John VanDyk
ISU Dept. of Entomology

I am writing to share our joy of seeing our Camp Marston story retold after 50 years. [I remember] that lots of visitors got stranded on Rainy Lake. I should explain that "lots of visitors" means three or four about every two or three years. It was hard to get there, and most folks had lived rough enough lives; they didn't need new experiences. I suppose Mother or the camp cook got pretty worried when the grocery supply ran down.

We plan to go to Ranier for a Dodds family reunion in August. We expect to go up the lake as far as Kettle Falls.

— J. Parry Dodds, '39, '40
Fresno, California
Son of the late Jack Dodds, Camp Marston director

My father, Professor W.L. (Pop) Foster, was, along with Professor Jack Dodds, one of the inaugural leaders of Camp Marston. Starting in 1927, our family – my mother, two brothers, and I – would join my dad at Camp Marston to spend the last half of the summer there. Even though I was only 5 years old in 1927, those memories are very vivid. For the next six years it was an annual event in my life.

We saw the camp grow progressively each year from just tents to a series of cabins, each of which bore names. All those cabins were built by the students themselves, but the combination kitchen and dining room was skidded to the Browns Bay site over the heavy ice cover on the lake during winter months. It was secured from a nearby abandoned lumber camp, as was the computation building.

We as a family always stayed in the Polaris Cabin after the students had departed. It was the nicest cabin and is the one shown on your title page of the Camp Marston article.

I have visited with several of the alumni of the Rainy Lake camp who all say the same thing: "This was the most valuable experience of my life, and I learned more than you can get out of books. I will never forget it!"

My father was killed in a tragic automobile accident while he was on his way to make a speech at the 1934 American Society of Civil Engineers conference in Chicago. I was 11 years old. In the summer of 1935, the Iowa State campers erected a flagpole near the end of the camp peninsula. It was founded on native rock, and a small brass plaque was fitted into the base. The monument was dedicated to the memory of my father, and the plaque read: "Walter L. Foster, teacher, woodsman and friend, 1882-1934."

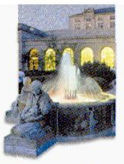
I have never forgotten Rainy Lake and that campsite. It will always hold special memories for me.

— Jim Foster, '46
The Woodlands, Texas

Football on film?

My father, Charles K. Hill (1904-1987), played quarterback on the Cyclone football squad in the seasons of 1923-24-25, in the same backfield with the Behm brothers (and in at least one season with Jack Trice in the line). Were those players ever captured on movie (newsreel) film? The ISU Athletic Department reports that it does not have any motion-picture footage of the footballers from that entire decade, unfortunately.

But knowing that "movies" were being shot



Marketing yourself

Career Insights

by Amy Williams, '98

American workers will have eight to 10 jobs in their working lives. Ten percent of the U.S. workforce switches jobs each year. What does this mean to you? It means that if you are not currently seeking a new job or starting a new career, there's a good chance that you might be in the near future. In fact, a national survey by career services firm Lee Hecht Harrison found that more than 25 percent of America's workforce explored a job change in 1999.

Sell yourself

In this fast-paced world of career change, your best preparation for the future is learning to market yourself. Just as in marketing a product or service, the most important aspect of self-promotion is to broadly identify your competitive advantages (i.e., your skills and interests). Don't sell yourself short when making this list! Start by writing all of the activities you enjoy and narrow it down to determine jobs best suited for your abilities.

Once you have targeted your dream jobs, the next step is to develop a strong résumé. Think of a résumé as your personal advertisement – you only have seconds to make an impression on your audience, so you must show them your unique skills as quickly and succinctly as possible.

While it is important to include your education and training in a résumé, remember that this not only includes formal education but also any professional training you have gained. Think about the seminars you attended or on-the-job training you received. Be sure to list those experiences which would be valuable in your new job.

Network, network, network!

The old saying, "It's not what you know, it's who you know," still holds true in today's workplace. While it will not land you that dream job, networking will get your foot in the door and make you stand out from the stack of applicants.

Networking simply means to collaborate and converse with others, both professionally and personally. Your peers act as a network to help you work through challenging issues. This same group can be just as helpful when seeking a new job opportunity. Professional associations, community groups and social clubs are great ways to develop peer relationships. Job openings are often announced at these gatherings or filled through selective phone screenings of people within the network.

The home stretch

When you go for that final interview, remember to exude confidence. Be sure to have researched the company so you can interview them while they interview you. This not only puts you more at ease, it also gives you more insight into the organization and shows a level of interest that will set you apart. Most importantly, know your résumé inside and out.

If you have done your homework and marketed yourself effectively, you'll be well on your way to a new career.

Amy Williams is a business partner in human resources for the Iowa Health System. She is a 1998 ISU graduate in speech and communications.

On the Web

ISU Alumni Association Career Services: Developing a strong peer network: www.isualum.org/go/career

ISU Career Placement Services: Information from Iowa State's college placement offices: www.public.iastate.edu/~career_info

Iowa Smart Career Move: Information on career opportunities in Iowa: www.smartcareermove.com

Career Journal: Career news, statistics and advice: www.careerjournal.com

Task force formed to evaluate space needs

More than 120 years ago, offices of the fledgling Iowa State Alumni Association were housed in Alumni Hall. In 1928, the Association relocated to the Memorial Union. Since that time, the number of graduates served by the Alumni Association has increased dramatically, and the services provided by the Association have continued to expand.

Today, the ISU Alumni Association is still housed in the Memorial Union, and the organization is pushing the limits of its space, which has been historically shared with the ISU Foundation. In May of 2001, the Board of Directors formed a facility feasibility task force to begin looking into future space needs and options for the Association. The committee involves board members, staff members, a university liaison, a student, and alumni at large. The committee will assess space issues, staff and alumni needs, and location.

The ISU Foundation conducted a similar review and recently announced its plans to move to a new location south of the main campus on Elwood Drive.

Watch for updates in future issues of VISIONS.

PERSON

INQUIRING GROWING ASPIRING COMPETING LEARNIN

PHOTOS BY JIM HEEMSTRA

One of Iowa State's most oft-heard phrases these days is "engaging students." But the fact of the matter is, they engage us! We are inspired, as we watch them simultaneously compete and collaborate – pursuing their own personal best and building connections with peers, professors, and alumni. As we highlight their accomplishments in the coming year, there is much to be proud of. Undergraduates are making new inroads in the world of scholarly research, as illustrated by the following stories about four engineering students who contributed to NASA's experiments in zero gravity, and a zoology student whose name appears on a patent for a new bee insecticide. Students are also using their undergraduate experience to discover truths about themselves and help bring out the best in their peers, as illustrated by our story about an industrial engineering sophomore.

Expanding, seeking, and exploring, Iowa State students are embarking on a lifetime of becoming their best...

AL BEST

LEADING UNDERSTANDING DISCOVERING **BECOMING**

IOWA STATE UNIVERSITY

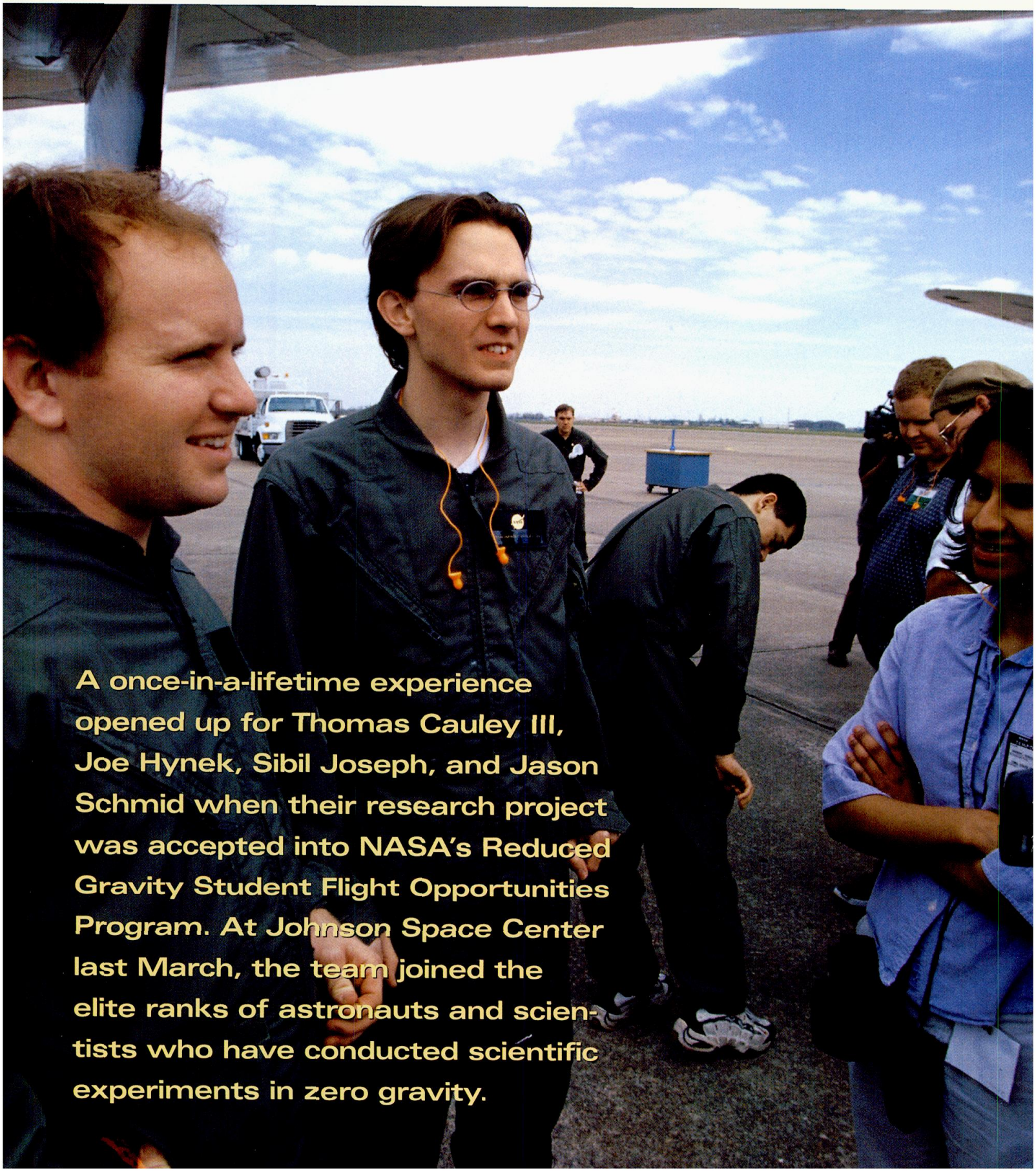
Students are in the spotlight this year as Iowa State focuses its university-wide theme on "challenging students to become their best."

"Iowa State has a lot to be proud of in terms of the accomplishments of our student body and the services the university provides for them," said Thomas Hill, vice president for student affairs. "We are challenging students to become their best. More importantly, Iowa State students are stepping up to meet the challenge."

The yearlong student focus will include lectures by Nobel Peace Prize recipient Lech Walesa and others, community visits, building dedications, and special events. As part of the celebration, VISIONS will highlight student programs and achievements in each issue during the 2001-2002 academic year.

SEEKING A SO

EXPANDING T



A once-in-a-lifetime experience opened up for Thomas Cauley III, Joe Hynek, Sibil Joseph, and Jason Schmid when their research project was accepted into NASA's Reduced Gravity Student Flight Opportunities Program. At Johnson Space Center last March, the team joined the elite ranks of astronauts and scientists who have conducted scientific experiments in zero gravity.

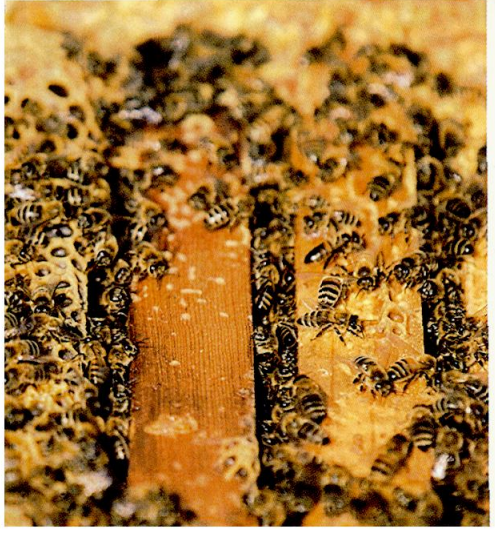
work with Coats at Iowa State, where he serves as a mentor for her Honors Program research project. Graduate student Justin Frodnitzky has also been involved in the project.

International recognition

Four successful compounds emerged, and Carol is co-owner of a patent filed by the ISU Research Foundation for a natural insecticide for the varroa parasite. The compounds reduce the mite population in tested settings by about 60 percent in the preliminary field tests. Improved delivery techniques and timing are the goals for her next project.

Carol has received multiple international awards and has been invited to present her research to scientific audiences in London, Japan, and Germany. In October 2000, she received the grand award of the Worldwide Young Researchers for the Environment Competition, in which she competed against 140 young scientists from 73 countries. This summer, she completed an internship in southern Germany with the Nestlé Corporation. Her research and international awards have gained her media attention from *USA Today,* the *New York Times, Good Morning America, London Financial Times, Ladies' Home Journal,* and the *American Bee Journal.*

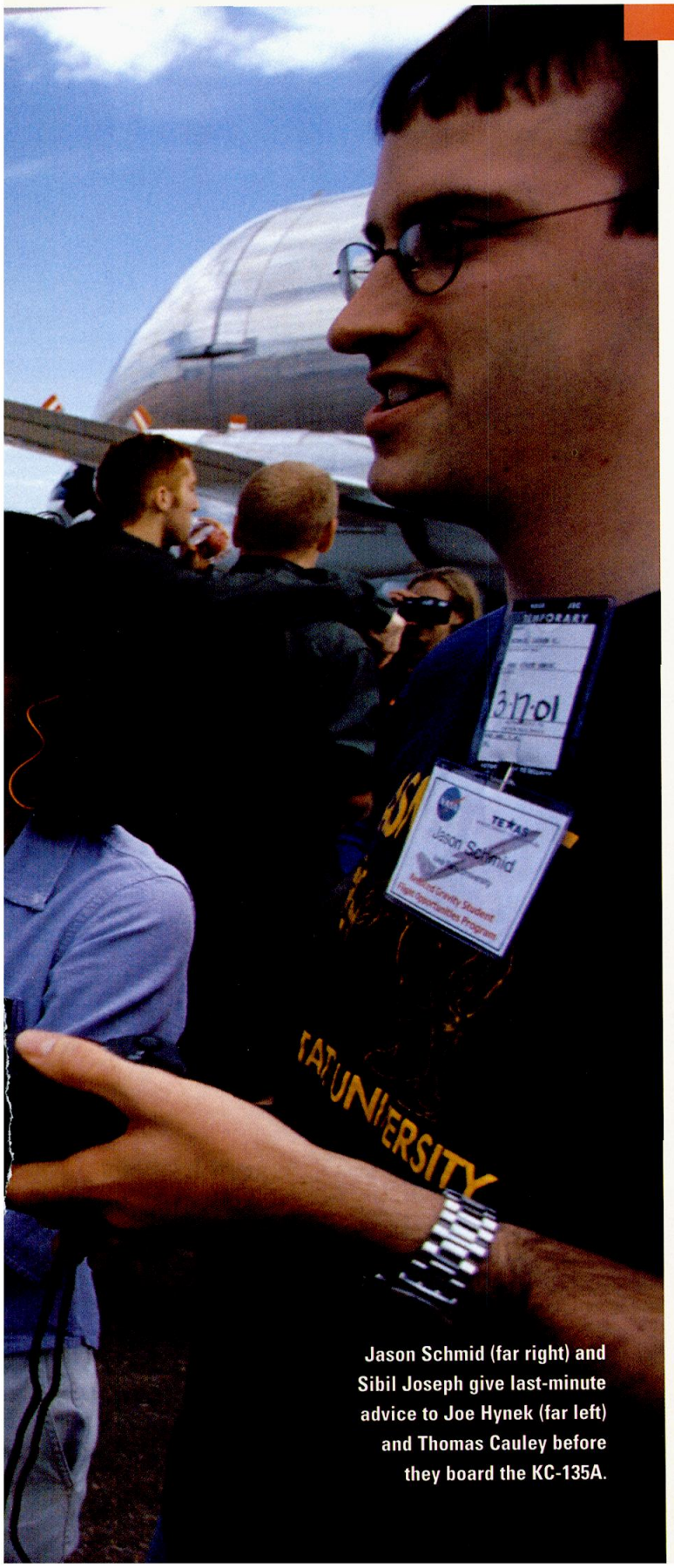
Growing up on a bee farm of 2000 hives, Carol Fassbinder has been involved in every aspect of beekeeping. Helping her family eliminate the scourge of bee mites was her motivation for researching and developing a successful insecticide.



Since she has been at Iowa State, Carol says her own personal philosophy regarding the natural world has grown stronger. Guided by parents and a childhood that reinforced the interconnectedness of life, and by new ideas gained from classes that explored the works of environmentalist philosophers, Carol says she has a new understanding about herself.

"Mainly in the past year, I realized something. I love nature. This work that I have done with the honey bees has been my own attempt to preserve one part of nature. There is no task that is more important."

HE UNIVERSE



Jason Schmid (far right) and Sibil Joseph give last-minute advice to Joe Hynek (far left) and Thomas Cauley before they board the KC-135A.

BY CAROLE GIESEKE

The hangar at Ellington Field is eerily quiet. The constant shriek of jet engines has subsided, and small groups of scientists and engineers are speaking in hushed tones.

Four Iowa State students are working wordlessly, with the intensity that only an impending deadline can create. Jason Schmid and Joe Hynek are filling a tank with water, checking carefully for leaks. They look at each other, nodding. The seal holds. Seconds count. Hynek still needs to reprogram the computer before the demonstration can begin. Across the table, Thomas Cauley III is frantically scrawling mathematical notations onto a yellow legal pad – last-second recalculations for a last-minute design change. Sibil Joseph is preparing the workspace, storing tools and supplies, and removing the debris that has accumulated in the four days since they arrived in this hangar. There has been little time for appearances, but now time is running out.

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"All right. Well, our experiment is to determine if acoustic radiation pressure can knock small bubbles off of these two faces here." He points at small metal plates inside the tank that his team members have just filled with water. "One is a polished surface; the other is a sand-blasted surface. That's to simulate various surfaces within tanks or pipes."

The inspectors nod. How does it work?

As Cauley explains the experiment, the inspectors question every surface, material, and movement. How much heat will it produce? How will the data be recorded? What do the students expect to observe? How many people does it take to operate the system? What if both operators get sick? Is it automated?

Cauley is confident. "I can go over the operation procedures, and Joe will demonstrate while I describe."

EXPANDING THE UNIVERSE

Hynek crouches into position, and Cauley explains the process.

The inspectors continue to question. How sharp are the corners? Will the "shaker" be wearing gloves? How much does this thing weigh? How is the spring system constrained? Where will the camera be mounted?

One member of the inspection team has taken notes. "So what I have down is there's an issue with the ventilation. We might ask you to put some screening on it. And you need to be wearing gloves."

"Other issues?" There are none. "Sounds good. Thank you very much. North Carolina, you're up next."

The relief on the faces of the Iowa State team is immense. "We passed with flying colors."

"They told us that we're about to join a small group of people in the world who have experienced weightlessness. There are only three planes in the world that do the parabolic maneuvers. So we're going to be in a league with the astronauts."

– Joe Hynek

The road to Johnson Space Center

Last March, Iowa State's four-person zero-gravity team was part of NASA's Reduced Gravity Student Flight Opportunities Program. The program has been operating at Johnson Space Center since 1995 to provide educational experiences and to involve students in research areas of interest to NASA.

Key to the program's success has been the allure of the KC-135A reduced-gravity aircraft, a military version of the Boeing 707. Dubbed the "vomit comet" because its flight patterns induce a vomit reflex in many passengers, the zero-G plane gained exposure in the mid-'90s when it was used to film the weightless flight scenes in the film *Apollo 13*. University teams involved in the student flight program experience up to 40 brief periods of weightlessness as the aircraft performs parabolic maneuvers over the Gulf of Mexico. During each period of reduced gravity, student teams conduct experiments in a unique, weightless condition not available to earth-bound researchers.

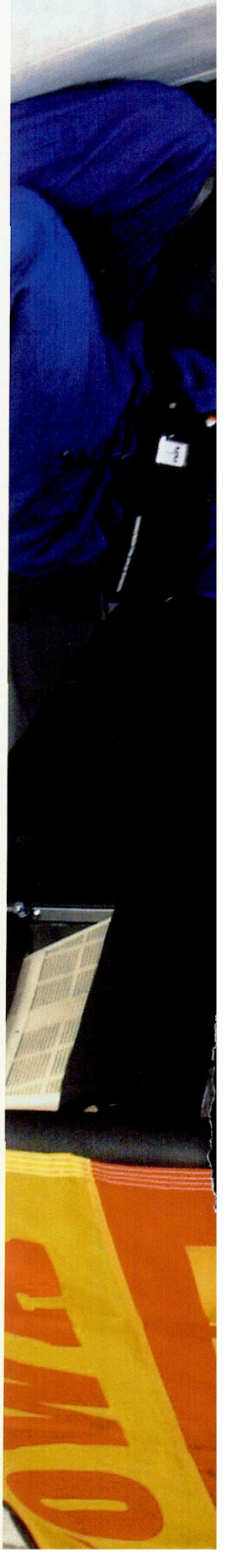
Hynek first learned about the program last fall, and he rallied Cauley, Schmid, and Joseph to form a team. Hynek's experience in computer engineering complemented the background of the other team members, all mechanical engineering majors. The team decided to design an experiment that would reflect their interests and have applications for the space program. They knew that NASA would be evaluating their project for its investigation of novel or interesting phenomena and on its scientific merit.

"We went idea shopping around the university," said Schmid. "We asked everyone we knew if anyone at Iowa State was working with microgravity."

The group ended up with a project that would study the phenomena of acoustic manipulation of objects in water. Research applications could be applied to mixing and separating particles in liquids and to removing air bubbles from fuel in space.

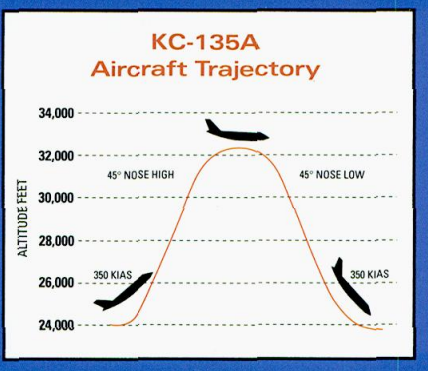
On Dec. 15, the team's application was accepted for the spring 2001 Reduced Gravity Student Flight Opportunities Program.

"When we heard about our acceptance into the NASA program, we were just thrilled," said Hynek. "I immediately called up the Iowa Space Grant Consortium and told them we had just been accepted. It was the same day that they were having a meeting to allocate funds. They ended up giving us a $6,000 grant."



Thomas Cauley and Joe Hynek are exhilarated as they experience weightlessness for the first time. Behind them is Drew Nash, a 1998 ISU graduate who works with NASA's reduced gravity program.

PHOTO COURTESY OF NASA



The closest thing to being in space

Called the "weightless wonder," NASA uses the KC-135A to train astronauts and test equipment for orbit. Zero gravity is achieved by flying a specific parabolic trajectory to provide brief periods of weightlessness. Flying at an altitude of 24,000 feet over the Gulf of Mexico, the plane flies up at a 45-degree angle, over the top, and then down at 45 degrees in a free fall that lasts for about 25 seconds on each flight's 30-40 parabolas. The free-fall that gives passengers the feeling of weightlessness is followed by a brief, heavy feeling of 1.8 times normal gravity as the plane pulls through the bottom of the arc. The constant switching from zero G and 1.8 G often makes people queasy, earning the KC-135A the nickname "vomit comet."

Since 1959, the Johnson Space Center's reduced-gravity program has provided a weightless training environment for researchers. Originally used solely for astronaut training, the KC-135A has recently been used to provide other researchers (NASA, government, academic, and commercial) with an opportunity for testing reduced-gravity experiments. The Texas Space Grant Consortium administers the program.

In addition to the Iowa Space Grant Consortium funding, the students received financial support from the ISU Mechanical Engineering Department and from a number of individuals and companies in Ames.

"Whenever we mentioned NASA and described what we were doing, people were very willing to give us money and supplies," said Cauley.

At Ellington Field

In mid-March, the team traveled to Ellington Field at Houston's Johnson Space Center. Before taking their project aboard the KC-135A, they had to assemble the 230-pound steel frame, which would eventually hold 200-plus pounds of electronic equipment. They had to cover and seal the water tank, program the computer, and add padding to every edge of the frame. Everything had to be tested and retested.

But meanwhile, the team had to prepare itself to ride on the "zero-G bird." Each of the 13 participating teams went through safety briefings, motion sickness videos, physiological training, and a ride in the oxygen chamber.

The day before the Iowa State team's first flight (each team flew its experiment twice), NASA inspectors conducted their Test Readiness Review, and the experiment was loaded onto the KC-135A.

From the outside, the KC-135A looks like an ordinary 707, but the interior looks nothing like a commercial aircraft. A few seats remain at the rear of the plane, but the cargo area is open, covered floor to ceiling with white foam padding. Straps and rings are provided to tie down people and equipment.

After being loaded onto the plane, ISU's experiment was bolted securely to the floor. The team made last-minute adjustments to the computer, mounted the video camera, and hung an Iowa State banner. Before leaving Ellington Field, the team was fitted with flight suits and issued airsickness bags.

Drew Nash (center) debriefs Joe Hynek and Thomas Cauley following their flight.

'It's good to see Cyclones down here'

The Reduced Gravity Student Flight Opportunities Program has been open to university students across the nation for five years. As of fall 2000, no team from an Iowa university had ever been represented in the program.

ISU alumnus Drew Nash wanted to change that. Nash had been involved in a co-op program with NASA/Johnson Space Center during the summer while he was a student at Iowa State. When he graduated in 1998 with a bachelor's degree in mechanical engineering, NASA hired him full time as a test director for the KC-135A. Nash now works directly with the Reduced Gravity Student Flight program, and last year he told some of his former engineering professors that he thought Iowa State students ought to be involved.

"We first heard about the program because of a letter from Drew Nash," said team member Joe Hynek. "So I went to work thinking about it."

Nash continued to encourage the fledgling ISU team and was clearly proud to have his school represented at Johnson Space Center during the spring of 2001.

"It's about time," he said, wearing a red Iowa State hat with his blue NASA flight suit. "It's good to see Cyclones down here. I want to see them here every year."

The 'weightless wonder'

Flight day finally arrived. In the early-morning light, teams nervously pulled on flight suits, swallowed anti-nausea medication, checked their pockets, took pictures of each other in front of the plane, and gave each other final words of advice and luck.

Teams were divided into flight crews and ground crews. The next day the roles would be reversed. As Hynek and Cauley boarded the plane, Schmid and Joseph remained on the ground, where they watched the KC-135A taxi, lift off, and disappear on the horizon, heading toward the Gulf of Mexico.

Inside an administrative office building, television monitors were set up for the ground crews to watch their team members on a live downlink. Everyone cheered when the plane went into its first parabolic maneuver and students began to float, tumble, and spin. By parabola number three, the students settled down to the business of

running their experiments. By the eighth parabola, some students began to feel the effects of the alternating double gravity and zero gravity on their systems, and airsickness bags were pulled out. Some students became so ill that they were removed from the cargo area and strapped in seats at the back of the plane for the duration of the flight.

Cauley and Hynek were airsick but were able to perform their experiment. During each brief period of microgravity, Hynek shook the water tank and Cauley operated the acoustic transducer. In zero gravity, the bubbles created by shaking the tank hung in the water and were clearly dislodged by ultrasonic waves. "We can see the bubbles being pushed around by the transducer!" Hynek shouted excitedly during the flight. "This is so cool!"

After the plane returned to Ellington Field, John Yaniec, lead KC-135A test director, questioned teams about their experience. Most groups reported "good data." The team from Alabama had a tough time since one team member spent the entire flight lying on the floor. An Arizona State team member projectile vomited on his partner, causing a chain reaction of airsickness on the plane.

After the reports, Yaniec told flight crews to relay information to their teammates who would be flying the next day.

"If you did anything that was a failure – if some of the things didn't work the way you planned – you learned something," he said. "None of you has experienced working in the microgravity environment before, so it's a learning experience. I've had people with multi-million-dollar packages on the aircraft and nothing worked, but they learned, and they came back. So pass the information on to your teams, and tomorrow will be an even better day for the research."

Cauley and Hynek were visibly weak from the flight, but enthusiastic about the experience.

"It was pretty awesome," said Hynek. "You don't realize at first what's happening when it switches to free floating. I pushed off with my feet and just shot up to the ceiling. It was really neat. During the first three parabolas we just kind of jumped around, then we got serious and started doing the experiment."

"It's hard to describe," said Cauley. "The biggest thing is that when you get back on land, earth gravity feels funny." In retrospect, Cauley and Hynek agreed that the experiment would have been easier to administer in zero gravity if it would have been fully automated. Simple manual tasks became laborious aboard the KC-135A.

"But I think even though this was our first year here, the experiment we chose and the way it ended up was top caliber," Cauley said. "It was on par with all the other experiments on the plane."

An Iowa Stater in the pilot's seat

Just four pilots are certified to fly NASA's KC-135A zero-gravity airplane. One of them is Stephanie Wells.

Wells, a 1975 ISU graduate, spent 10 years as a KC-135A co-pilot before becoming pilot-in-command. She was one of the first women accepted for flight training by the U.S. Air Force after graduating from Iowa State with a degree in meteorology. She was an Air Force weather officer and flew Desert Storm missions and other overseas assignments before joining NASA in 1986 as a staff pilot.

As a NASA pilot, Wells trains pilot astronauts and flies the KC-135A. She's enthusiastic about the Reduced Gravity Student Flight Opportunities Program.

"It's awesome," she said. "It's a heck of an opportunity. It's time consuming, and there's competition, but there's a real good chance to get into the program."

Meeting with the Iowa State team in March, Wells told the students that although flying the KC-135A isn't particularly dangerous, it's different than flying "straight and level."

"You approach the maximum speed on every maneuver," she said. "The risk is getting too 'nose-down' and getting too high a speed and too high a G pulling out. That's probably the biggest danger of it."

So how did she learn the KC-135A's special parabolic, zero-gravity inducing maneuver?

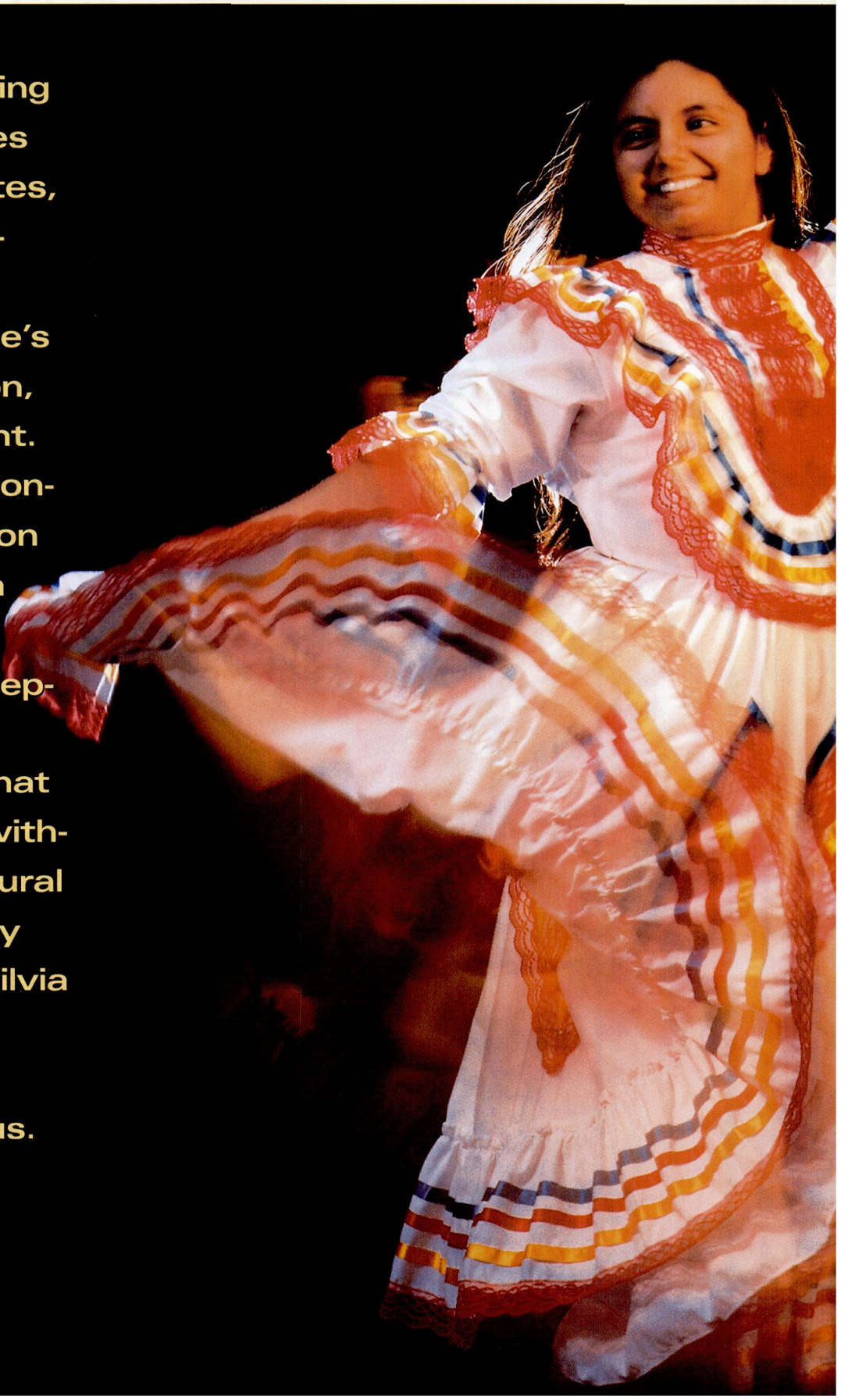
"I just went up and did it," she said.

Iowa State students meet with Stephanie Wells, a 1975 ISU graduate, on their first day at Johnson Space Center. Wells is one of only four pilots currently certified to fly the KC-135A.

On the Web
Johnson Space Center
For further information, see www.jsc.nasa.gov/

EXPLORING A

The fastest-growing group of minorities in the United States, Latinos still represent a very small part of Iowa State's student population, at only 1.5 percent. The melting-pot concept of assimilation is giving way to a different way of thinking about keeping alive cultural traditions. But what happens when, within a minority, cultural traditions are very different? ISU's Silvia De La Cruz helps support other Latinas on campus.

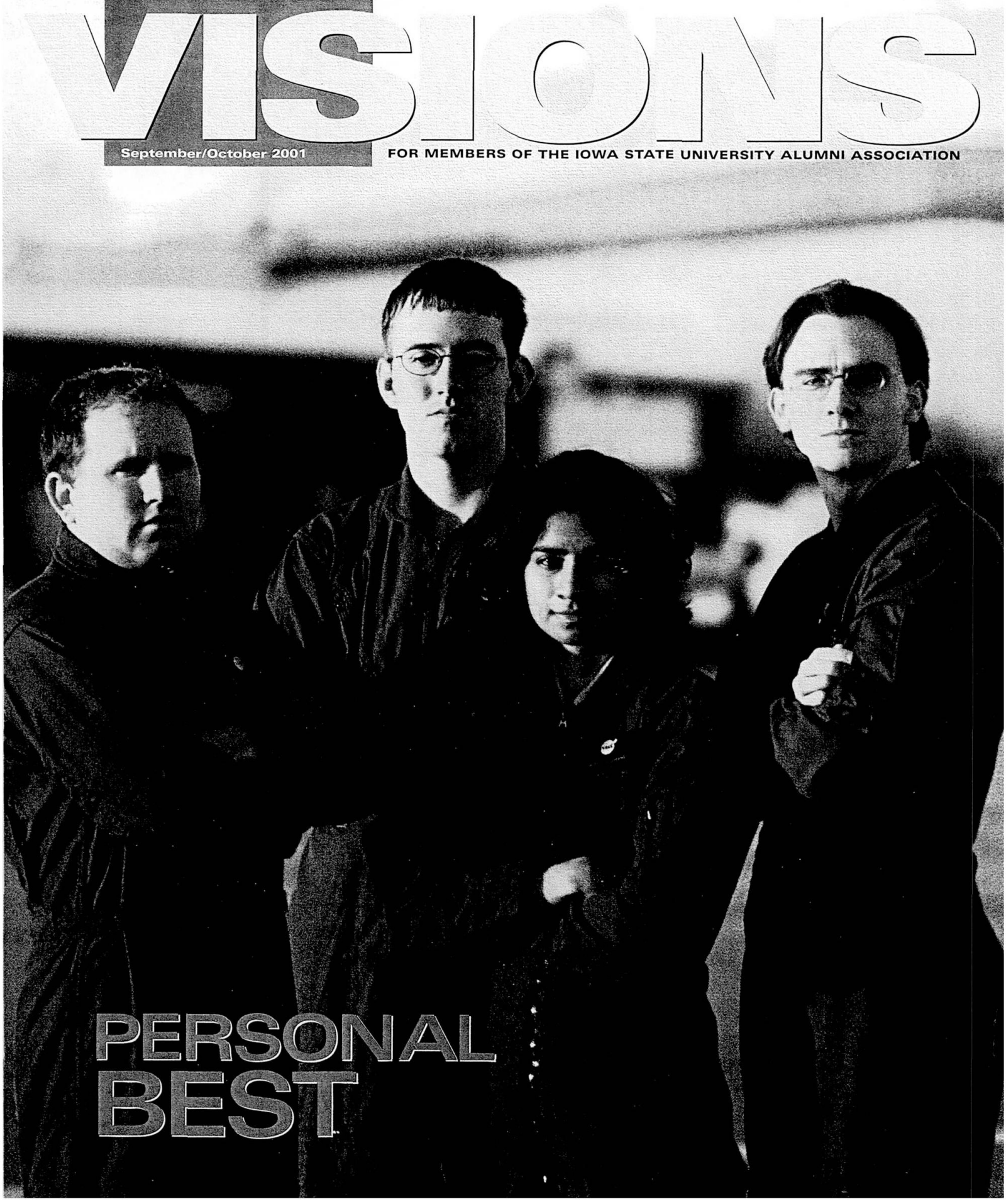


IOWA STATE UNIVERSITY

VISIONS

September/October 2001

FOR MEMBERS OF THE IOWA STATE UNIVERSITY ALUMNI ASSOCIATION



PERSONAL BEST

THE UNIVERSE

BY CAROLE GIESEKE

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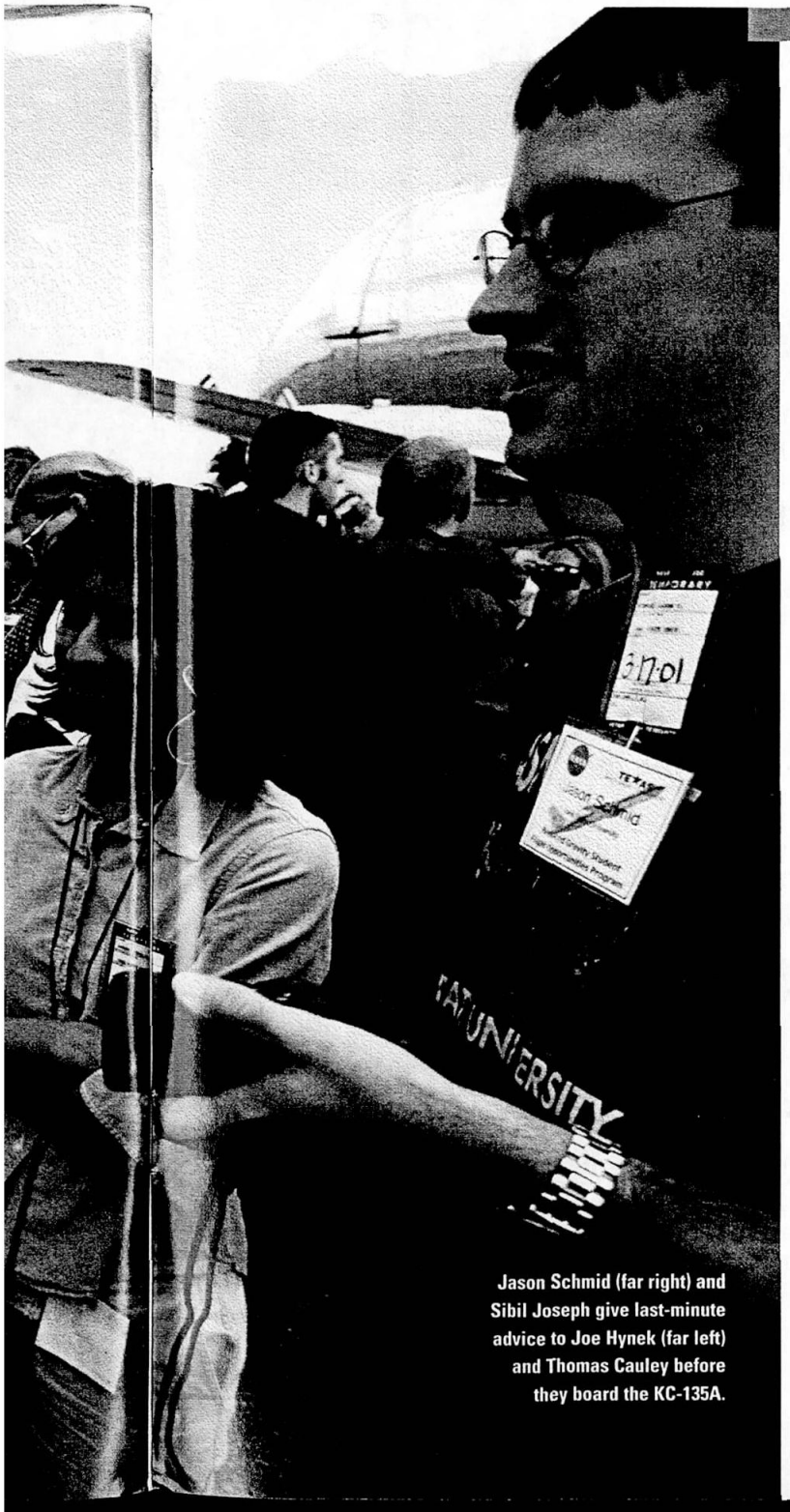


Jason Schmid (far right) and Sibil Joseph give last-minute advice to Joe Hynek (far left) and Thomas Cauley before they board the KC-135A.

Hynek crouches into position, and Cauley explains the process.

The inspectors continue to question. How sharp are the corners? Will the "shaker" be wearing gloves? How much does this thing weigh? How is the spring system constrained? Where will the camera be mounted?

One member of the inspection team has taken notes. "So what I have down is there's an issue with the ventilation. We might ask you to put some screening on it. And you need to be wearing gloves."

"Other issues?" There are none. "Sounds good. Thank you very much. North Carolina, you're up next."

The relief on the faces of the Iowa State team is immense.

"We passed with flying colors."

"They told us that we're about to join a small group of people in the world who have experienced weightlessness. There are only three planes in the world that do the parabolic maneuvers. So we're going to be in a league with the astronauts."

– Joe Hynek

The road to Johnson Space Center

Last March, Iowa State's four-person zero-gravity team was part of NASA's Reduced Gravity Student Flight Opportunities Program. The program has been operating at Johnson Space Center since 1995 to provide educational experiences and to involve students in research areas of interest to NASA.

Key to the program's success has been the allure of the KC-135A reduced-gravity aircraft, a military version of the Boeing 707. Dubbed the "vomit comet" because its flight patterns induce a vomit reflex in many passengers, the zero-G plane gained exposure in the mid-'90s when it was used to film the weightless flight scenes in the film *Apollo 13*. University teams involved in the student flight program experience up to 40 brief periods of weightlessness as the aircraft performs parabolic maneuvers over the Gulf of Mexico. During each period of reduced gravity, student teams conduct experiments in a unique, weightless condition not available to earth-bound researchers.

Hynek first learned about the program last fall, and he rallied Cauley, Schmid, and Joseph to form a team. Hynek's experience in computer engineering complemented the background of the other team members, all mechanical engineering majors. The team decided to design an experiment that would reflect their interests and have applications for the space program. They knew that NASA would be evaluating their project for its investigation of novel or interesting phenomena and on its scientific merit.

"We went idea shopping around the university," said Schmid. "We asked everyone we knew if anyone at Iowa State was working with microgravity."

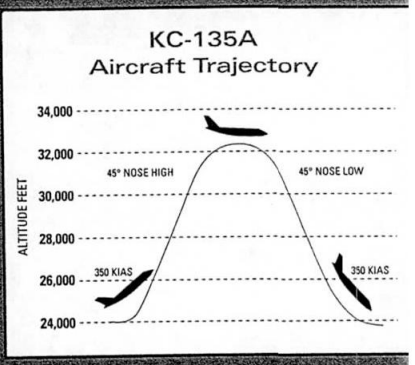
The group ended up with a project that would study the phenomena of acoustic manipulation of objects in water. Research applications could be applied to mixing and separating particles in liquids and to removing air bubbles from fuel in space.

On Dec. 15, the team's application was accepted for the spring 2001 Reduced Gravity Student Flight Opportunities Program.

"When we heard about our acceptance into the NASA program, we were just thrilled," said Hynek. "I immediately called up the Iowa Space Grant Consortium and told them we had just been accepted. It was the same day that they were having a meeting to allocate funds. They ended up giving us a $6,000 grant."

Thomas Cauley and Joe Hynek are exhilarated as they experience weightlessness for the first time. Behind them is Drew Nash, a 1998 ISU graduate who works with NASA's reduced gravity program.

PHOTO COURTESY OF NASA



The closest thing to being in space

Called the "weightless wonder," NASA uses the KC-135A to train astronauts and test equipment for orbit. Zero gravity is achieved by flying a specific parabolic trajectory to provide brief periods of weightlessness. Flying at an altitude of 24,000 feet over the Gulf of Mexico, the plane flies up at a 45-degree angle, over the top, and then down at 45 degrees in a free fall that lasts for about 25 seconds on each flight's 30-40 parabolas. The free-fall that gives passengers the feeling of weightlessness is followed by a brief, heavy feeling of 1.8 times normal gravity as the plane pulls through the bottom of the arc. The constant switching from zero G and 1.8 G often makes people queasy, earning the KC-135A the nickname "vomit comet."

Since 1959, the Johnson Space Center's reduced-gravity program has provided a weightless training environment for researchers. Originally used solely for astronaut training, the KC-135 has recently been used to provide other researchers (NASA, government, academic, and commercial) with an opportunity for testing reduced-gravity experiments. The Texas Space Grant Consortium administers the program.

In addition to the Iowa Space Grant Consortium funding, the students received financial support from the ISU Mechanical Engineering Department and from a number of individuals and companies in Ames.

"Whenever we mentioned NASA and described what we were doing, people were very willing to give us money and supplies," said Cauley.

At Ellington Field

In mid-March, the team traveled to Ellington Field at Houston's Johnson Space Center. Before taking their project aboard the KC-135A, they had to assemble the 230-pound steel frame, which would eventually hold 200-plus pounds of electronic equipment. They had to cover and seal the water tank, program the computer, and add padding to every edge of the frame. Everything had to be tested and retested.

But meanwhile, the team had to prepare itself to ride on the "zero-G bird." Each of the 13 participating teams went through safety briefings, motion sickness videos, physiological training, and a ride in the oxygen chamber.

The day before the Iowa State team's first flight (each team flew its experiment twice), NASA inspectors conducted their Test Readiness Review, and the experiment was loaded onto the KC-135A.

From the outside, the KC-135A looks like an ordinary 707, but the interior looks nothing like a commercial aircraft. A few seats remain at the rear of the plane, but the cargo area is open, covered floor to ceiling with white foam padding. Straps and rings are provided to tie down people and equipment.

After being loaded onto the plane, ISU's experiment was bolted securely to the floor. The team made last-minute adjustments to the computer, mounted the video camera, and hung an Iowa State banner. Before leaving Ellington Field, the team was fitted with flight suits and issued airsickness bags.

Drew Nash (center) debriefs Joe Hynek and Thomas Cauley following their flight.

'It's good to see Cyclones down here'

The Reduced Gravity Student Flight Opportunities Program has been open to university students across the nation for five years. As of fall 2000, no team from an Iowa university had ever been represented in the program.

ISU alumnus Drew Nash wanted to change that. Nash had been involved in a co-op program with NASA/Johnson Space Center during the summer while he was a student at Iowa State. When he graduated in 1998 with a bachelor's degree in mechanical engineering, NASA hired him full time as a test director for the KC-135A. Nash now works directly with the Reduced Gravity Student Flight program, and last year he told some of his former engineering professors that he thought Iowa State students ought to be involved.

"We first heard about the program because of a letter from Drew Nash," said team member Joe Hynek. "So I went to work thinking about it."

Nash continued to encourage the fledgling ISU team and was clearly proud to have his school represented at Johnson Space Center during the spring of 2001.

"It's about time," he said, wearing a red Iowa State hat with his blue NASA flight suit. "It's good to see Cyclones down here. I want to see them here every year."

The 'weightless wonder'

Flight day finally arrived. In the early-morning light, teams nervously pulled on flight suits, swallowed anti-nausea medication, checked their pockets, took pictures of each other in front of the plane, and gave each other final words of advice and luck.

Teams were divided into flight crews and ground crews. The next day the roles would be reversed. As Hynek and Cauley boarded the plane, Schmid and Joseph remained on the ground, where they watched the KC-135A taxi, lift off, and disappear on the horizon, heading toward the Gulf of Mexico.

Inside an administrative office building, television monitors were set up for the ground crews to watch their team members on a live downlink. Everyone cheered when the plane went into its first parabolic maneuver and students began to float, tumble, and spin. By parabola number three, the students settled down to the business of

running their experiments. By the eighth parabola, some students began to feel the effects of the alternating double gravity and zero gravity on their systems, and airsickness bags were pulled out. Some students became so ill that they were removed from the cargo area and strapped in seats at the back of the plane for the duration of the flight.

Cauley and Hynek were airsick but were able to perform their experiment. During each brief period of microgravity, Hynek shook the water tank and Cauley operated the acoustic transducer. In zero gravity, the bubbles created by shaking the tank hung in the water and were clearly dislodged by ultrasonic waves. "We can see the bubbles being pushed around by the transducer!" Hynek shouted excitedly during the flight. "This is so cool!"

After the plane returned to Ellington Field, John Yaniec, lead KC-135A test director, questioned teams about their experience. Most groups reported "good data." The team from Alabama had a tough time since one team member spent the entire flight lying on the floor. An Arizona State team member projectile vomited on his partner, causing a chain reaction of airsickness on the plane.

After the reports, Yaniec told flight crews to relay information to their teammates who would be flying the next day.

"If you did anything that was a failure – if some of the things didn't work the way you planned – you learned something," he said. "None of you has experienced working in the microgravity environment before, so it's a learning experience. I've had people with multi-million-dollar packages on the aircraft and nothing worked, but they learned, and they came back. So pass the information on to your teams, and tomorrow will be an even better day for the research."

Cauley and Hynek were visibly weak from the flight, but enthusiastic about the experience.

"It was pretty awesome," said Hynek. "You don't realize at first what's happening when it switches to free floating. I pushed off with my feet and just shot up to the ceiling. It was really neat. During the first three parabolas we just kind of jumped around, then we got serious and started doing the experiment."

"It's hard to describe," said Cauley. "The biggest thing is that when you get back on land, earth gravity feels funny." In retrospect, Cauley and Hynek agreed that the experiment would have been easier to administer in zero gravity if it would have been fully automated. Simple manual tasks became laborious aboard the KC-135A.

"But I think even though this was our first year here, the experiment we chose and the way it ended up was top caliber," Cauley said. "It was on par with all the other experiments on the plane."

An Iowa Stater in the pilot's seat

Just four pilots are certified to fly NASA's KC-135A zero-gravity airplane. One of them is Stephanie Wells.

Wells, a 1975 ISU graduate, spent 10 years as a KC-135A co-pilot before becoming pilot-in-command. She was one of the first women accepted for flight training by the U.S. Air Force after graduating from Iowa State with a degree in meteorology. She was an Air Force weather officer and flew Desert Storm missions and other overseas assignments before joining NASA in 1986 as a staff pilot.

As a NASA pilot, Wells trains pilot astronauts and flies the KC-135A. She's enthusiastic about the Reduced Gravity Student Flight Opportunities Program.

"It's awesome," she said. "It's a heck of an opportunity. It's time consuming, and there's competition, but there's a real good chance to get into the program."

Meeting with the Iowa State team in March, Wells told the students that although flying the KC-135A isn't particularly dangerous, it's different than flying "straight and level."

"You approach the maximum speed on every maneuver," she said. "The risk is getting too 'nose-down' and getting too high a speed and too high a G pulling out. That's probably the biggest danger of it."

So how did she learn the KC-135A's special parabolic, zero-gravity inducing maneuver?

"I just went up and did it," she said.

Iowa State students meet with Stephanie Wells, a 1975 ISU graduate, on their first day at Johnson Space Center. Wells is one of only four pilots currently certified to fly the KC-135A.

On the Web

Johnson Space Center
For further information, see www.jsc.nasa.gov/

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Free-Falling

SCOTT NORR PHOTOGRAPH
NASA/JOHNSON SPACE CENTER

Kim Zinkgraf (left) and Brandon Ross hold on to a truss structure to keep from floating inside the fuselage of NASA's KC-135 laboratory aircraft.

UW engineering students test the limits of their knowledge and experience in microgravity experiments at NASA.

by Heather Feeney

Thirty thousand feet above the Gulf of Mexico, engineering seniors Kim Zinkgraf and Brandon Ross struggle to control their hands and feet while testing construction methods that don't require tools. The carbon-epoxy rods they are assembling into a truss structure look like Tinker Toys, but this experiment isn't child's play.

Zinkgraf's ponytail has come loose, and her long brown hair bobs like tentacles around her head as she works. On the other side of the building platform, Ross has assumed a tentative Superman pose, legs floating out behind him while he tries to hold on and assemble his half of the structure at the same time. Above the roar of jet engines, they remind each other of the sequencing they rehearsed on the ground and discuss ideas for dealing with unanticipated difficulties in flight. They also look like they are having the time of their lives.

Zinkgraf and Ross use pin connectors to secure their structure. Their experiment will be followed by UW engineering juniors Leslie Haug and Pete Radzay, who build the same

artifacts are housed in the British Museum and the Metropolitan Museum of Art in New York City.

"While the objects belong to the British and Metropolitan museums," says Strudwick, who also wrote the accompanying interpretive text for the exhibition, "cultural property like this really belongs to the world."

How did the exhibition find its way to UW? Six years ago former Art Museum director Charlie Guerin, on vacation with his family in England, visited the Highclere Castle's collection of Egyptian materials. While there, Guerin learned that the seventh earl of Carnarvon was married to Jean Wallop, the sister of former Wyoming U.S. Sen. Malcolm Wallop. The serendipitous discovery prompted Guerin to write to the Carnarvons upon his return to the United States and arrange a meeting with them at Highclere Castle. During the visit, he learned more about the fifth earl's collection of artifacts and his keen interest in photography. Guerin also developed an understanding of the importance of patronage in archaeology and other scientific and artistic endeavors, a concept that would form the core of the Carnarvon exhibition.

Lord Carnarvon

HIGHCLERE CASTLE PHOTO

Art Museum Interim Director Susan Moldenhauer says the *Legacy of Lord Carnarvon* is the first exhibition in Wyoming to present Egyptian antiquities and is the first in the United States to recognize Carnarvon's abilities as a photographer. Collectively, the artifacts and photographs open a window into the past, allowing visitors to imagine what it was like to be part of a grand exploration – and to see the results of that labor.

In its first four days, Moldenhauer says, more than 1,200 visitors toured the exhibition.

"This exhibition suggests what the university's Art Museum is capable of doing," she says. "It is truly an extraordinary collection."

Carnarvon might never have discovered such treasures if he hadn't been something of a thrill seeker. He was fond of horse racing and motor cars, Strudwick writes, and as a young man, was more interested in traveling and adventure than in scholarship. In 1903, he suffered injuries in a motor car accident and was advised by doctors to spend the winter in warmer climes, a common prescription during that era for speeding convalescence. Carnarvon went to Egypt, where he developed a passion for excavating and collecting Egyptian artifacts. In 1907, he was given permission to dig in a part of Thebes that purposely was selected to discourage him from pursuing further excavations. After six weeks, the party retrieved only a small coffin with a cat mummy inside. But rather than deter Carnarvon, the experience motivated him to continue his expeditions and eventually enlist the help of Carter.

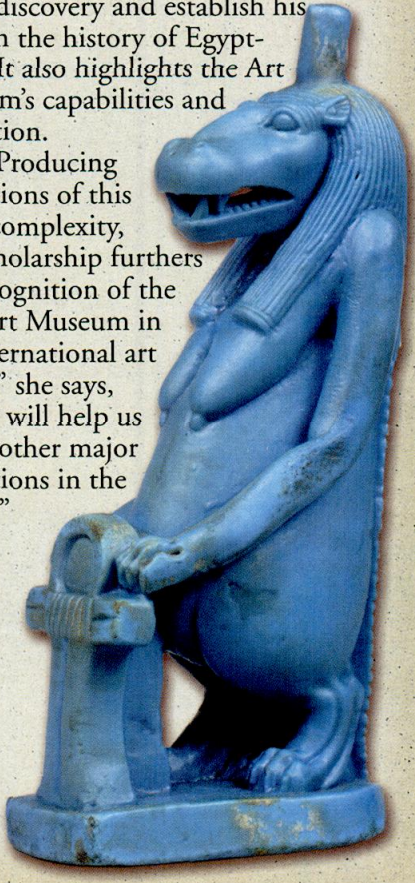
Strudwick writes that their systematic scouring of the Valley of Kings in Thebes, beginning in 1914, led to the discovery of King Tut's tomb in 1922. That breakthrough discovery not only unearthed some 5,000 artifacts, but also at a time when ancient sites often were looted and pillaged, brought about major changes in the way excavations were managed and antiques found and distributed.

c.

The exhibition's photo collection includes several images of the Tutankhamun discovery, including a photo of Carnarvon, Carter, and Carnarvon's daughter, Lady Evelyn Herbert standing inside the tomb, wearing formal dress. For Carnarvon, however, the glory of his archaeological triumph would be short-lived. Within a year after the discovery, he accidentally cut a mosquito bite on his face while shaving, and the wound became infected. Blood poisoning and pneumonia set in, and on April 5, 1923, he died at the Continental Hotel in Cairo.

Carnarvon's death allowed Carter to receive most of the credit for discovering King Tut's tomb. The exhibition, Moldenhauer says, helps to clarify Lord Carnarvon's role in the discovery and establish his place in the history of Egyptology. It also highlights the Art Museum's capabilities and reputation.

"Producing exhibitions of this scale, complexity, and scholarship furthers the recognition of the UW Art Museum in the international art world," she says, "and it will help us secure other major exhibitions in the future."



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(a.) Shabti of Sety I, 19th dynasty, c. 1294-1279 B.C., deep blue faience, with details in black (possibly manganese dioxide), 11.875 inches, originally from the tomb of Sety I in the Valley of the Kings, The Metropolitan Museum of Art, 26.7.919, (b.) falcon inlay, possibly late 30th dynasty or Ptolemaic, c. 380-30 B.C., colored faience, length 11.375 inches, said to be part of a group of inlays from Hermopolis, The Metropolitan Museum of Art, 26.7.991, (c.) serpent, early 18th dynasty, perhaps time of Thutmose I, c. 1504-1492 B.C., bronze, 65.5 x 3.5 x 1.25 inches, found inside the coffin of Mentuhotep in chamber A of tomb 37 in the Birabi, Carnarvon excavations 1911, British Museum, Department of Egyptian Antiquities, EA 52831, (d.) Statuette of Tawere glassy faience, 4.25 x 1.25 inches, said to have been discovered in the district of Qena in the early 1900s, The Metropolitan Museum of Art, 26.7.1193.

structure using ball-and-socket connectors. Comparing experiments shows the young scientists which of the two connectors is easier to manipulate in zero-g.

In March, these four were the first UW students to fly on NASA's KC-135 laboratory aircraft, which carries researchers and astronaut-trainees through brief periods of microgravity, or "zero-g," that simulate the weightlessness of space. They were part of an eight-member student group to propose an experiment for the KC-135, which is based at NASA's Johnson Space Center in Houston. Three other engineering students – seniors Rollston Frangopoulos and Mike Spee and junior Jim Green – comprised the ground crew, with mass communications senior Kassidy Kern serving as student journalist and outreach coordinator.

The UW students' proposal was one of 17 chosen from several hundred submitted to NASA this spring. The four flyers were chosen by lot, but all seven student engineers contributed to the design and ground-testing phases of the project long before the KC-135 ever took flight. The team spent countless hours in the university's engineering machine shop, precision-cutting rods and connectors under the guidance of staff machinists. And two underwater test assemblies at UW's Corbett swimming pool gave students some idea of how it would feel to be weightless and to build something in microgravity using no tools.

"The fact that their project was chosen from among so many demonstrates something important," says Kathleen Harper, project coordinator for the Wyoming Space Grant Consortium at UW, which supported the microgravity project. "It showed these students that they and UW's engineering program are as good as any in the world."

Before taking their turn in zero-g, the UW team visited with astronaut Mike Foreman, who will serve as a mission specialist on a future space shuttle flight. The most exciting aspect of working for NASA, Foreman told the group, is coming to work every day knowing that you're going to make history – and knowing that everyone else at NASA is there for the same reason.

The UW students already sensed they were making history. They planned to unfurl a Wyoming flag and a university banner aboard the KC-135, in the manner of the Apollo astronauts planting the Stars and Stripes on the surface of the moon. And each student described the microgravity project as a once-in-a-lifetime opportunity.

The team's alternate flyer, Mike Spee, may have been most keenly aware of this fact. Spee had to prepare for the flight even though he knew the only way he could fly was if one of the flight crew got sick or injured. Still, he brimmed with enthusiasm when asked about being involved in the project.

"My dad told me that I *had* to do this. He told me, 'Even if it means having to take another semester to graduate, you can't pass this up,'" Spee said. "I'm sure glad I listened to him."

© Krispy Kreme Doughnuts Corp./Illustration Paula Wilson-Cazier

Top to bottom: Ross, Leslie Haug, Pete Radzay, and Zinkgraf. The four were among eight UW students who participated in NASA experiments.

Outside the 'in' crowd

On a rainy evening before the flight, the seven student engineers pressed their faces against the glass at a Krispy Kreme doughnut shop in Houston, watching the intricate process of turning raw dough into a work of art.

Ross, who will begin graduate studies at UW in the fall, first tasted these legendary pastries while living in Florida. Before leaving Laramie he set two goals for his mission in Houston: representing UW proudly on the KC-135 and introducing his teammates to the delights of Krispy Kremes.

Ross grinned as he ushered everyone to the back of the shop, and the expression spread quickly through

the team as they lined up facing the waist-to-ceiling plate glass window along the back wall. Behind this proscenium, the machinery mixed, raised, fried, and glazed the doughnuts. Ross narrated the industrial-looking process in mock-poetic terms: the dough "floats down a river of hot grease," he said, before passing under "a waterfall of glaze."

The workings of these precisely calibrated pulleys, thermostats, and stainless steel parts fascinated this group, even more than the sugar-coated end product. Analyzing how things work is second nature to these future engineers – even off duty. A few nights before the Krispy Kreme excursion, Radzay was floating at the edge of the hotel pool, intently studying the movement of a thumb-size snail. Without knowing it, he may have summed up the profession in a single sentence: "Engineers," he said, "are just so interested in *stuff*."

Civil engineering professor and project adviser Thom Edgar, who grew up in Houston along with the space program, surveyed his students mesmerized in Doughnut Theater and smiled.

"Once you decide you're going to be an engineer," he explained, "you then have to accept the fact that you're also going to be a nerd, that you're never going to be cool and hang with the 'in' crowd. I mean, we are people for whom a debate about the relative merits of Texas Instruments and Hewlett Packard calculators is great conversation."

Two days after their visit to Krispy Kreme, the students would be rewarded for their attention to detail. The science experiment they designed would become part of one of the most amazing machines ever devised, and four of them would experience something fewer than 20,000 people in the world ever have.

Weightless wonder

Galileo was the first person to realize that all objects fall toward earth with the same acceleration when gravity is the only force acting on them. But he lacked the tools to make further experimental observations about such falling objects.

Enter Isaac Newton who invented calculus and formulated experiments to pick up where Galileo left off. He pictured a cannon firing off the summit of a tall mountain. Each cannonball is influenced by two forces: the explosion of gunpowder in the barrel pushes the ball outward (horizontally) while gravity pulls it toward the ground (vertically). In combination, the two forces cause cannonballs to travel in parabolic arcs.

By increasing the amount of force behind the cannonball, Newton theorized, you could make it fall to earth increasingly farther from the cannon. If the firing were forceful enough, the cannonball's arc would be large enough to allow it to fall entirely around the earth without hitting the ground.

But Newton stopped short of asking what it would feel like to be a *person* in orbit. That task fell to Albert Einstein, who had this insight: a person in freefall will not feel his own weight. For his thought experiment, Einstein cast himself as Newton's cannonball. He imagined climbing into a box that closed behind him, leaving him no way to verify whether he was stationary on earth

or if he and the box were accelerating upwards at, say, 32.2 feet per-second per-second (32.2 ft/s^2) – the rate at which objects accelerate due to earth's gravity alone.

If he and the box were moving at this rate, he would feel weightless.

Flying in the KC-135 is like climbing into Einstein's box. The windowless cabin leaves no reference point to the ground. Pilots maneuver the plane through a series of parabolas during which the aircraft and all its contents accelerate at 32.2 ft/s^2, making them weightless in their winged box.

After takeoff the plane climbs to about 24,000 feet. Pilots then take it into a 45-degree "nose-high" climb, ascending to 32,000 feet in about 20 seconds. During this interval, everything and everyone in the cabin experiences two-g's – things feel twice as weighty as on the ground.

At 32,000 feet the pilots level off, throttle the engines back to nearly idle, and push the control stick forward, hurling the plane and every molecule of everything inside through the air at a 45-degree "nose-low" angle. Now under the influence of gravity alone, the plane speeds 32.2 feet per second faster each second the maneuver continues.

In zero-g there is nothing to help stabilize a person's hands and feet. Nor are the periods of microgravity inside the KC-135 really like the few seconds of weightlessness created on some roller coasters. The onset of zero-g is much gentler, so there is no sensation of leaving your stomach somewhere above you as you become weightless.

There is, however, the distinct feeling that if not for the plane's fuselage, you would float upwards forever.

Everything is in freefall – the fuselage, the experiments on board, the fluid in inner ears. Everything inside the plane that isn't secured floats. That's why the UW team spent nearly two full days covering their experiment box with Velcro to keep rods and connectors in place before assembly. It seemed like busywork until the morning when NASA officials reviewed experiments for "test readiness." UW was the last team reviewed, and tension mounted after one university's team was grounded for lack of preparedness. Haug and Zinkgraf paced anxiously, listening for any hints that they had overlooked a flaw in their design. When NASA officials finally arrived at UW's table, they listened closely as Haug presented the experiment. Finding no serious problems, they granted final clearance to fly.

Jim Green and Rollston Frangopoulos suspected that the review team went easy on the group because they were tired and eager to get to lunch. But having observed the review, mechanical engineering Professor Doug Smith suggested instead that the students take due credit for coming to Houston with a good design in the first place.

The right stuff

Isaac Newton once said, "I do not know what I may appear to the world, but to myself I seem to have been only like a boy, playing on the seashore … while the great ocean of truth lay all undiscovered before me."

He was, of course, understating his role in history.

Similarly, to note that UW's zero-g flyers were "only" able to partially assemble their structures downplays their achievement. As several of the students observed, the microgravity program is not only about science; it is also about going beyond personal limits.

"Here on earth … there are not many ways to build things that have not already been discovered," Frangopoulos wrote in the group's final report. "Space is a new frontier. New techniques and new structures will have to be designed. The men and women who work at NASA are pioneers. I only hope that I may work there some day."

Two days after the second flight, UW's eight microgravity researchers returned to Laramie to catch up on homework, study for exams, and line up summer employment. The group's final report to NASA and obligatory post-flight presentations threatened to reduce their Houston trip to a blur of paperwork and PowerPoint slides, remnants of their brush with glory.

But each time they look up into the sky they can remember what it was like to be heroes for a day. ■

New Thinking

In the increasingly competitive world of higher education, UW's integrated marketing campaign helps the university make a name for itself.

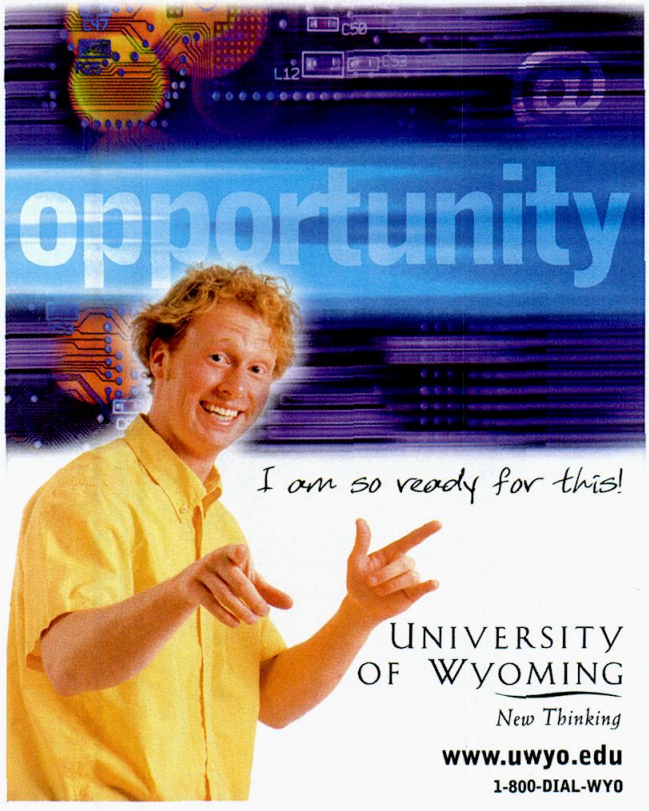
by Jay Fromkin

Branding is hardly a new concept in Wyoming. For generations, ranchers have used distinctive brands to identify their cattle. Over time, the brands came to identify, or stand for, the ranches themselves. Branding also has been a time-honored marketing technique used throughout the business world – Volvo stands for safety, BMW stands for high-performance, Cadillac stands for luxury.

Until recently, colleges and universities have been slow to adopt branding as a way to differentiate themselves from their competitors. That reluctance may derive from a suspicion of marketing practices that are common in the commercial world. After all, how can an institution as complex as a university possibly describe itself with the same verbal and visual shorthand that automobile manufacturers use to give themselves a competitive advantage?

The hard truth is that the higher education market today is much more competitive than the automotive market. Prospective students have more than 4,000 community colleges, four-year colleges, and universities from which to choose. What really differentiates one public university from another? Why should a student choose one school instead of another? How can a university set itself apart from its competitors?

Last fall, the University of Wyoming began the process of establishing a brand for itself that stands for something special within the higher education market. That process relies in part on integrated marketing communications – giving people throughout the university the tools they need to build a distinctive identity for UW in the minds of prospective students, as well as donors and supporters of the university.



"In our over-communicated society, students get bombarded with thousands of marketing messages every day, and it's increasingly difficult for colleges and universities to break through the clutter with their important messages about education," says Bob Brock, president of Educational Marketing Group (EMG), Inc., of Denver, the agency helping UW develop its branding campaign. "Forward-thinking universities such as UW have found that an integrated brand marketing approach allows them to reach their important audiences much more effectively."

The core of UW's integrated marketing communications program is a positioning statement that defines what the university stands for. Historically, that's been a significant challenge. The university is so complex that different UW offices often have described their individual attributes to prospective students without giving them a clear picture of the entire university. Using the results of focus groups conducted with students, faculty, staff, and administrators, UW officials worked with EMG to develop a positioning statement that defines what the university stands for:

The University of Wyoming is a nationally recognized public research university focused on students who seek personalized learning in a Rocky Mountain environment. UW is the perfect size: big enough for great opportunities, small enough for

Free-Falling

SCOTT NORR PHOTOGRAPH

Kim Zinkgraf (left) and Brandon Ross hold on to a truss structure to kee from floating inside the fuselage of NASA's KC-135 laboratory aircraft.

UW engineering students test the limits of their knowledg and experience in microgravity experiments at NASA.

by Heather Feeney

Thirty thousand feet above the Gulf of Mexico, engineering seniors Kim Zinkgraf and Brandon Ross struggle to control their hands and feet while testing construction methods that don't require tools. The carbon-epoxy rods they are assembling into a truss structure look like *Tinker Toys*, but this experiment isn't child's play.

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Zinkgraf and Ross use pin connectors to secure their structure. Their experiment will be followed by UW engineering juniors Leslie Haug and Pete Radzay, who build the same

structure using ball-and-socket connectors. Comparing experiments shows the young scientists which of the two connectors is easier to manipulate in zero-g.

In March, these four were the first UW students to fly on NASA's KC-135 laboratory aircraft, which carries researchers and astronaut-trainees through brief periods of microgravity, or "zero-g," that simulate the weightlessness of space. They were part of an eight-member student group to propose an experiment for the KC-135, which is based at NASA's Johnson Space Center in Houston. Three other engineering students – seniors Rollston Frangopoulos and Mike Spee and junior Jim Green – comprised the ground crew, with mass communications senior Kassidy Kern serving as student journalist and outreach coordinator.

The UW students' proposal was one of 17 chosen from several hundred submitted to NASA this spring. The four flyers were chosen by lot, but all seven student engineers contributed to the design and ground-testing phases of the project long before the KC-135 ever took flight. The team spent countless hours in the university's engineering machine shop, precision-cutting rods and connectors under the guidance of staff machinists. And two underwater test assemblies at UW's Corbett swimming pool gave students some idea of how it would feel to be weightless and to build something in microgravity using no tools.

"The fact that their project was chosen from among so many demonstrates something important," says Kathleen Harper, project coordinator for the Wyoming Space Grant Consortium at UW, which supported the microgravity project. "It showed these students that they and UW's engineering program are as good as any in the world."

Before taking their turn in zero-g, the UW team visited with astronaut Mike Foreman, who will serve as a mission specialist on a future space shuttle flight. The most exciting aspect of working for NASA, Foreman told the group, is coming to work every day knowing that you're going to make history – and knowing that everyone else at NASA is there for the same reason.

The UW students already sensed they were making history. They planned to unfurl a Wyoming flag and a university banner aboard the KC-135, in the manner of the Apollo astronauts planting the Stars and Stripes on the surface of the moon. And each student described the microgravity project as a once-in-a-lifetime opportunity.

The team's alternate flyer, Mike Spee, may have been most keenly aware of this fact. Spee had to prepare for the flight even though he knew the only way he could fly was if one of the flight crew got sick or injured. Still, he brimmed with enthusiasm when asked about being involved in the project.

"My dad told me that I *had* to do this. He told me, 'Even if it means having to take another semester to graduate, you can't pass this up,'" Spee said. "I'm sure glad I listened to him."

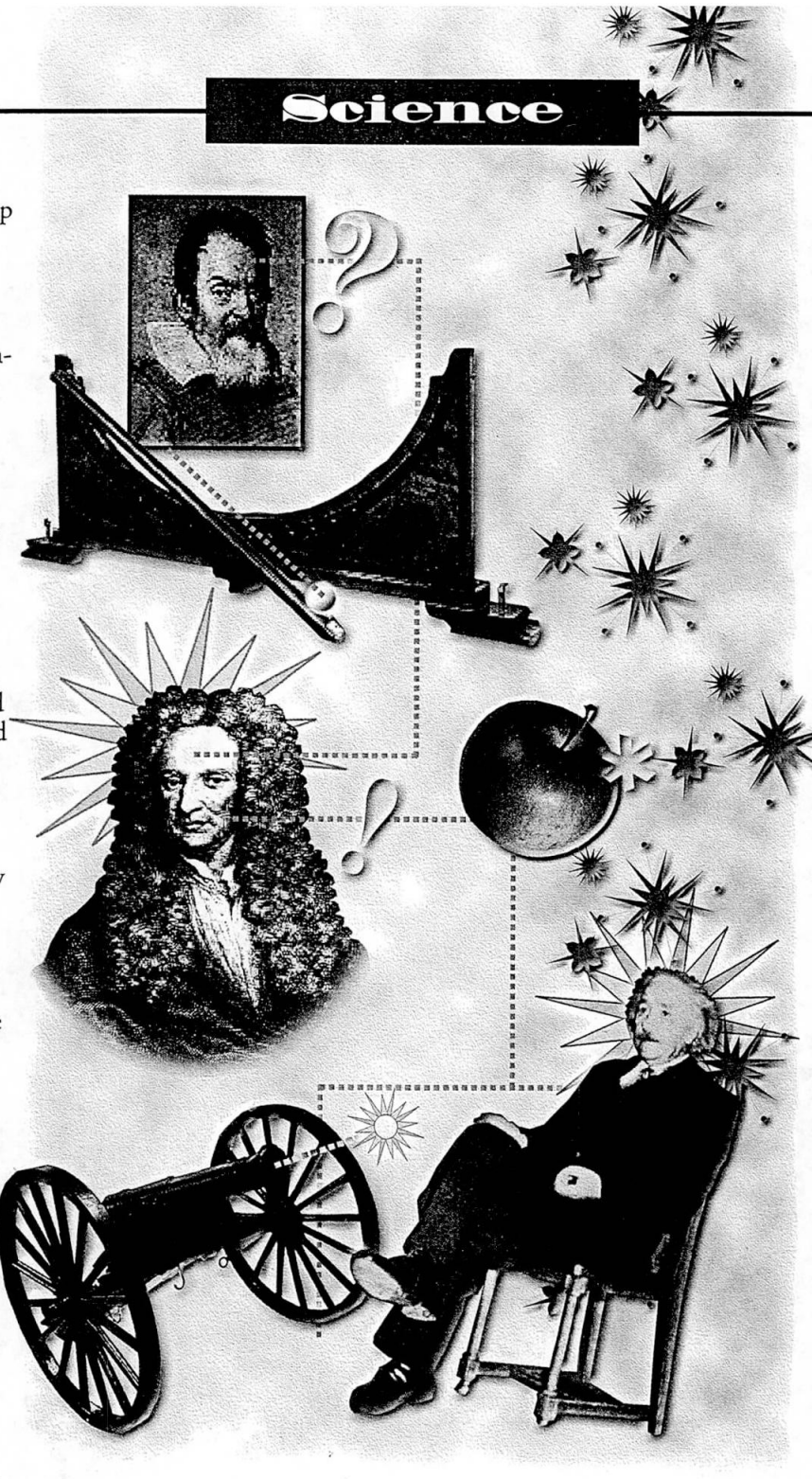
Top to bottom: Ross, Leslie Haug, Pete Radzay, and Zinkgraf. The four were among eight UW students who participated in NASA experiments.

Outside the 'in' crowd

On a rainy evening before the flight, the seven student engineers pressed their faces against the glass at a Krispy Kreme doughnut shop in Houston, watching the intricate process of turning raw dough into a work of art.

Ross, who will begin graduate studies at UW in the fall, first tasted these legendary pastries while living in Florida. Before leaving Laramie he set two goals for his mission in Houston: representing UW proudly on the KC-135 and introducing his teammates to the delights of Krispy Kremes.

Ross grinned as he ushered everyone to the back of the shop, and the expression spread quickly through



the team as they lined up facing the waist-to-ceiling plate glass window along the back wall. Behind this proscenium, the machinery mixed, raised, fried, and glazed the doughnuts. Ross narrated the industrial-looking process in mock-poetic terms: the dough "floats down a river of hot grease," he said, before passing under "a waterfall of glaze."

The workings of these precisely calibrated pulleys, thermostats, and stainless steel parts fascinated this group, even more than the sugar-coated end product. Analyzing how things work is second nature to these future engineers – even off duty. A few nights before the Krispy Kreme excursion, Radzay was floating at the edge of the hotel pool, intently studying the movement of a thumb-size snail. Without knowing it, he may have summed up the profession in a single sentence: "Engineers," he said, "are just so interested in *stuff*."

Civil engineering professor and project adviser Thom Edgar, who grew up in Houston along with the space program, surveyed his students mesmerized in Doughnut Theater and smiled.

"Once you decide you're going to be an engineer," he explained, "you then have to accept the fact that you're also going to be a nerd, that you're never going to be cool and hang with the 'in' crowd. I mean, we are people for whom a debate about the relative merits of Texas Instruments and Hewlett Packard calculators is great conversation."

Two days after their visit to Krispy Kreme, the students would be rewarded for their attention to detail. The science experiment they designed would become part of one of the most amazing machines ever devised, and four of them would experience something fewer than 20,000 people in the world ever have.

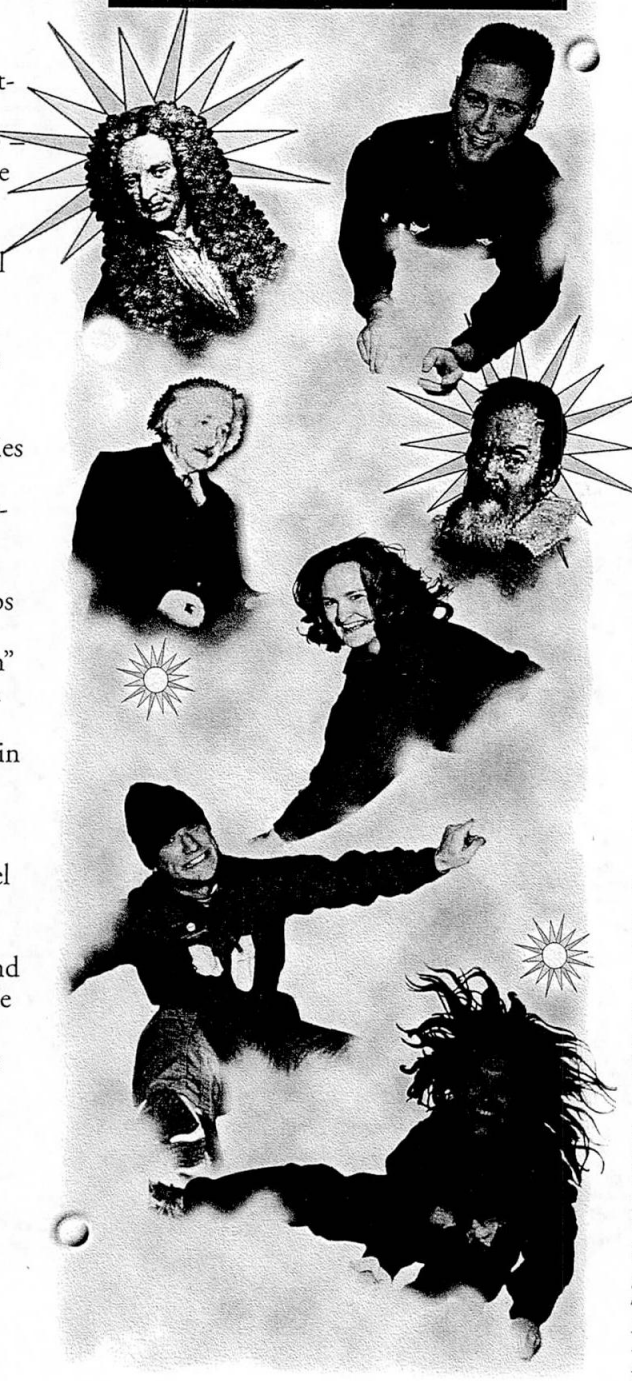
Weightless wonder

Galileo was the first person to realize that all objects fall toward earth with the same acceleration when gravity is the only force acting on them. But he lacked the tools to make further experimental observations about such falling objects.

Enter Isaac Newton who invented calculus and formulated experiments to pick up where Galileo left off. He pictured a cannon firing off the summit of a tall mountain. Each cannonball is influenced by two forces: the explosion of gunpowder in the barrel pushes the ball outward (horizontally) while gravity pulls it toward the ground (vertically). In combination, the two forces cause cannonballs to travel in parabolic arcs.

By increasing the amount of force behind the cannonball, Newton theorized, you could make it fall to earth increasingly farther from the cannon. If the firing were forceful enough, the cannonball's arc would be large enough to allow it to fall entirely around the earth without hitting the ground.

But Newton stopped short of asking what it would feel like to be a *person* in orbit. That task fell to Albert Einstein, who had this insight: a person in freefall will not feel his own weight. For his thought experiment, Einstein cast himself as Newton's cannonball. He imagined climbing into a box that closed behind him, leaving him no way to verify whether he was stationary on earth



or if he and the box were accelerating upwards at, say, 32.2 feet per-second per-second (32.2 ft/s^2) – the rate at which objects accelerate due to earth's gravity alone.

If he and the box were moving at this rate, he would feel weightless.

Flying in the KC-135 is like climbing into Einstein's box. The windowless cabin leaves no reference point to the ground. Pilots maneuver the plane through a series of parabolas during which the aircraft and all its contents accelerate at 32.2 ft/s^2, making them weightless in their winged box.

After takeoff the plane climbs to about 24,000 feet. Pilots then take it into a 45-degree "nose-high" climb, ascending to 32,000 feet in about 20 seconds. During this interval, everything and everyone in the cabin experiences two-g's – things feel twice as weighty as on the ground.

At 32,000 feet the pilots level off, throttle the engines back to nearly idle, and push the control stick forward, hurling the plane and every molecule of everything inside through the air at a 45-degree "nose-low" angle. Now under the influence of gravity alone, the plane speeds 32.2 feet per second faster each second the maneuver continues.

In zero-g there is nothing to help stabilize a person's hands and feet. Nor are the periods of microgravity inside the KC-135 really like the few seconds of weightlessness created on some roller coasters. The onset of zero-g is much gentler, so there is no sensation of leaving your stomach somewhere above you as you become weightless.

There is, however, the distinct feeling that if not for the plane's fuselage, you would float upwards forever.

Everything is in freefall – the fuselage, the experiments on board, the fluid in inner ears. Everything inside the plane that isn't secured floats. That's why the UW team spent nearly two full days covering their experiment box with Velcro to keep rods and connectors in place before assembly. It seemed like busywork until the morning when NASA officials reviewed experiments for "test readiness." UW was the last team reviewed, and tension mounted after one university's team was grounded for lack of preparedness. Haug and Zinkgraf paced anxiously, listening for any hints that they had overlooked a flaw in their design. When NASA officials finally arrived at UW's table, they listened closely as Haug presented the experiment. Finding no serious problems, they granted final clearance to fly.

Jim Green and Rollston Frangopoulos suspected that the review team went easy on the group because they were tired and eager to get to lunch. But having observed the review, mechanical engineering Professor Doug Smith suggested instead that the students take due credit for coming to Houston with a good design in the first place.

The right stuff

Isaac Newton once said, "I do not know what I may appear to the world, but to myself I seem to have been only like a boy, playing on the seashore … while the great ocean of truth lay all undiscovered before me."

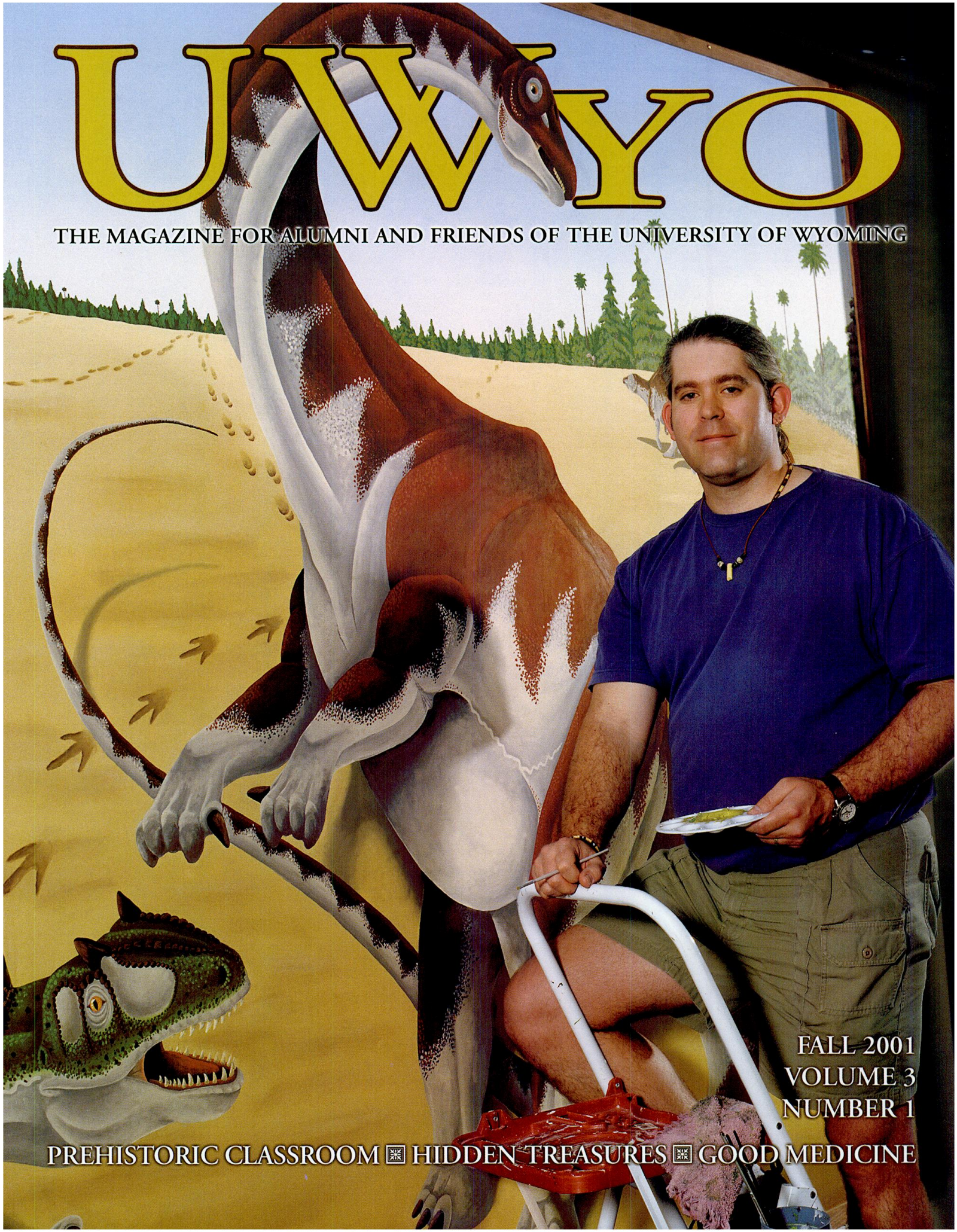
He was, of course, understating his role in history.

Similarly, to note that UW's zero-g flyers were "only" able to partially assemble their structures downplays their achievement. As several of the students observed, the microgravity program is not only about science; it is also about going beyond personal limits.

"Here on earth … there are not many ways to build things that have not already been discovered," Frangopoulos wrote in the group's final report. "Space is a new frontier. New techniques and new structures will have to be designed. The men and women who work at NASA are pioneers. I only hope that I may work there some day."

Two days after the second flight, UW's eight microgravity researchers returned to Laramie to catch up on homework, study for exams, and line up summer employment. The group's final report to NASA and obligatory post-flight presentations threatened to reduce their Houston trip to a blur of paperwork and PowerPoint slides, remnants of their brush with glory.

But each time they look up into the sky they can remember what it was like to be heroes for a day. ■



UWYO

THE MAGAZINE FOR ALUMNI AND FRIENDS OF THE UNIVERSITY OF WYOMING

FALL 2001
VOLUME 3
NUMBER 1

PREHISTORIC CLASSROOM ⊠ HIDDEN TREASURES ⊠ GOOD MEDICINE

Fall 2001

AIAA Student Journal

A Publication of the American Institute of Aeronautics and Astronautics

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The Magnetic Micro-Gravity Mountaineers Fly the Weightless Wonder

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The Magnetic Micro-Gravity Mountaineers Fly the Weightless Wonder

Robert Paczula
AIAA Student Journal Representative

Once, thoughts of human flight were little more than fanciful dreams; however, in 1903 two boys from Ohio proved to the world that sustained powered flight is possible. Today, flying is just another method of travel. Once, the thought of escaping the unrelenting tug of Earth's gravity was simply the fantasy of inspired minds. The actions of pioneers like Yuri Gagarin, Alan Shepard, and Neil Armstrong showed the world that it can be done. While experiencing micro-gravity is not an everyday occurrence for the masses, NASA is providing an opportunity to bring the experience a little closer to home.

Since 1996, over 1,000 undergraduate students and nearly 500 high school students have had the chance to fly on the KC-135A "Weightless Wonder" through NASA's Reduced Gravity Student Flight Opportunities Program (RGSFOP). This year, a talented group of students from the West Virginia University (WVU) Student Branch of AIAA had the privilege of adding their names to the short list of people who have felt prolonged micro-gravity.

Growing up in Ridgeley, West Virginia, Matt Lechliter was always good at math and science and had a passion for airplanes and spacecraft. This drive and ability led him to WVU after he graduated high school. Through its superb aerospace and mechanical engineering programs, WVU provided him with the challenge he needed.

> NASA has provided the opportunity to experience micro-gravity to select students.

Toward the end of the year 2000, Matt came up with a project for his senior year at WVU. Since fluid flow in micro-gravity is of vital importance in space propulsion and many other facets of space flight, Matt devised an experiment to measure the Kelvin forces that act on the surface tension of paramagnetic fluids. Unfortunately, the effect of gravity on the fluid strongly outweighed the effect of even high-powered magnets. Thus the experiment could not be adequately performed under normal conditions.

Matt approached a fellow student, Jennifer Hazelton, and they began to collaborate to figure out how they could get their experiment into a micro gravity environment. Like Matt, Jennifer grew up fascinated with the space program and excelled in math and science. Even as a girl scout, she participated in space camp four times. Between the two of them, they found the solution to their problem—the KC-135A.

Once they realized that it would be possible to get the project into micro gravity, they went to work. Through the RGSFOP Web site, http://jsc-aircraft-ops.jsc.nasa.gov, they began to gather the information they needed to submit their proposal. They invited two other classmates, Austin Barnard and Andrew Starn, to aid them in the project. Like Matt and Jennifer, Austin and Andrew grew up in West Virginia dreaming of high-speed jets, interplanetary satellites, and space stations. The team approached Professor John Kuhlman and Professor Donald Gray, who recognized the drive and desire within this exceptional team of students and lent their support. ➤

Although the images of Tokyo Bay in 1985 and 1995 are virtually identical, utilizing the remote sensing technique the viewer can see the Haneda International Airport's extended runway, the Rainbow Bridge that is newly constructed, a slight decrease in green and the reclaimed land that has become larger in the 1995 image (Figure 6).

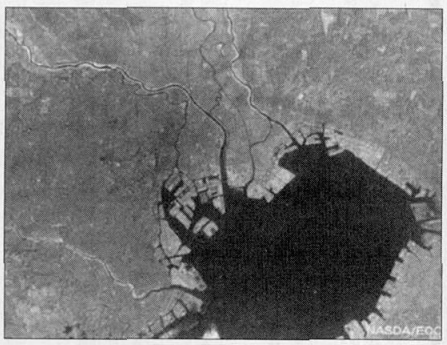


Fig. 5: Tokyo Bay Area 1985.

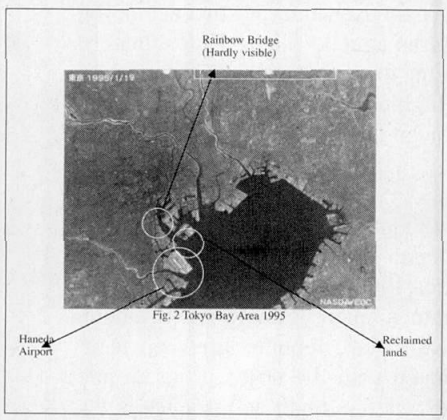


Fig. 6: Tokyo Bay Area 1995.

The future of space development requires more research to be used in practice, but is neccessary in order to sustain life in space.

Model Rocket Competition

A model rocket was handed to each attendee on the first day of the seminar and had to be built prior to the lecture. The rocket used real gunpowder and reached more than 100m above sea level. Attendees were surprised how high they reached (Figures 7 and 8).

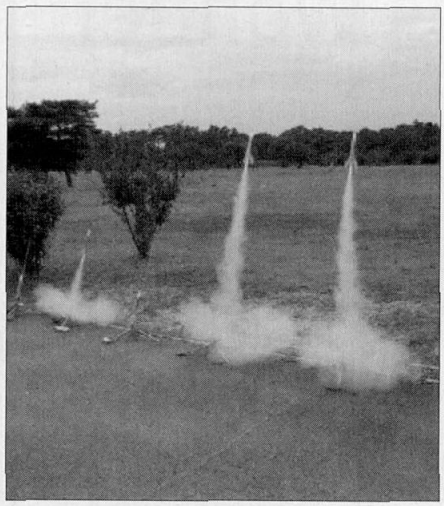


Fig. 7: Model rocket launch.

Fig. 8: Setting up the model rockets.

Space Technologies Needed in the Future

Some of the requirements for the future of space development were discussed. Although each of the areas discussed requires more research to be used in practice, they are certainly going to be necessary when man begins living in space. The figure below shows the lecturer teaching how the space robots are controlled from the ground.

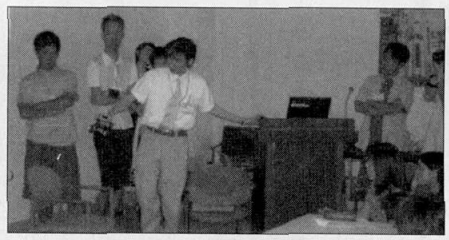


Fig. 9: The instructor showing how the space robots work.

Final Discussions

The attendees were divided into 5 groups and each presented their opinion about what kind of publicity work will be necessary for future space development. Many interesting opinions were presented such as making artificial shooting stars through the use of debris and making a forecast of visible satellites by cell phones. Following the presentations, NASDA staff members commented on the presentations. All the presentations were outstanding and stimulating (Figure 10).

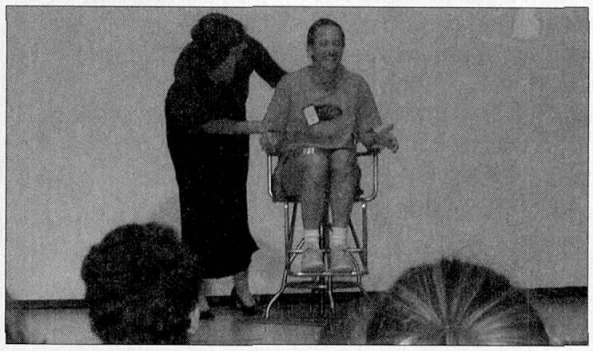
The attendees had a wonderful experience attending this seminar. The attendees were provided with the opportunity to do valuable networking with peers who share the same interests about space development. ■

Figure 10: Final discussion.

For the next eight months, the team worked relentlessly to put everything together. The Johnson Space Center and Texas Space Grant Consortium accepted the final proposal titled, "Experimental Study of the Effect of the Kelvin Force on Surface Tension Phenomena."

On Wednesday, 7 August 2001, the team arrived in Houston, Texas with their experiment. The next morning at 7:00 AM at Ellington Field, the first morning briefing took place. The team was introduced to the JSC members in the RGSFOP team and the other student teams. Donn Sickorez and John Yaniec, the project leaders, introduced the rules of the impending events: Rule one: Be safe; Rule two: Be on time. Those two rules were strictly enforced. All 12 teams of students from across the country listened intently while F-16s and T-38s were taking off just outside the KC-135's hangar where the students sat. The rumble of those engines was timid compared to the excitement and energy these students radiated, even at 7:00 AM.

WVU students working in the KC-135 hangar.



Testing orientation and balance at the JSC headquarters.

After introductions, the students unloaded their experiment and began preparations for the flights scheduled for the next two days. The van was pulled around the empty hangar to be unloaded. As the box containing the framework and Plexiglas was opened, the first unexpected event occurred. It seemed that Styrofoam peanuts catch air vortices around minivans extremely well. The next 15 minutes were spent running across the parking lot catching the little foam nuisances before they could blow out onto the runway. While they would not be likely to cause problems if they were sucked into an engine, the rules about foreign object damage (FOD) was very clear. Everything must be accounted for.

At the end of the day, when all the peanuts were caught and disposed of and the plans for the following week were laid out, the RGSFOP team treated the students to dinner at a place called Pe-Te's. The students soon learned that Pe-Te's is not only a place for astronauts to celebrate successful missions or a place for JSC staff to unwind. Pe-Te's is the kind of place you walk into, look at the walls covered in license plates from around the world, golf memorabilia, and astronaut photos with autographs, and think, "this little building has more stories to tell than I could hope to hear in a lifetime."

After a massive dinner of BBQ ribs, all of the students, flight crew, and journalists sat around telling stories and getting even more excited about the upcoming flight. In the midst of the laughing and joking, Pe-Te himself went from group to group telling stories of his 20-plus years in that restaurant. While looking in awe at a license plate saying "STS-1", the WVU team had Pe-Te tell them about Bob Crippen (first shuttle pilot on mission STS-1, former CEO Thiokol Propulsion, and past President of AIAA) giving him that license plate to hang on the wall. He went on to tell them stories about some of the Apollo astronauts coming in there, getting pretty soused and riding the giant chicken. Not being sure they heard that statement correctly, the students smiled politely and said nothing. As they left, they noticed out back, behind a high chain link fence, a six-foot tall steel chicken with a saddle, leaning against the building.

The next day, the team met at JSC headquarters to begin physiological training. The following four hours were full of classroom training designed to prepare students for the upcoming flight and the hyperbaric chamber test scheduled for the end of the day. During the four hours of class time, the teams learned about aerospace physiology and motion sickness in particular. Several students were spun around in chairs as a demonstration of how our orientation and sense of balance are pliable perceptions that can be easily deceived. While the "weightless wonder" is the official nickname of the KC-135A micro gravity plane, the "vomit comet" is its more memorable handle. Suddenly removing the force of gravity from a body can be very disorienting and can lead to an unpleasant flight for you and everyone in your immediate vicinity. ➤

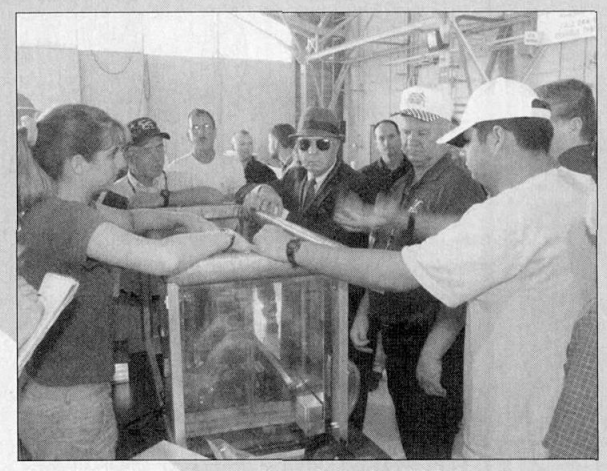
Another topic covered in great detail was the hyperbaric chamber flight. In addition to a third-class flight medical, all participants in the RGSFOP are required to successfully complete a hyperbaric chamber run up to 25,000 feet. This means that the team is put in a sealed room and the air pressure in the room is decreased to simulate the atmosphere at 25,000 feet. Once "at altitude", the oxygen masks are removed and five minutes are spent breathing air so thin that the lungs cannot transfer the oxygen to the blood. This has the effect of causing hypoxic hypoxia.

With the actual flight four days away, attention was directed at the chamber flight scheduled for the end of that day. Stories of drunken behavior exhibited by people experiencing hypoxia drove the imagination of the WVU team into wondering how they would react to oxygen deprivation. At the recommendation of the flight doctor and administrators, lunch was light and not likely to produce much gas; since at 25,000 feet, contained gasses expand to three times their original volume. And since there is always some gas trapped in the human digestive system, the climb in altitude will cause the gas to expand and exit through one of two potential exits. The instructors made it very clear that in the chamber there are no social taboos. Releasing that trapped gas is necessary to prevent a rather painful episode. Belching, or the colorfully named "left-right cheek roll," might be uncouth in many settings, but in the chamber flight, they are required actions.

After lunch the team drove to the Neutral Buoyancy Lab (NBL) for its chamber flight. Since they arrived a half-hour early, there was time to visit the NBL visitor center to sneak a peek at the world's largest indoor pool. When they climbed to the viewing platform, the WVU students were treated to a special sight; one of the astronauts training for a future ISS mission was being extracted from the pool. While watching the support team working together to pull the astronaut out, the WVU team just stared through the glass with big smiles watching the training wrap up.

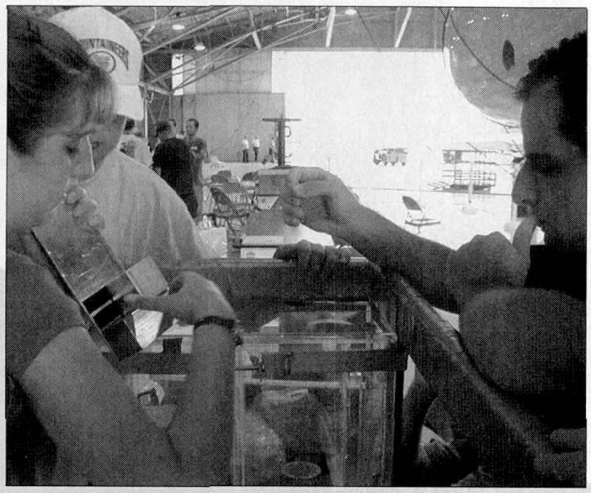
As the team members were getting prepped for the chamber flight, they were reminded of what to expect. Everyone reacts to hypoxia differently, but common symptoms include increased breathing rate, cyanosis (blueing of lips and fingernails), euphoria, mental confusion, belligerence, blurred vision, fatigue, headache, dizziness, numbness, tingling, nausea, and other afflictions vaguely similar to the effects of a really good party. In most cases, humans will have between three and five minutes of useful consciousness at 25,000 feet. The students were relieved that they would not have to simulate 43,000 feet, where consciousness is lost after only 10 seconds. They were happy to leave those flight tests to the professionals.

Preparing for the chamber flight.

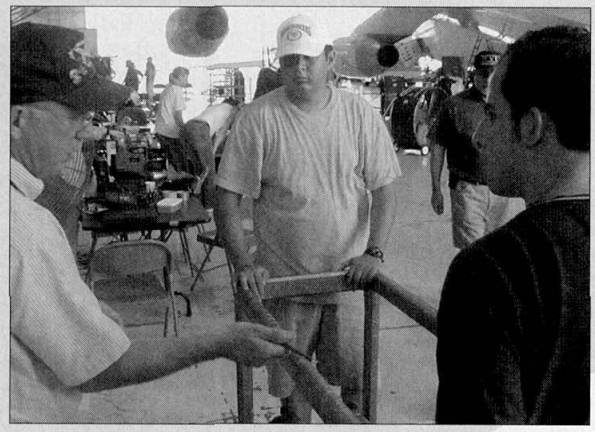


The WVU Team is questioned by the TRR board.

The team was suited up, given instructions on how to attach the oxygen masks, and led to the hyperbaric chamber. Once inside, the masks were attached to hoses and turned on to provide 100% oxygen. For a half-hour they breathed the oxygen to decrease nitrogen in the bloodstream and prevent the bends upon repressurization. The flight crew checked everyone out and the simulated "ascent" began. The ambient pressure was decreased to simulate a climb in altitude of 5,000 feet per minute. The climb caused ears to 'pop' during the first 10,000 feet as the air trapped inside the ear escaped. As the pressure continued to drop, the expanding internal gasses worked their way out. The chamber was full of students very grateful to have a 'fresh' air supply for more than one reason. At that point, the flight crew gave the order for half of the students to remove the masks, since the pressure leveled off at 25,000 feet. Austin and Matt sat in seats 11 and 13, respectively, and were the first to remove themselves from their lifeline of pure pressurized oxygen. ➤



The Team works to resolve the TRR issues.



The Team comes up with a solution to the problem.

Within the first minute, one of the flight crew suspected that Austin might be having some difficulty. "Number 11, how are you doing?" No response. "Number 11, if you can hear me, give me a 'thumbs up'." No response. "Number 11, can you put on your mask?" No response. After two more minutes, the flight crew put his mask on him and turned on the emergency oxygen supply. After another minute or so, Austin began to look around at things other than that one spot somewhere just beyond the floor that seemed to hold his attention during his hypoxic episode.

After five minutes everyone was instructed to put the masks back on. About half managed without assistance. After they stabilized and started to regain their composure, the second half of the group removed their masks. Jennifer in seat 12 and Andrew in seat 14 didn't have quite as obvious effects, but were affected nonetheless. While Andrew was looking around and noticing how shaky his hands were, Jennifer was busy playing with the pencil and small activity sheet she was given. Simple math became difficult. Her handwriting became chaotic.

The chamber began to repressurize after everyone was back on oxygen and breathing as normally as can be expected through a hose six feet long pumping pressurized oxygen. The chamber "descended" at a rate equivalent to 2,000 feet per second. During descent, the outside air pressure began to push in on the outer ear. To equalize this, everyone was instructed on how to perform the "valsalva" technique. Simply put, this involves pinching the nose and sharply exhaling with a closed mouth to repressurize the Eustachian tube.

Immediately after the experience was concluded, the students were asked to give their opinions as to what they encountered while the thoughts were fresh in their minds. Andrew commented that it didn't feel as euphoric as it had been described, but watching his hands twitch uncontrollably was a very surreal feeling. Austin simply said, "nothing is fresh in my mind. I only remember about two seconds of it."

Monday morning brought another early start. This was the day that the experiment was going to be put through its paces by the flight evaluation board. Professors Kuhlman and Gray were present to lend support to the team. The test readiness review (TRR) was performed to ensure the safety of everyone aboard, so it was designed to be tough.

The board approached each team and questioned the team leader about the project. All attention was directed at safety. Were all the edges padded? Is everything secure so that nothing will float away in zero-g? Are all wires secured and unexposed?

As the board approached the WVU team, their anxiousness could be felt in the air. Had they accounted for every possibility? What might have escaped their attention? All that could be done now was to see what the board could find. The questions began and Jennifer, the designated team leader and spokesperson, had answers readily available. The first potential problem was that they were dealing with a fluid in micro-gravity. The board wasn't a hundred percent convinced that the double sealed system to contain the fluid would be sufficient. Jennifer addressed the issue and the team suggested a solution involving drilling two additional holes in the outer container and covering them with a sheet of special filter paper (a vacuum cleaner bag cut into strips) so that the air pressure could be equalized without allowing fluid to escape.

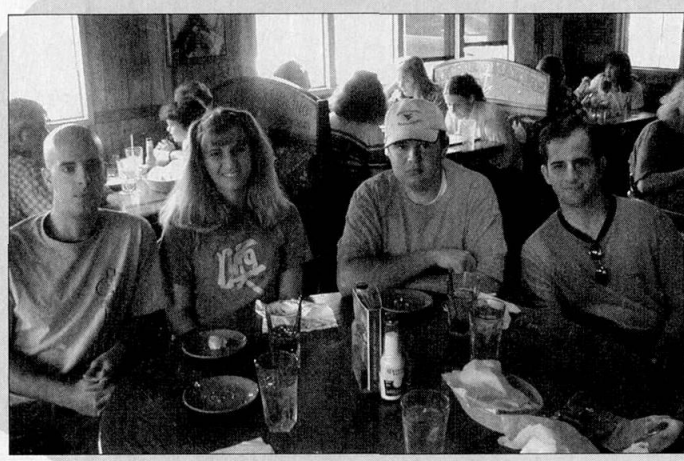
The board accepted their solution and continued to look for anything that could potentially go wrong. The next issue they found was even more nerve racking. The strength of the magnets had the potential to interfere with the aircraft systems. The only way to be sure that the magnets would not cause a problem was to put the apparatus on the plane and, during the preflight checks, watch carefully for any potential problems.

Once the TRR was complete, the team went to work. Austin and Matt began modifying the experiment to comply with the safety standards that the TRR ➤

review board had set. Meanwhile, Andrew and Jennifer began working with John Yaniec to weigh the experiment and load it onto the plane. Once loaded and final checks were made, nothing could be done but wait until morning to see if the magnet issue would cause them to be grounded.

Dinner that evening was spent discussing final plans and choreography of the next day's flight. Since the flight was scheduled for the afternoon, the two students who would be flying (Matt and Austin) could eat anything without concern of nausea during the flight. They were instructed to not consume any alcohol, though. The team recalled the instructor during the motion sickness class stating that if you drink the night before the flight, then during the flight "you will be afraid that you will die. Then you will be afraid that you won't." Instructions like that came easy to follow for the team.

The West Virginia University Team The Magnetic micro-gravity Mountaineers with Professor Gray.



The Mountaineers going over last minute details.

After a fitful night's sleep, the team was anxiously awaiting the preflight check of the plane to see if the magnets would pose a problem. As the plane was taxied out onto the tarmac, Matt and Austin reviewed their plans for the flight. While they prepared mentally, Andrew and Jennifer were making plans for flight day two when they would get their chance to fly. As the morning wore on, no word had come back to the team about the magnets. They kept telling themselves that no news was good news, but those words were said through clenched teeth. Noon brought the word that the magnets had no effect on the systems. They were ready to fly.

Matt and Austin sat in the back of the modified Boeing 707. Looking forward at the open space of the main test area, it was easy to see how this plane could carry many passengers. It was also easy to see how the Air Force used the KC-135 as a refueling tanker. But this was the KC-135 'A'. The Weightless Wonder. The Vomit Comet. One of the only ways to experience prolonged microgravity without going into orbit.

Sweat beaded on all the faces aboard as the Houston heat had driven the temperature inside to nearly painful levels. No air conditioning was on during takeoff since all power is dedicated to the engines. Earplugs were inserted while the powerful turbines throttled up to full. As the plane left the ground, smiles and excited looks permeated throughout the back of the plane. They were only 15 minutes from the flight path over the Gulf of Mexico.

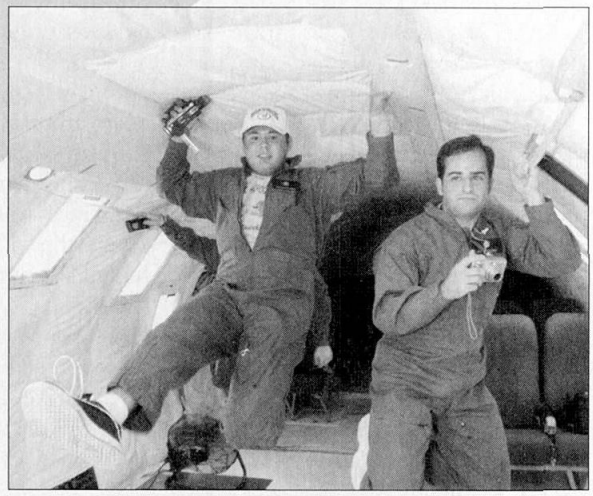
As the KC approached the path, the teams unbuckled and began to prepare for the first parabola. The two WVU students laid on their backs as the flight crew called out that they were about to go over the first parabola.

Then the plane dropped out from under them.

The feeling of the first moment of weightlessness is only loosely comparable to a rollercoaster on its first hill. Like a rollercoaster, your stomach seems to move just a bit higher than the rest of you. Unlike a rollercoaster, you are not securely fastened to a solid object. Also, unlike a rollercoaster, you are not suddenly pressed back into your seat and flung back and forth like a marble in a blender. Quite the contrary, as the plane drops out from under you, there is a brief moment of tranquility as you realize that, for a brief time, you have tricked gravity.

Matt and Austin carefully floated upward during that first parabola as excited yelps and cries of pure exhilaration filled the plane. Beside them, one of the reporters used a little too much leg strength to get off ➤

Austin drifting away from the experiment.



Austin and Matt regaining control.

the floor and bounced off the ceiling, then the floor, then the ceiling again before one of the flight crew helped stabilize him.

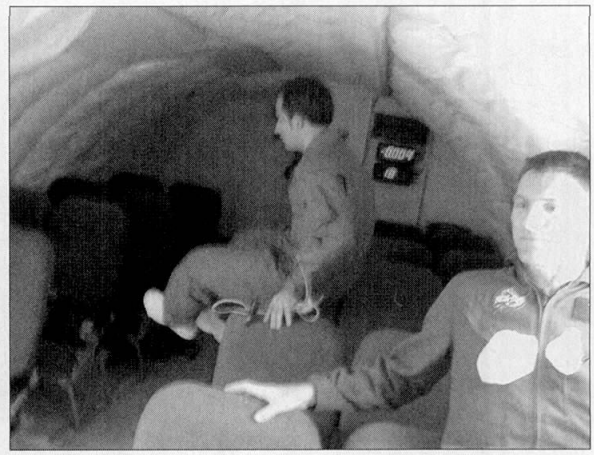
Just as suddenly as it began, the 25 seconds of weightlessness were over and the students dropped back to the floor. This began the first 2-g pull out. Weighing twice as much as they normally did, Austin and Matt lay motionless on the floor. Throughout the cabin, students' bodies lay strewn about, while the flight crew (who were in remarkable condition) walked amongst them in their blue flightsuits. It had the surreal look of a civil war battlefield.

The next two parabolas were dedicated to getting acclimated to maneuvering in a micro-gravity environment. Matt floated between the experiment and the wall, while Austin drifted in the middle of the cabin. Both quickly learned the true effect of their actions having "equal and opposite" reactions. Austin's gentle nudge against the ceiling did not only cause him to drift to the floor, but imparted a rotation as well. Even though it was disorienting, they swiftly adapted to this new environment.

Soon the students were hard at work during the micro-gravity portions of the flight. They checked the levels of the fluids visually and documented their findings as a backup to the two video cameras recording the results. Visual analysis confirmed the results they anticipated. Grins grew larger and cheers of a successful experiment drowned out the rumble of the four engines just outside their window. Back on Earth, Jennifer and Andrew cheered on as they watched their colleagues on the downlink monitor. Their anticipation of the next day's flight grew as they watched the success of their project unfold during each parabola. ➤

The WVU team relaxes as video cameras record the experiment's results.

Austin doing a somersault.

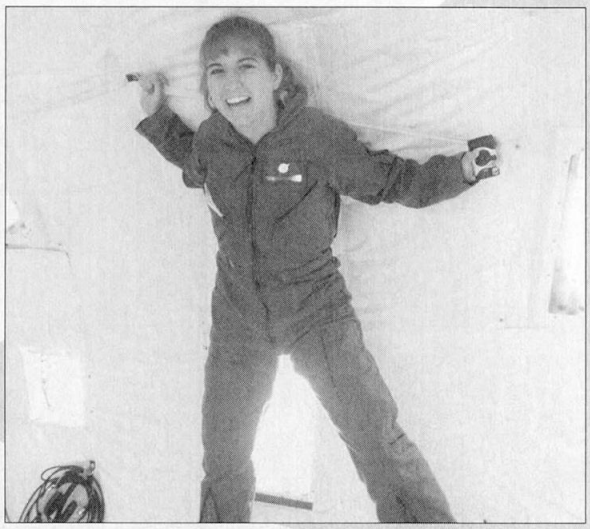


The effects of linear velocity in a somersault.

After 25 parabolas, any trace of seriousness drifted away as the students had some time to relax. With 5 parabolas of micro-gravity left to go, one of the flight crew had Austin curl up in a ball and spun him around in a mid-air somersault. "Oh yeah!" was all Austin would repeatedly say. On the next parabola, Matt took his turn. He had a bit of linear velocity at the beginning of his spinning and ended up drifting over the seats at the back of the plane. Once his head clipped the seat below him, he bounced to a stop.

At the end of the parabolas, the teams made sure everything was secured and returned to their seats. A quick glance at faces showed that two of the 14 students on this flight helped confirm the unofficial nickname of the plane. Motion sickness claimed two more victims. ➤

The first flight Team descends the KC-135 at the end of the trip.



Jennifer experiencing micro-gravity.

The next day, Jennifer and Andrew were ready to go bright and early. With a full flight of useful data from the previous day, they had a great deal of pressure lifted off of them. Their goal was to get additional data using a second magnet configuration that was developed only a week before they arrived in Houston.

Those two had the advantage of an early morning flight. While being required to be ready before the sun rises might not seem like a plus, climbing aboard a plane that has not been sitting between a fiery sun and black tarmac is an obvious advantageous.

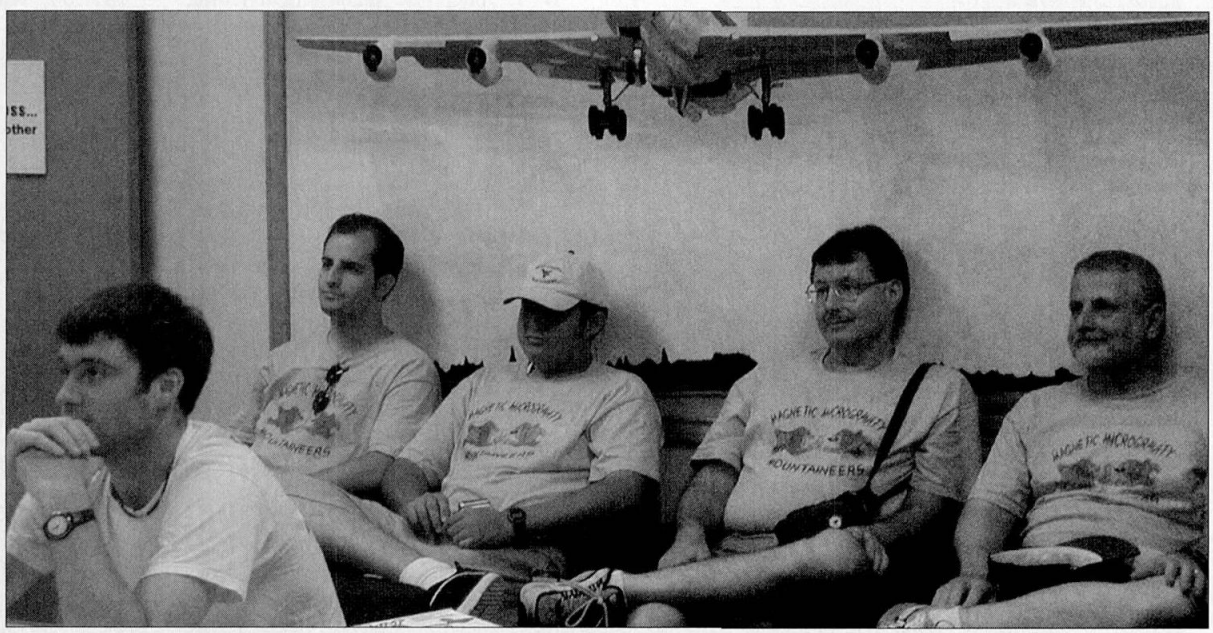
As Matt and Austin sat in a conference room waiting for the video downlink to connect, Jennifer and Andrew, along with 10 other students, began the ascent to their first taste of weightlessness. Making final checks of the experiment, they eagerly awaited the feel of what they had watched their companion's experience the day before. The flight crew called out "We're going over the top!"

Their bodies gently lifted off the floor. The lights brightened, the sounds of the engine lessened, and for a moment, all was still. That sudden moment of tranquility was shattered by the excited trill of a dozen students simultaneously charged with adrenaline. They were experiencing what only a handful of humans ever would. They were weightless.

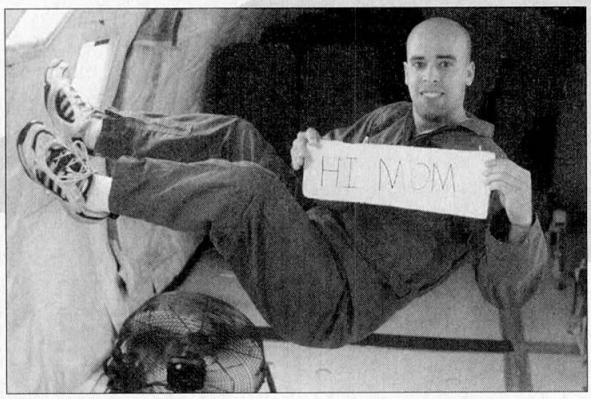
As on the previous day, the students needed only a few of the first parabolas to acclimate to the new rules of dynamics. By the fourth cycle through micro-gravity, Andrew and Jennifer were flying as if they were raised in orbit. Maneuvering around the framework of the experiment, they checked the results of the new configuration.

At this point the downlink camera antenna was being fixed so that the ground crews could see what was going on in the air. Austin and Matt waited to see how their teammates fared during their first taste of micro-gravity. The monitor flickered and crackled, hissed once, then suddenly displayed a crystal clear image of Andrew and Jennifer floating sideways above the project. In the background, a voice was heard to call "feet down" a moment before the two of them settled back to the floor of the plane.

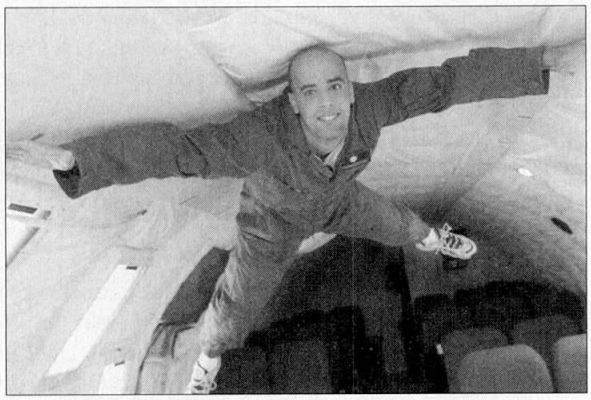
Austin then picked up the phone line that had a direct connection to the team flying somewhere between 24,000 and 34,000 feet over the Gulf of Mexico. The students discussed some minor problems with the new configuration. ➤



Matt and Austin watching their teammates from the ground with Professor Kuhlman and Professor Gray.



Andrew in micro-gravity.



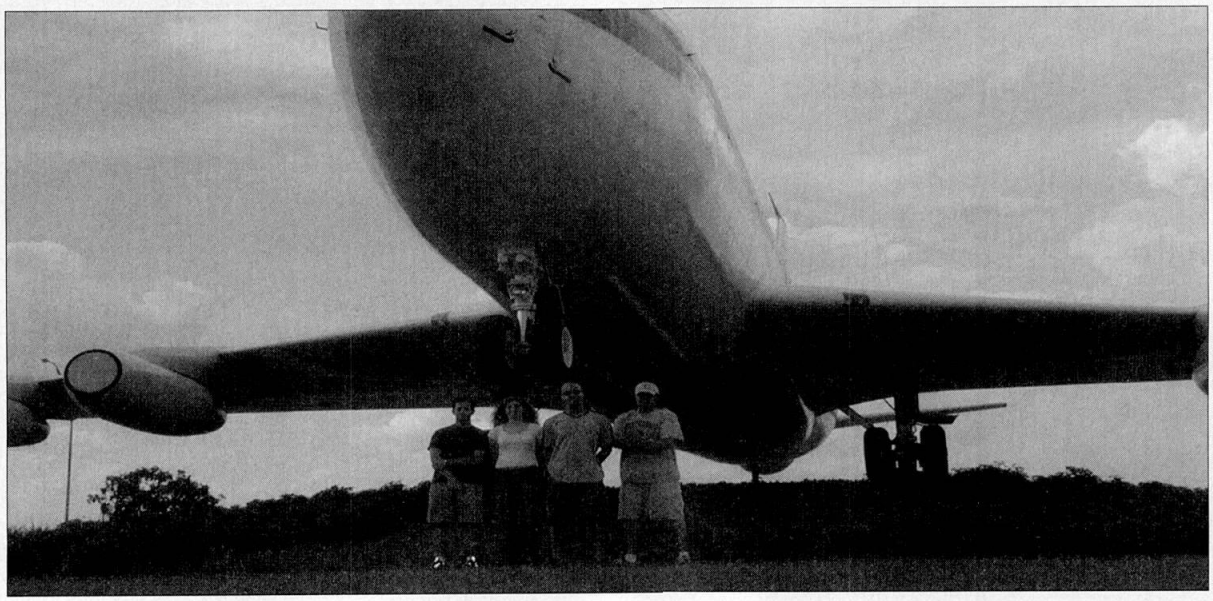
Andrew flying accross the cabin.

Andrew and Jennifer finished taking the measurements they needed, then left the project running, as it was completely self-sufficient. As data was being gathered, Jennifer practiced flat spins while Andrew flew across the cabin.

As the 30th and final micro-gravity parabola neared its end, the fliers prepared for another thrill. Two additional parabolas were about to be flown with a slight difference. By expanding the parabolic flight path, lunar and Martian gravity were simulated. The students began doing push-ups in one-sixth (lunar-g) of Earth's gravity. They had no problems, even with three people on their backs. A small step would cause them to bound across the cabin. As the 32nd and final parabola began, the teams got to experience one-third (Martian-g) of Earth's gravity. While not as disconcerting as micro-gravity, nor as noticeable as lunar-g, the students enjoyed bouncing around the cabin, as a slight step would result in a hop.

When the plane returned to Ellington field, the teams were reunited. Cheers of success soared across the tarmac. The West Virginia Magnetic Micro-gravity Mountaineers had flown in zero-g. ■

The plane has returned on day 2.



The West Virginia Magnetic Micro-gravity Mountaineers.

El Nuevo Herald is US' Spanish daily per excellence. The largest Spanish-language publication within the U.S. / Based in Miami -

Una experiencia sin las ataduras de la gravedad

ANGELA POSADA-SWAFFORDT
CENTRO ESPACIAL JOHNSON

Un proyecto científico permitió a cuatro estudiantes hispanos de la Universidad de Miami disfrutar un vuelo en condiciones de ingravidez

Una reñida competencia entre universidades de todo el país, un proyecto científico que atrajo el interés de la NASA, y una semana de entrenamiento en el Centro Espacial Johnson en Houston, culminaron hace unos días con un emocionante vuelo en gravedad cero para cuatro estudiantes hispanos de la Universidad de Miami y una reportera con suerte.

Con un experimento sobre dinámica de fluidos, Faure J. Malo-Molina, Pastora Valdez, Mariela Aguilar y Jorge Icabalceta, estudiantes de ingeniería, sicología y biología, lograron lo que para muchos no pasa de ser un sueño: volar en el KC-135A, el mítico avión de entrenamiento en microgravedad de la NASA.

El avión, conocido como "La Maravilla Ingrávida" es básicamente la versión militar de un 707 sin ventanas ni sillas de pasajeros, su interior recubierto de una gruesa capa de espuma blanca. El KC-135A fue rediseñado para lograr cortos períodos de microgravedad durante una serie de parábolas, un término que describe la trayectoria del aparato. Dibujando en el cielo del Golfo de México constantes curvas pronunciadas en ángulos de 45 a 50 grados, los pilotos logran que en el arco de cada curva la aceleración del avión sea exactamente igual a aquella de la gravedad de la Tierra. Cuando esto sucede, todo lo que hay dentro del aparato comienza a flotar

Gs, es decir, una persona que pesa 100 libras pesará ahora 180, el reloj sobre la muñeca parece una piedra, y una grabadora es equivalente a un ladrillo. Medio minuto después, el rugido ensordecedor de las turbinas desaparece, mientras los pilotos empujan la nariz del aparato hacia abajo, y la gravedad cero, que arranca chillidos de felicidad y sorpresa entre los primerizos, sobreviene justo antes de iniciar una caída de 10,000 pies.

En un vuelo de dos horas en esta montaña rusa máxima, los experimentados pilotos del KC-135A logran realizar entre 30 y 44 parábolas, a una altura de 34,000 pies en la curva superior de la parábola. Y aunque ellos, por estar atados a sus asientos no sienten casi los efectos de la falta de gravedad, los demás tripulantes de la cabina principal los reciben en pleno. Porque unas cuantas parábolas después de los primeros mágicos 25 segundos de ingravidez llega el momento en que el avión hace gala de su otro apodo, "El Cometa del Vómito".

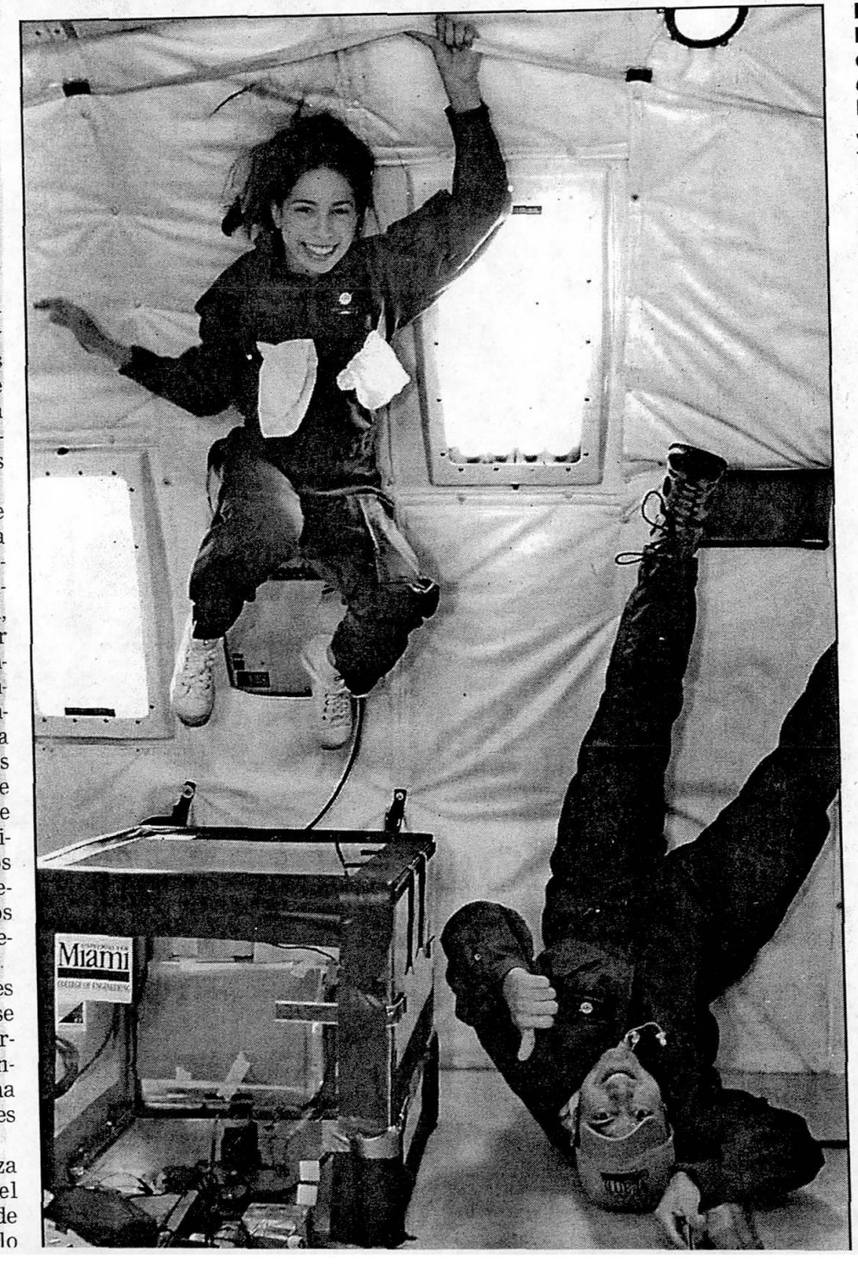
"De cada tres personas que suben abordo, una se marea terriblemente, otra se marea un poco, y otra no se marea para nada', dice John Yaniec, veterano director de vuelos del célebre avión de la NASA,

que la NASA prescribe especialmente para quienes se van a someter a esta experiencia. La pastilla, una potente combinación de escopolamina y Dexedrin, no tiene mayores efectos secundarios aparte de secar la boca y producir cierta hiperactividad, y ha demostrado funcionar en muchos casos.

Justamente porque somete los objetos a los efectos de la microgravedad, es que el KC-135A es uno de los instrumentos más efectivos que existen, no solamente para entrenar astronautas y pilotos, sino también para experimentar el comportamiento de materiales, aparatos electrónicos, y hasta plantas y animales destinados al espacio. Además, la NASA se asegura que cada año grupos de estudiantes tengan la oportunidad de ensayar sus propios experimentos en microgravedad. Después de todo, éstos serán los astronautas e ingenieros del futuro.

En el caso de los estudiantes de la Universidad de Miami, se trataba de observar el comportamiento del combustible dentro de los tanques de gasolina de los aviones, satélites y naves espaciales.

"Cuando un avión realiza diversos movimientos, el líquido dentro de los tanques de



LOS ESTUDIANTES de la Universidad de Miami, Mariela Aguilar y Jorge Icabalceta, flotan al lado de su experimento durante uno de los períodos de ingravidez creados en cada parábola del avión de entrenamiento en microgravedad de la NASA, KC-135A. NASA.

pañía BE Aerospace para esta aventura. "Esto hace que el combustible tienda a acumularse en las esquinas de los tanques, ocasionando que las turbinas aspiren gases en lugar de líquido y creando vibraciones e inestabilidades en el avión, que a veces han resultado en accidentes aéreos".

Actualmente, dice su compañero Jorge Icabalceta, el problema se trata poniendo divisiones metálicas con agujeros en los tanques de combustible para dejar pasar el líquido. "Pero éstas divisiones añaden mucho peso a la aeronave, y si pensamos en el Transbordador Espacial, este peso se convierte en toneladas y por lo tanto, en mucho dinero".

Observando y cuidadosamente filmando el comportamiento en gravedad cero de medio galón de agua que iba siendo bombeado hacia un tanque transparente de plástico, Malo-Molina y sus compañeros se pudieron formar una idea del desafío que tienen por delante.

"Ví que el agua se concentraba en una gran burbuja, tal como esperaba, y tengo algunas ideas para resolverlo", dice.

Cuando éstas cristalicen en un futuro, uno de los interesados en los resultados será el veterano astronauta Andy Thomas, quien hace poco llevó las mismas inquietudes en otro experimento a la Estación Espacial, y quien casualmente voló en el KC-135A con los estudiantes de la Universidad de Miami, y hasta les ayudó en sus observaciones.

"Mis estudios de ingeniería también se concentraron en mecánica de fluidos", dice Thomas, quien vivió cuatro meses a bordo de la estación rusa MIR, y ha completado cuatro misiones espaciales. "El problema del combustible en las alas de aviones y tanques del transbordador y de los satélites es uno bien reconocido, por lo que es importante que mentes brillantes le pongan atención".

No obstante, antes de poner un pie el avión, estudiantes y periodistas debimos pasar rigurosos exámenes de corazón, pulmones, visión, y estado físico y mental en general. Después, asistir a largas e interesantes sesiones de clase cubriendo las diversas leyes que afectan a los gases bajo presión, abundantes detalles sobre ciencias atmosféricas, los principios del equilibrio y todo lo concerniente a la fisiología del mareo.

La experiencia, de esas que no se olvidan jamás, también sirvió para darle a los participantes una idea de los desafíos que a diario enfrentan los astronautas que construyen y viven en la Estación Espacial. Desafíos que se irán acentuando ahora que tenemos una colonia permanente fuera de este planeta.

Ahora que entraron a este exclusivo club de la microgravedad, Malo-Molina y sus compañeros entienden lo que muy pocos mortales han intentado explicar desde que un ser humano dejara por primera vez las ataduras de la gravedad.

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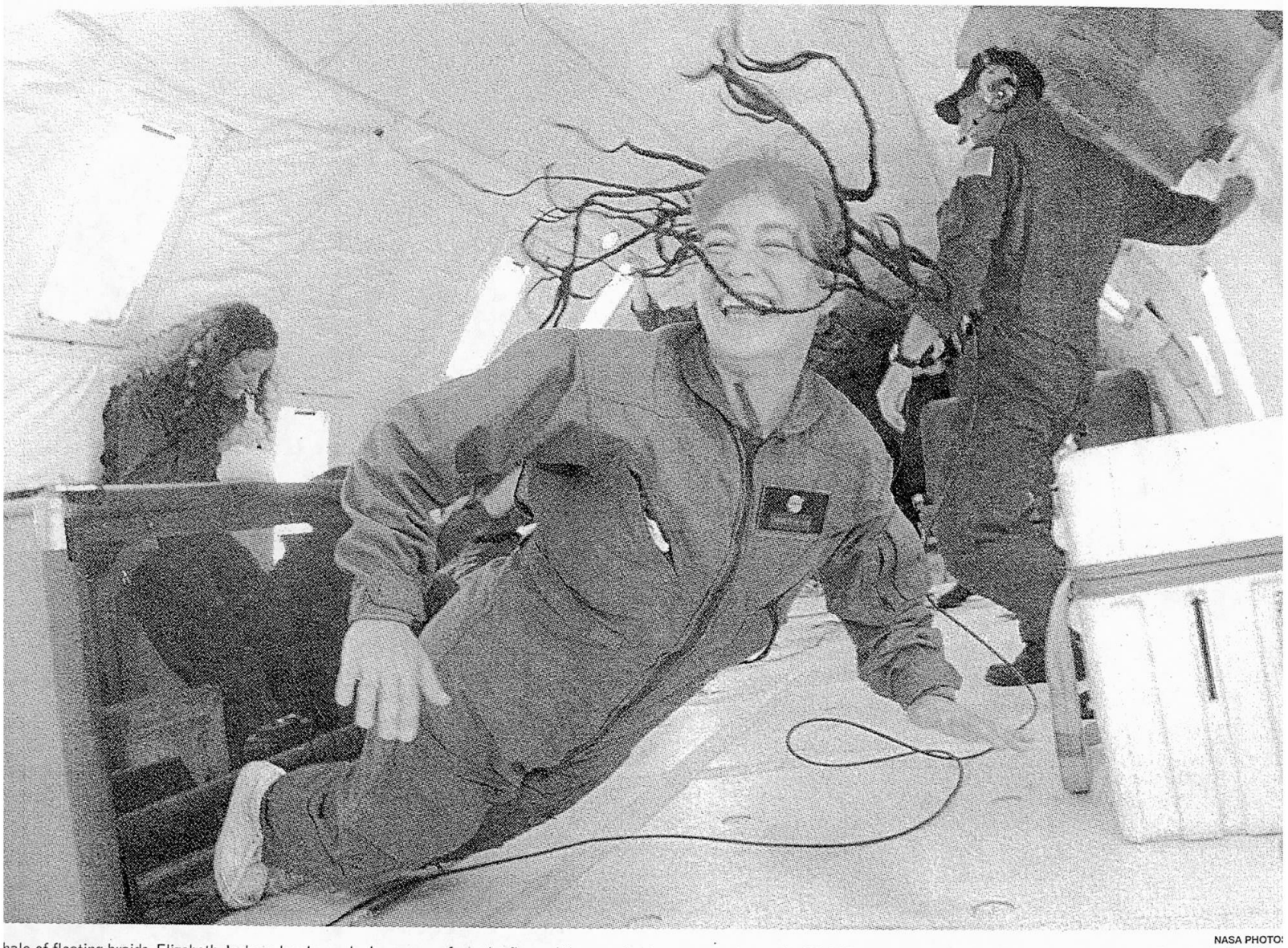
Odyssey and ecstasy

Follow one journalist and a handful of students as they share the wonder of defying gravity **5**

Flights of fancy



NASA PHOTO

halo of floating braids, Elizabeth Jackson laughs as she bounces up from the floor while experiencing zero gravity on the KC-135. A student at the San Francisco Art Institute, Elizabeth dyed her s red to celebrate the event.

Aboard a modified Air Force plane, would-be space explorers (and one interested observer) soar above the ordinary

By DIANE LONG
Staff Writer

Surrounded by brilliant white, we grin goofily at each other as we sit stiff-backed on opposite sides of a stuffy airplane cargo bay.

It could be a weird scene from *2001: A Space Odyssey*, where they might stash astronauts who'd gone berserk in space. Clean, white floor cushioned with inch-thick foam. Padded walls and ceiling swathed in white vinyl. Clumps of strange-looking apparatus bolted to the floor.

But this is no movie scene. It's NASA's sleek KC-135, a modified Air Force gas tanker dubbed the "weightless wonder," flying out from Houston over the Gulf of Mexico on a hot July morning at more than 400 mph.

After takeoff, our small group of college students and journalists get up from the handful of regulation airline seats and scatter to our positions on the floor across the modified cargo bay.

Within minutes we all are sitting tensely, just like astronauts John Young, Neil Armstrong, Sally Ride or Bonnie Dunbar, waiting for what few people ever experience: the floating freedom of zero gravity.

Since 1959, a structurally reinforced KC-135, the military equivalent of a commercial Boeing 707, has been the

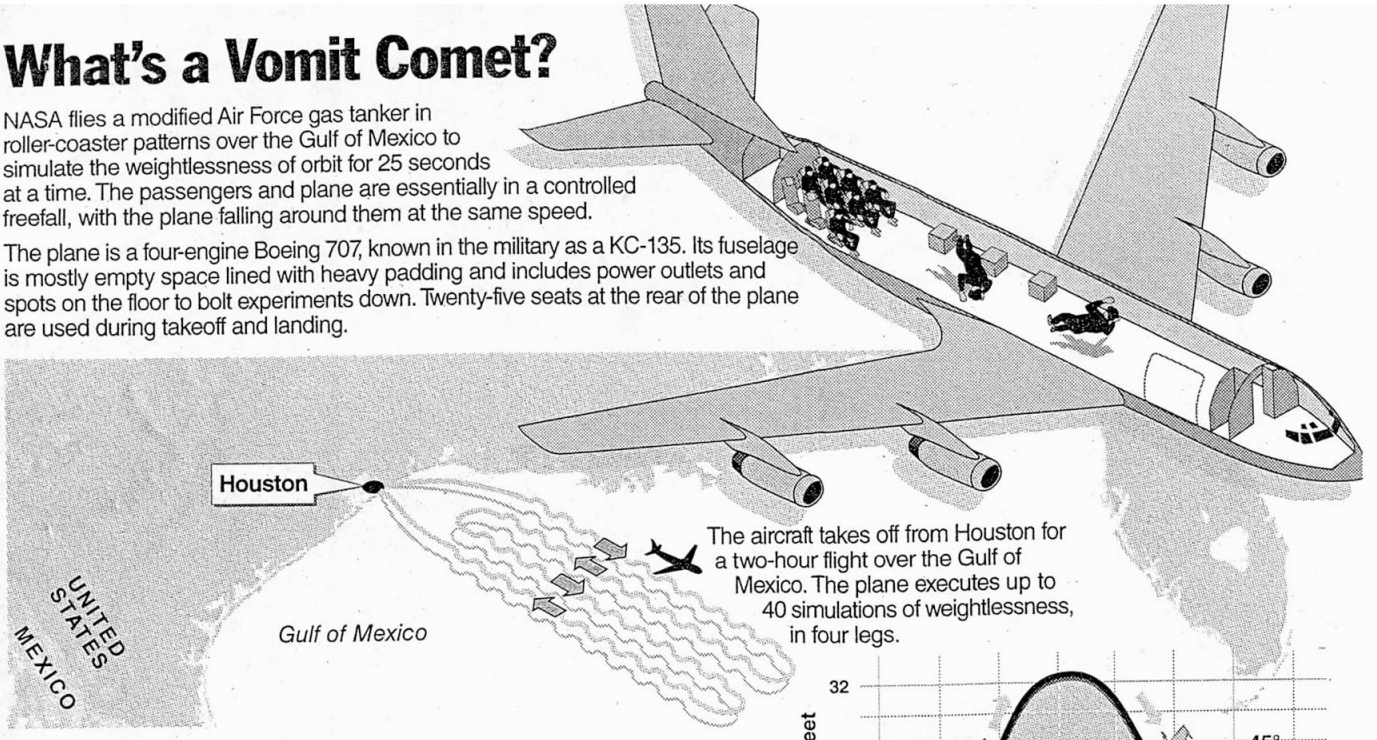
ON THE WEB

See video of the students as they float in weightlessness at www.tennessean.com.

What's a Vomit Comet?

NASA flies a modified Air Force gas tanker in roller-coaster patterns over the Gulf of Mexico to simulate the weightlessness of orbit for 25 seconds at a time. The passengers and plane are essentially in a controlled freefall, with the plane falling around them at the same speed.

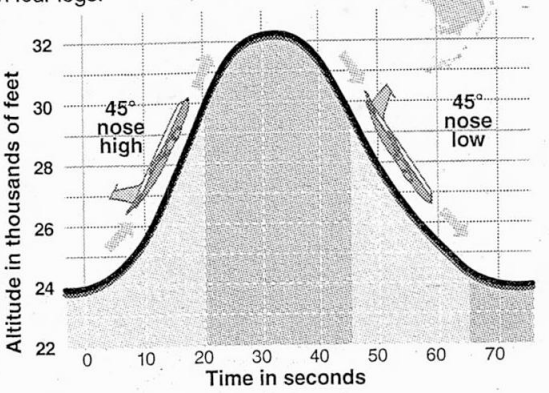
The plane is a four-engine Boeing 707, known in the military as a KC-135. Its fuselage is mostly empty space lined with heavy padding and includes power outlets and spots on the floor to bolt experiments down. Twenty-five seats at the rear of the plane are used during takeoff and landing.



Ups and downs of gravity

The plane climbs at 45 degrees until reaching an altitude of about 32,000 feet. Then the pilot cuts the engines and coasts over the top of an arc, giving the passengers the same weightless sensation roller-coaster riders get on that first small hump after coming down the big hill. As the fall continues 45 degrees downward, passengers begin to feel gravity, eventually peaking at nearly twice the normal force of Earth's gravity.

*At 1.8 Gs, people who weigh 200 pounds would feel like they weigh 360 pounds.



GNS

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flying laboratory for NASA's Reduced Gravity Program, operated out of Lyndon B. Johnson Space Center in Houston.

More than 80,000 times, the airplane has replicated zero-G flight for the purpose of preparing NASA's astronauts for space, testing the limits of hardware and human reactions in a weightless environment.

The experiments of the students on board for this July flight would follow in that tradition, testing everything from hand-eye coordination to space-mining techniques.

Everyone takes a deep breath as the plane's crew calls out, "Going up," and the airplane begins to zoom up from its cruising altitude of 24,000 feet. The drone of the jet engines kicks into a crescendo as the plane noses up at a 45-degree angle, climbing 8,000 feet in 20 seconds.

Logic insists that we should slide down the body of the plane to the tail section, rolling into a tangled clump of arms and legs. But sometimes physics is as simple as a child's trick.

Hold a bucket of water by the handle and spin around fast so the bucket flies out horizontally. Where does the water stay? In the bottom of the bucket.

In this case, we are the water in the bucket, plastered to the floor by almost twice Earth's normal gravity.

It glues us down. Breathing takes conscious effort to expand the rib cage. Around our mouths, the skin stretches down and pulls at our lips. The weight of each toe is clearly discernible inside our Nikes and Reeboks.

Just when the pressure seems unbearable, the plane hits the top of its big, bell-shaped parabola and the nose tilts down 45 degrees.

We began to float.

We watch in amazement as our arms start to rise up with absolutely no effort. Suddenly there is an inch or two of clear space between the floor and our backsides as our bodies strain up against our nylon lap straps.

Then we rip open the Velcro fasteners and stand up. It is way too easy.

With just the gentlest push of leg muscles, we find ourselves propelled upward and grabbing for the ceiling straps. The first impulse is to deny that we could be floating, to flail in an effort to keep our feet on the floor. Our brains click along in overload, trying to process how it could be that suddenly our feet are dangling and why keeping our balance in a vertical position is so difficult.

Tennessean reporter Diane Long fills out a questionnaire to test her alertness during a low-oxygen test in NASA's altitude chamber.

In 25 seconds, which seems more like five or six, the crew calls out, "Feet down, coming out." That's the signal that the plane has fallen 8,000 feet to the bottom of its parabola and is about to start another climb.

The next instance of double gravity — 2G in NASA lingo — plops us down like rocks, with enough force to snap a neck or crack an arm if we hadn't already positioned our feet and backsides toward the floor.

And so it continues, like a space-age roller coaster: 20 seconds of 2G, 25 seconds of weightlessness, 2G, zero G, up,

down, up, down, up, down, 30 times.

That's why the plane has another nickname: The Vomit Comet.

Flight notes: For NASA, paperwork must be completed to a T.

All the team members, including the reporter, had to pass FAA Class 3 medical exams. I faxed a copy of my certificate, but NASA wanted more: The handwritten doctor's note showing that I had recovered without complications from my drippy sinuses in January; the specification that my blood pressure was 114/68, not just "normal."

And because I'm an old person, over 35, NASA wanted an EKG. To be safe, I faxed over the whole printout of my normally thumping heart.

Serious science

Back about 1995, the KC-135 flew 634 parabolas just so Tom Hanks and his fellow actors could film the weightless scenes in the hit movie *Apollo 13*.

But there's more to the KC than the novelty of weightlessness.

For four decades, it's provided zero-G training for astronauts, and it's been the lab for hundreds of university researchers whose experiments interest NASA. The costs are steep: To get on the KC, scientists pay $6,500 per hour of flight time.

Six years ago, the program expanded to include college students: up to 96 teams of four students and a professional journalist each. NASA picks up the tab, creating an opportunity for young astronaut wannabes and budding engineers to get their first taste of space.

"We're providing them with a capstone experience," says Don Sickorez, university affairs officer for Johnson Space Center.

"They've done pieces of this all through their college career: They've done analysis, they've done tests, they've done design, they've done implementation," he says. "But they've never pulled it all together like this. The kids work harder than they ever thought they would, and they don't mind."

During the July-August summer campaign, students from 34 universities throughout the country made their pilgrimage to Houston to test their experiments.

At the University of Alabama-Huntsville, the process began this past September in the UAH chapter of Students for the Exploration and Development of Space.

Of the 15 or so interested students, one team missed the proposal application deadline in March. Another team's proposal was rejected.

But a team of five engineering students, representing Tennessee, Alabama, California and Texas, had the right stuff as they concocted an experiment to test human coordination in zero G.

Don't be surprised if, in 20 years, newspapers report that humans have landed on Mars and among the astronauts are:

- Chris Brown, an aerospace engineer and spacecraft pilot from Birmingham, Ala.
- Russell Meyerriecks, an aerospace computer engineer from Fayetteville, Tenn., in Lincoln County.
- Elizabeth Lampkin, an aerospace electrical engineer from Petersburg, Tenn., a tiny town near Fayetteville.
- Lauren Meisenheimer, an extra-vehicular activity and spacesuit engineer from Big Bear Lake, Calif.
- George Olden, an aerospace propulsion engineer from Austin, Texas.

Right now, these five still are UAH students who must collect the necessary expertise while chomping at the bit to help design and then fly the first craft to Mars.

"Didn't you know?" asks Chris in the most matter-of-fact manner. "I'm going to be the first man on Mars."

But you'd never know you were meeting a potential Mars crew if you met these young adults on the street.

Chris, 20, probably will be bald by the time he gets to space. But he'll undoubtedly have the same, quiet, laid-back manner, and his quick brown eyes will still catch all the action as he steps in easily to assume the duties of team leader.

With her long, black hair and easy, outdoorsy manner, 22-year-old Elizabeth would look right at home galloping across the range. Animals are her second love, and her two horses are waiting patiently on her parents' farm.

A merry but gentle mischief lights up 18-year-old Russell's twinkling green eyes as he flaps up in his unbuckled brown sandals, taps someone on the shoulder and quickly sneaks to the person's other side.

Lauren, 18, talks at a quick California click about off-roading in her Jeep or the ever-growing tattoo on the small of her back, now featuring her Leo zodiac sign and Chinese wave symbols.

Towering above everyone at 6-foot-3, 19-year-old George could easily parlay his guitar talent, black wrap-around sunglasses and hip mustache and goatee into a rock star's role.

But since childhood, all five have been dabbling in astronomy, shooting off model rockets or just taking things apart. At lunch, it takes only a casual comment to turn the conversation into a hot discussion of different types of aircraft, Newton's law or Einstein's theory of relativity.

That burning interest is pushing them through the rigorous engineering program at UAH. They're each dedicating at least five years to get all the necessary classes, and there are master's degrees and even

At the center of attention, University of Alabama-Huntsville student Chris Brown explains how the team's experiment will test human coordination in zero gravity. From left are team members Elizabeth Lampkin, Lauren Meisenheimer, George Olden, Russell Meyerriecks and NASA staffers John Lamb and John Yaniec.

doctorates ahead as they prepare for a future of flight.

And now, in just days, they would find out first-hand if their dreams mesh with the reality of space.

Flight notes: NASA loves acronyms. Here's a typical conversation that any NASA staffer in Houston would understand:

"Let's start at JSC with a check on EVA before we go over to the MCC. If the ASCANs don't need us at the NBL, we'll swing by Ellington to catch the students' TRR. And we might get to see the KC if it's not out for HAT."

Translation: "Let's start at the Johnson Space Center with a check on extravehicular activity systems (suits used for space walks) before we go over to the Mission Control Center (where all space flights are monitored). If the astronaut candidates don't need us at the neutral buoyancy lab (the giant pool where astronauts train underwater), we'll swing by Ellington (Field, an airport) to catch the students' test readiness review (to make sure experiments are safe). And we might get to see the KC-135 (airplane) if it's not out for heavy aircraft training."

Unconfirmed rumor: Somewhere in NASA-land, there's a manual that lists all the acronyms used by the agency, a book that's supposedly two or three inches thick.

The ground rules

It's just before 10 a.m. on July 12, and the temperature already is soaring above 90 degrees. Ten teams of students are settling into Hanger 990 on Ellington Field, about 10 miles from Johnson Space Center at the southern edge of Houston's city limits.

In the shade of the soaring walls and roof, on a spotless concrete floor, sits the KC-135, white body and blue racing stripe gleaming from a full-body wash in Oklahoma just days before.

The mere sight of our ride to weightlessness ratchets up the excitement. In the next six days, we will need that adrenaline to jump through NASA's safety hoops and procedures that start just after sunrise every morning.

If NASA folks are sticklers for paperwork, they're positively rabid about safety.

"It almost goes without saying," university director Sickorez says. "It is priority one. We know we can hurt somebody if we're not careful."

Hanger 990 is a "safe workplace and a hazardous playground," we're told. "Keep your head on a swivel" to watch for danger, we're warned.

And then John Yaniec, chief test director of the plane, gets really serious.

"You break my rules in this house and you go home," Yaniec says.

It's a three-prong obsession: Earthbound equipment concerns, in-flight equipment worries and medical safety in the air.

To start with, Yaniec says the plane is loaded with 50,000 pounds of fuel. If there were any sort of fire in the hanger, the entire 10-story structure would fill with foam in less than five seconds.

He warns us about FOD: foreign object damage. Trash or tools can become windborne weapons if they're hurled by jet exhaust. And such loose objects can be sucked into the plane's jet engines, which cost $350,000 a pop to replace.

All the staff is compulsive about tools. Students are allowed to use the hundreds of tools in two locked cabinets, but they have to sign out each item and then sign it back in.

"This is a hot issue for us," Yaniec says. "All tools are shadowed. If a tool is missing, that airplane does not leave the ground."

But even while being stern, Yaniec and all the other NASA staffers are quick with a sharp sense of humor.

"We're going to have some fun if you play by the rules," Yaniec says.

Before the fun, the UAH students

must finish building their ticket to space.

Their apparatus is simple: an odd-looking, 5-foot contraption of half-inch copper water pipe, a PVC disk cut to hold 10 tennis balls and a spring-loaded plunger to whack the balls loose one by one.

In zero G, a student wearing a black glove dotted with white spots will sit at the bottom of the apparatus, poised to catch a falling ball. Back in their Huntsville lab this fall, the moving dots captured on video tapes from two cameras will help the students analyze how the ball-catcher adjusted his or her reflexes.

"The basic concept here is that the brain is programmed from birth to realize that there is constant acceleration on Earth," Chris says. "Now, obviously, in microgravity, you have your initial velocity and no acceleration added to that."

Disoriented by zero G, the brain must adapt to the new environment.

"We're testing how long it takes to get back to your original coordination, for the brain to compensate," he says.

The students, who had shipped their apparatus to Houston in two over-size boxes, swelter as they weld it together with tin-based solder outside Hanger 990 in 95-degree heat.

They add the PVC disc they had made in a UAH machine shop. The disc has holes just large enough to snugly hold tennis balls, Above that is a plunger, fashioned from two springs and the round metal washer scavenged from a caulk gun.

Total cost: less than $150. It definitely isn't fancy, and it looks entirely different from the students' first sketch.

"You sit down and think about how you're actually going to make it and you realize there is just no way on God's green earth with the money you have," George says. "So then you start going through and methodically cutting out what isn't terribly necessary."

When it's finished, the contraption is space-worthy enough to withstand the pressure of 9G. It sails through the rigorous test readiness review as eight NASA experts poke and prod to find anything that would be a safety hazard in zero G.

To the common eye, it isn't pretty, but that perception is easily colored by the eye of a potential engineer and astronaut.

"It's beautiful," Chris says.

Flight notes: When the students first got their apparatus assembled, KC crew member Dominic Del Rosso fretted over the plunger part, worrying that a hand could get pinched or that all the stored-up energy in the spring could turn the plunger into a space dagger in zero G. The whole area needed a shield, he said.

So I loaded up Russell and George in my rented Saturn and took them to Target for engineering supplies.

University of Alabama-Huntsville student Russell Meyerriecks, of Fayetteville, Tenn., claps his hands together as he plays patty-cake to test his reflexes during five minutes of low oxygen in an altitude test chamber.

We wandered through the home-supply isles until they found a clear, over-size shoebox and a transparent, half-gallon Rubber Maid Seal and Save container. Back at the hanger, the students sawed, clipped and punched until they fitted the plastic over the top of their apparatus.

Such adaptations are a basic fact of the profession, Chris said.

"You go as simple as you can to get the data you want," he said. "Half of engineering is building the simplest, cheapest thing you can and still do it right."

Space perils

No one ever just steps onto the KC-135 and takes a joy ride in zero G. NASA's price for adventures in weightlessness is a basic version of what real astronauts get: lessons on hypoxia, hyperventilation, decompression sickness and spatial disorientation.

We start at 7:30 a.m. in Building 30 of Johnson Space Center, the windowless home of the famous mission control center.

We walk past the three, heavy stainless-steel doors, where NASA is monitoring the July flight of the shuttle *Atlantis*, to an amphitheater where the overload of space information begins.

We follow along in our 33-page handbook as NASA experts explain the hazards. We start with the percentages of nitrogen, oxygen, carbon dioxide and trace gases in the atmosphere and their effects on human respiration and circulation. We learn about Dalton's Law, which explains

hypoxia, a deficiency of oxygen to the brain. We study lung diagrams to understand hyperventilation, an abnormal increase in the rate and depth of breathing.

We spend almost an hour on decompression sickness and trapped gas.

At high altitudes, nitrogen in the blood can bubble up in joints or under the skin, causing excruciating pain. The agony from trapped air in the ear canals or sinuses can knock a pilot or astronaut out cold. And trapped gas in the stomach expands to three times its normal size at 25,000 feet, and keeps expanding as you go higher. Luckily, the instructor says, nature has provided humans with two natural vents for this gas ... one pointing forward and one to the aft.

In a session on spatial disorientation, we learn how it's impossible for the brain to be sure of up, down, left or right under certain conditions. That's the bane of pilots such as John F. Kennedy Jr., who probably was disoriented when he crashed his small plane into the Atlantic Ocean.

There's a big lecture on the causes of motion sickness. Upshot of that: No one knows for sure why people get sick, although stress, lack of visual clues and erratic head movements play a big role. Short people get sick more often than tall folks. A prescription-strength dose of scopolamine and dexedrine makes you 15% less likely to throw up. Eat before you fly, but make it light and nongreasy.

After lunch, we meet in small groups at Sonny Carter Training Facility, where the 40-foot-deep astronaut training pool is housed, for first-hand lessons on oxygen and hypoxia.

After 45 minutes of details on different air tanks and masks, we are fitted with olive green cloth "helmets" and stiff, black rubber masks that cover our faces from just below the eyes down to our chins.

With each of us looking like a bizarre Rocky the Squirrel, we sit in a narrow decompression chamber, sealed with a five-inch-thick door, along with three NASA guys who guard us against crazy behavior when we are deprived of oxygen at a simulated 25,000 feet.

With five more NASA safety personnel watching us through narrow, thick windows, we breath pure oxygen for 30 minutes to reduce the nitrogen levels in our blood. Then in just five minutes, the pressure — and oxygen — in the chamber drop and we take off our masks for five minutes.

To visualize the scene, think of the scene from *An Officer and a Gentleman*, when the Navy pilot trainees giggle, trying to play patty-cake while giddy from oxygen deprivation, and Richard Gere rushes over to save his buddy by replacing his oxygen mask.

No one in our group gets that silly or desperate, but after five minutes, thinking is real work. And it is easy to understand how the fuzzy-headed feeling could sneak up on astronauts, impair judgment and befuddle simple decisions.

After a slow "descent" to avoid decompression sickness, we debrief, take an open-book test on the day's information and receive our little blue cards that certify us for hazardous duty for the next three years.

After a sweaty day of experiment assembling and then nine more hours of medical training, we are clear for take-off. Next stop: zero G.

Flight notes: During chamber training, we filled out a simple questionnaire that got harder with each passing moment of low oxygen. At first, I made it through five simple math problems and I signed my name very legibly. But with a minute to go, my brain slowed down. Asked to list U.S. presidents in reverse order, I could only remember Bush and Clinton. Trying to write what NASA stood for, I put down "national space aerno" and couldn't get any further. And my last two signatures were sloppy imitations of the first.

If you have a low gag reflex, skip these next notes on motion sickness.

It's just a fact of life that people throw up during the up-and-down parabolas of the plane, a k a The Vomit Comet. In almost every session, all the staff members tried their best to take the embarrassed snickers out of the subject.

"If you're over 21, don't drink alcohol the night before," said test director Yaniec. "If you get sick, I guarantee I can tell you what kind (of alcohol) you were drinking. A good breakfast is an English muffin, a bagel or toast. Stay away from the bacon and eggs. And Cheerios and milk doesn't look too good the second time up. Remember, there is no gravity, folks. If you miss the bag, it becomes projectile, and it goes forever."

But he reassured us that throwing up wasn't a disgrace.

"I have been baptized nine times, and that's not with holy water," Yaniec said. "Up there, you're family. If you get sick, we're going to take care of you. We're going to give you bags, we're going to give you tissues, we're going to clean you up if we have to. Don't even worry about it."

University officer Sickorez summed it up.

"We're trying to make vomiting a pleasant experience," he said.

Leaving gravity behind

The day already is hot as we zip into our olive-green flight jumpsuits just after 7:30 a.m. on July 19.

With all the prerequisites completed, each college team is divided into two groups and assigned to one of four flight days. UAH students Chris and Russell go up the third day, with Elizabeth and George scheduled for the fourth. Lauren is an alternate in case any one of the four can't fly.

In the flight briefing, we sit with 12 other flyers for one last lesson on motion sickness, including specific instructions on how to tuck one white, plastic motion-sickness bag into each breast pocket of our suits where it would be handy at a moment's notice.

Motion sickness medication is optional, and none in the UAH team takes it because the drugs can affect the hand-eye coordination that is crucial to the experiment.

Next, pilot Stephanie Wells guides the plane through a smooth takeoff and a 15-minute flight to get out over the Gulf of Mexico into the restricted zone that prohibits other aircraft from flying nearby.

Now, the students are about to get their first taste of weightlessness.

How can a blind person get the concept of red? How can a person who has never escaped gravity understand the feeling of zero G?

Back on the ground after the flight, Russell and Chris struggle to describe the experience.

"It's like you're swimming and you don't have to come up for air," Russell says. "I figured it would be like, just smooth, but there I was floating and it was kind of dizzying."

"I had to remember to hold onto the straps to keep from floating straight to the ceiling," Chris says. "You just have to remember that if you push yourself in any direction, there is nothing substantial to stop you from moving, except for the side of the plane or the other fliers."

University of Alabama-Huntsville student Elizabeth Lampkin grabs the apparatus to keep from floating away while she tried to conduct a human coordination experiment in zero gravity with team member George Olden.

Up in the plane, all the students are busy with their experiments during most of the parabolas, which give them 25-second windows of zero G.

For the UAH experiment, Chris stands with his feet under nylon straps to anchor him down as he operates the plunger. Russell has a strap across his lap, holding him down as he tries to catch the tennis ball in his gloved hand.

The biggest surprises: It is almost impossible to plug in the catch pin of the plunger while struggling to stand upright. Chris just gives up and lines up the plunger by sight. And the ball is tough for Russell to catch, because with no gravity, it bounces off his palm before he can get his fingers to curl up to grab it.

But after 20 or 25 parabolas, most of the students polish off their experiment requirements and have time to play.

With his hands on the overhead strap and his feet dangling six inches off the floor, Chris "walks" down the cargo bay. Russell pulls his feet up and bounces his back off the ceiling.

The trick is getting the brain to realize that floating is OK, that we won't tumble down if we aren't upright. The crew members have it down pat and pull all kinds of stunts. One goes sailing past us down the cargo bay, stretched out on his back perfectly horizontal to the floor.

Despite refusing the medication, all four UAH students make it without motion sickness. But three students on our flight don't have much fun, even though the eight crew members constantly move up and down the cargo bay, handing out bits of hard candy to help settle our stomachs while checking to see if any one is pale green.

The reason for the nausea is the 2G force at the beginning of each parabola. The ride seems cool during zero G, but in 2G, breathing takes so much work that sweat dribbles down our rib cages. The only way to survive is to sit or lie down perfectly still.

"It really felt strange, much like the bottom of the big hill on a roller coaster, but prolonged," Chris says.

"I had never felt my stomach more than on this flight," Russell adds. "I knew where it was the whole time. It was like my stomach was saying, 'Hey, don't forget me. I can make you miserable if I feel like it.' "

With the benefit of some after-flight coaching from their teammates, Elizabeth and George fare better on their flight the next day.

They knock off their experiment in just about 15 parabolas, and then get the crew to help them do weightless somersaults.

"At first, it was almost an uneasy feeling because he just said, 'Curl up in a ball,' " Elizabeth says. "Your first reaction is, as soon as you curl up in a ball, you're going to fall straight to the floor. And so you curl up in a ball and you don't fall on the floor. Then it's just really neat because you really had the feeling you were weightless because you just spun, spun, spun right in the same place."

George notes a major body change in zero G.

"The one thing I really noticed was the strange feeling in my head," he says. "I was lightheaded, but not in the normal sense. It's not just that I was dizzy or about to pass out. Elizabeth said my face looked a little more flushed, but that's just because the gravity was not pulling all the blood from my head."

And then Elizabeth struggles to describe the 2G experience.

"It's like you're plastered up against something in a carnival ride, or like you're covered with a really thick mat or you've been dunked in a swimming pool and you've got really heavy clothes on and you can't move very fast. That's the best I can describe it."

"It's like being completely covered with that lead apron that they use when they take X-rays at the dentist's office," George adds. "If you were lying down flat, your cheeks kind of slide

back. That was an interesting feeling. It was a lot harder to lift up your arms and your legs. Even trying to sit up was a chore."

For the UAH students, the flights cement their desire to work in some phase of aerospace.

Lauren, the alternate, is determined to fly with a team next year.

Russell still is pinching himself to verify a dream come true.

"I first heard about the KC in eighth grade, and I thought, 'Oh, my gosh, that is so awesome,' " he says. "And here I am, becoming one of the very, very, very few who have experienced zero gravity for any length of time."

"It definitely nailed down engineering for me," Elizabeth says. "I've always had a lot of respect for NASA, but this gave me even more a sense of awe for astronauts."

"Now I'm even more motivated to find out what the real thing is like," Chris says.

"That's why this is just a good program," George adds. "You give a lot of people the opportunity to experience something that is truly beyond words."

Flight notes: Old people like me look 10 years younger in zero G, where there's no gravity to stretch down our sags and bags. My chin-length hair was too short to float like Elizabeth's long locks, but it puffed up to a really nice imitation of a '60s bouffant.

During the first few parabolas, I struggled to stay upright as my brain desperately tried to adjust to a completely new set of directional rules. Finally, I forced myself to release the overhead strap, pushed gently with my legs and staggered 10 feet across the cargo bay. Catching myself on the far side, I clung to the overhead strap and managed a very nice Spiderman imitation as I hovered above the UAH experiment.

Later, I had to change the film in my camera, which I figured had to be done while I was sitting in 2G so things wouldn't float away. The camera was heavy, the tiny film canister was heavy, my fingers were heavy and I was literally panting from the effort by the time I was done.

I brought home a few mementos of the trip: my official NASA name tag, my temporary pass to enter certain buildings at Johnson Space Center and a Weightless Wonder decal with the plane soaring through a parabola.

But my best souvenirs are right here on my desk: two shiny, white — and unused — motion-sickness bags.

Diane Long covers education for *The Tennessean*. Contact her at 726-5931.

DIANE LONG / STAFF

University of Wisconsin-Madison student Stephen Steiner bends over his plastic bag as he becomes the third motion-sickness casualty on the July 19 flight.

THE TENNESSEAN

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Odyssey and ecstasy

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Life

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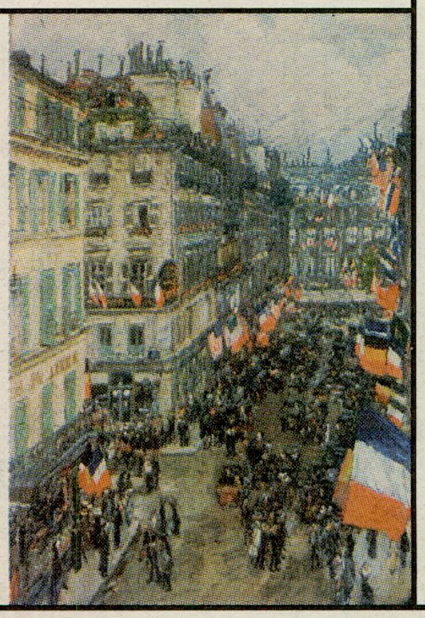

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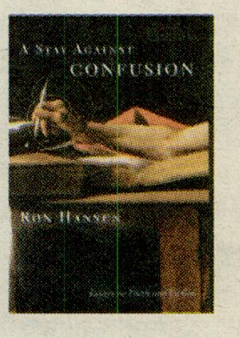

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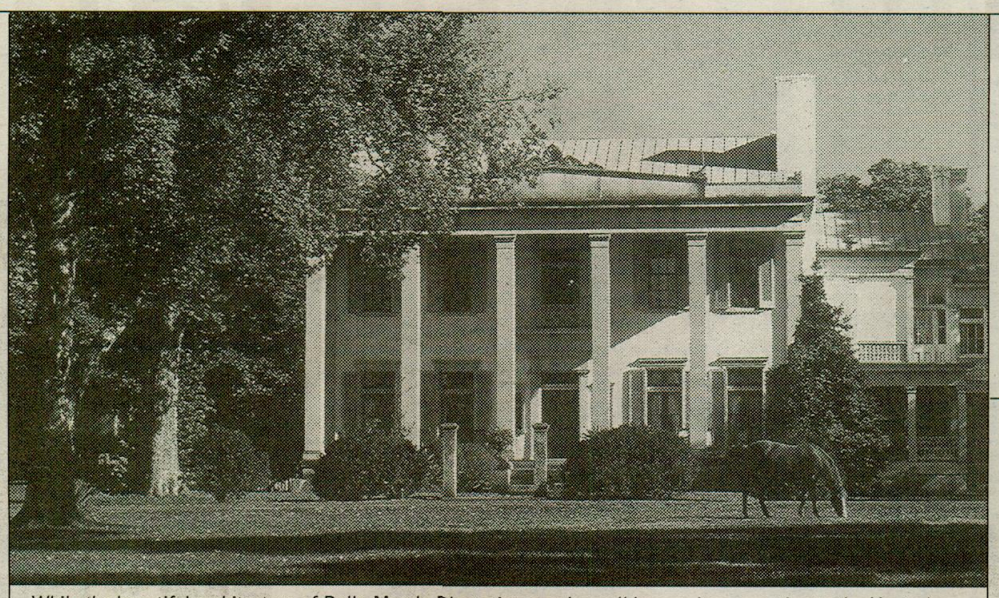
Belle Meade Plantation

Without the Harding family of the 1800s, a quarter of Nashville's streets and parks would be named something else, several presidents wouldn't have visited, and Kentucky horse racing would be pamphlet-thin instead of a 3-inch book.

Take a stroll across the "beautiful meadows" to the big house, with its limestone columns and tulip poplar doors, English rugs and New Revivalist Rococo furniture. The story begins with William Giles Harding, who made Belle Meade the profitable and upstanding name it continues to be.

Tours of the plantation home are available daily. A "new" addition to the permanent exhibit is a slave cabin, moved to Belle Meade in 2000. It is open daily for public browsing and for a special tour called Journey to Freedom. Reservations are required. Various exhibits are placed in the house throughout the year. Call 1-800-270-3991, www.bellemeadeplantation.com.



While the beautiful architecture of Belle Meade Plantation may be well known, its connection to the Kentucky Derby isn't.

1. The original log cabin on the property was purchased in 1807 by John Harding, a blacksmith at Dunham Station, along with 250 acres for $300. In 1815, his son, William Harding, watched from the cabin's hillside as Gen. Andrew Jackson led his soldiers home from the Battle of New Orleans during the War of 1812.

2. The original Belle Meade house was built in 1820. The federal style house experienced a devastating fire in 1851 and most of the mansion burned down. Harding rebuilt the house in 1853, doubling its size, adding a cantilever staircase and front porch with six 22-foot columns of solid limestone cut by hand from their own quarry.

3. At its height of wealth during the mid-1800s, the estate grew to 5,408 acres. As a self-sufficient plantation, Belle Meade smoked 20,000 pounds of pork as the year's supply for the people who lived there, including 136 slaves.

4. Nashville was the western depot of the Confederate Army. William Giles Harding was a Confederate sympathizer and gave half a million dollars toward the war effort. Politics aside, his family and estate came first, though. After his arrest in 1862 by the Union and imprisonment at Fort Mackinac, Harding agreed to cease any support for the Confederacy. After a few months, he was released on $20,000 bail and returned home.

5. Upon his return home, Gen. Harding swore not to cut his beard until the South won. Nashville fell to the Union Army that year. In 1886, a time when facial hair was out of fashion, he died with a very long, very white beard.

6. In 1864, Belle Meade was the site of one of the last Confederate battles to try and take Nashville back from the Union. Two hundred Union soldiers reportedly ran through the Belle Meade yard. On the main tour, you can view the only damage done to the house during the whole war: several bullet holes, hand-size craters in the limestone columns.

7. The carriage house became Belle Meade's provider, with racehorses and a track on the property. The Belle Meade jockey silks are the oldest known registered American jockey silks, registered in 1823 by the American National Jockey Club. The color is burgundy red, and the silks were retired in 1971.

8. Iroquois, a 16½-hand thoroughbred, was welcomed to the Belle Meade horse family in 1887 after having won the English Derby, upon which Iroquois became a national hero; Wall Street closed and a ticker tape parade was thrown in his honor. Strangely, the horse never won another race after that.

9. When state law prohibited gambling, Tennessee racetracks jumped the border to Kentucky. Our northern neighbors have enjoyed the racetrack market, but Belle Meade found another niche: stud breeding. Iroquois brought a $2,500 up-front stud fee with no guarantees. This in a time when a man's hourly wage was 12.5 cents. When the beloved horse died, Harding had two of his hooves cut off and sent them along with the horse's silver bit to Tiffany's in New York to be made into inkwells lined in sterling silver. They can be viewed in the gentlemen's parlor.

10. Gen. William Harding bought Bonnie Scotland at 19 years old and crippled in his left hind leg. He wasn't meant to win a race for the Hardings. Nonetheless, he was a good buy; every Kentucky Derby winner since 1972 save five horses has come from blood stock of Bonnie Scotland. You may have heard of a few of them: Secretariat, Seattle Slew, Sunday Silence, Charismatic.

11. President William H. Taft came to Belle Meade for several visits. On one occasion, being a clean and a particularly huge man at 370 pounds, he got stuck in the upstairs porcelain bathtub. By Taft's next visit, Harding had an overhead shower installed. Resembling a human carwash, it was state-of-the-art technology. Taft enjoyed the Needle Shower so thoroughly, he had one built just like it in the White House. That shower remained until Jackie Kennedy had it dismantled; it violated her sense of beauty in the bathroom.

12. Being a horse farm, Belle Meade acquired a lot of manure. As a self-sufficient plantation, they even figured a way to put the manure to use. Methane was an excellent source for electricity. Odorless and clean burning, methane gas was pumped throughout the newly remodeled house in 1853; meanwhile, fireplaces provided heat during winter.

13. Theodore Roosevelt was a hunting buddy of Harding's. As a token of friendship, Roosevelt gave Harding a chair made of huge Texas longhorns. It's gaudy, but genuine.

14. The magnolia is Belle Meade's signature tree. A 235-year-old magnolia sits between the carriage house and the back-side cooking quarters of the house. Its great skyward spread and knotting limbs shade many people and their picnics during live jazz performances on the lawn.

— KATIE SULKOWSKI / STAFF WRITER

WHATCHA KNOW? Got an idea of a place you'd like to learn a few things about? Better yet, got some inside information about such a place?
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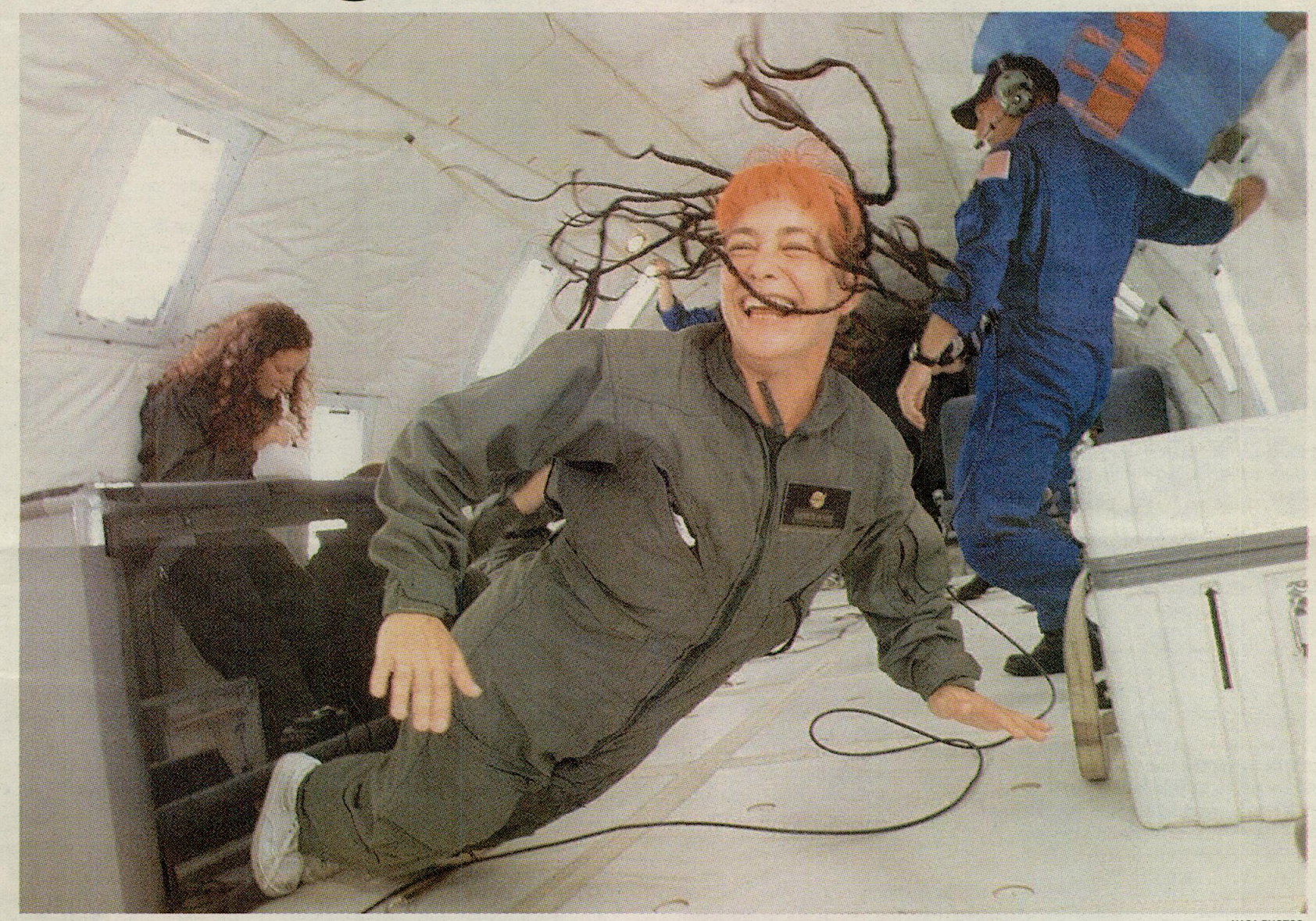
Flights of fancy



NASA PHOTOS

In a halo of floating braids, Elizabeth Jackson laughs as she bounces up from the floor while experiencing zero gravity on the KC-135. A student at the San Francisco Art Institute, Elizabeth dyed her bangs red to celebrate the event.

Aboard a modified Air Force plane, would-be space explorers (and one interested observer) soar above the ordinary

By DIANE LONG
Staff Writer

Surrounded by brilliant white, we grin goofily at each other as we sit stiff-backed on opposite sides of a stuffy airplane cargo bay.

It could be a weird scene from *2001: A Space Odyssey*, where they might stash astronauts who'd gone berserk in space. Clean, white floor cushioned with inch-thick foam. Padded walls and ceiling swathed in white vinyl. Clumps of strange-looking apparatus bolted to the floor.

But this is no movie scene. It's NASA's sleek KC-135, a modified Air Force gas tanker dubbed the "weightless wonder," flying out from Houston over the Gulf of Mexico on a hot July morning at more than 400 mph.

After takeoff, our small group of college students and journalists get up from the handful of regulation airline seats and scatter to our positions on the floor across the modified cargo bay.

Within minutes we all are sitting tensely, just like astronauts John Young, Neil Armstrong, Sally Ride or Bonnie Dunbar, waiting for what few people ever experience: the floating freedom of zero gravity.

Since 1959, a structurally reinforced KC-135, the military equivalent of a commercial Boeing 707, has been the

ON THE WEB

See video of the students as they float in weightlessness at www.tennessean.com.

High-flying studies

What do students investigate in zero gravity? Here's a sampling of experiments from the 96 teams that flew on the KC-135 this year.

• **San Francisco Art Institute:** To test human coordination, a student floated freely in zero G while wearing goggles and a black hood to block all visual cues. Then the student used a joystick to put a circle-shaped pointer exactly on top of another circle on a computer screen. A team also video-taped the behavior of butterflies and brine shrimp in zero G.

• **Colorado State University:** What's the best way for astronauts to exercise in space to avoid muscle atrophy during long stays on the International Space Station? A student was wired with electrodes to record the muscle activity in her legs as she bent down to pull up a bar connected to a machine that provided constant resistance. Team members had to revamp their experiment for the second day by adding a line that tethered the test subject's waist to the wall because, in zero G, she kept falling forward when she bent to pick up the bar.

• **Arizona State University:** How do you regulate the speed of objects that you need to separate in space? Adult researchers at the university are building a stack of three satellites that will be deployed as a unit from a future space shuttle. NASA's current method of separating the satellites is too fast, so this team of students tested both a tether and a magnetic force field to reduce the speed by 50% with minimal additional mass and no damage to delicate components attached to the outside of the satellites.

• **University of Arkansas**: Asteroids or comets could be rich sources of minerals if space colonists could efficiently locate and extract the resources. This experiment tested the effects of air velocity on a mix of silicate and metal particles in zero G. Such "fluidized particle sorting" could help define space mining.

• **University of Wisconsin-Madison:** Students tested their unique process that allows the formation of aerogel — a low-density solid that can bear hundreds of times its weight — in just seconds instead of the usual method, which can take hours. With the quick formation time, the aerogel can be hardened in zero G, which could produce completely different structures than in Earth-produced samples.

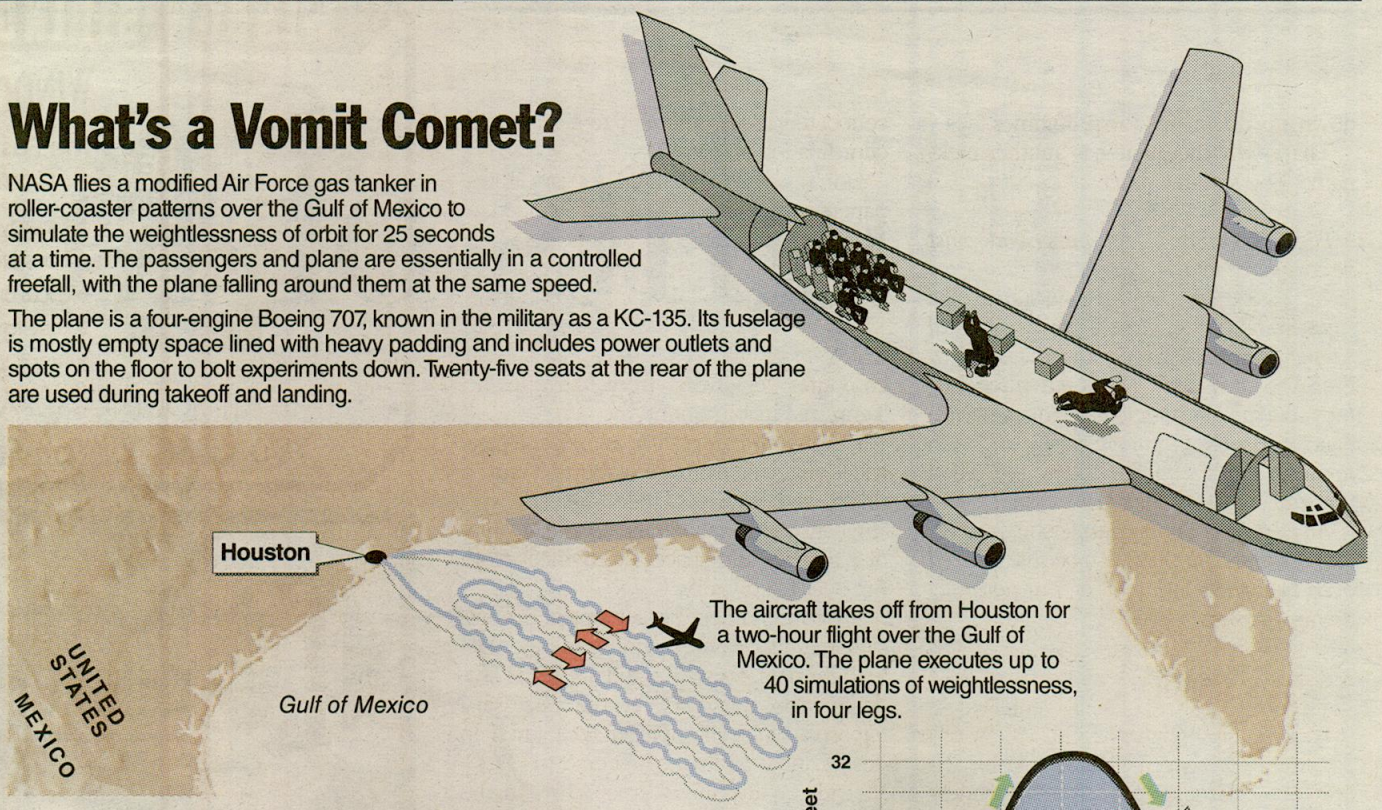
— DIANE LONG, STAFF WRITER

Students pose in a traditional post-flight photo that features the bag of motion-sickness refuse right up front. In six years, only one student flight has had no motion-sickness casualties.

What's a Vomit Comet?

NASA flies a modified Air Force gas tanker in roller-coaster patterns over the Gulf of Mexico to simulate the weightlessness of orbit for 25 seconds at a time. The passengers and plane are essentially in a controlled freefall, with the plane falling around them at the same speed.

The plane is a four-engine Boeing 707, known in the military as a KC-135. Its fuselage is mostly empty space lined with heavy padding and includes power outlets and spots on the floor to bolt experiments down. Twenty-five seats at the rear of the plane are used during takeoff and landing.

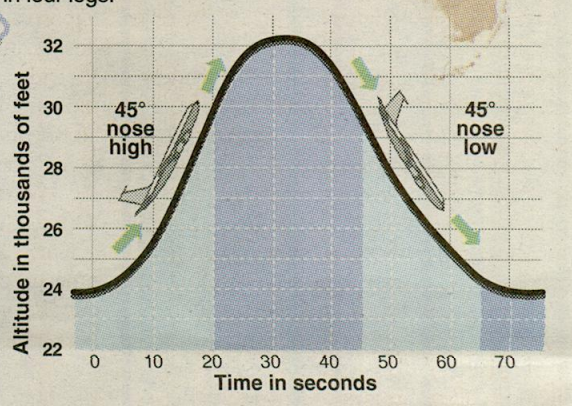


The aircraft takes off from Houston for a two-hour flight over the Gulf of Mexico. The plane executes up to 40 simulations of weightlessness, in four legs.

Ups and downs of gravity

The plane climbs at 45 degrees until reaching an altitude of about 32,000 feet. Then the pilot cuts the engines and coasts over the top of an arc, giving the passengers the same weightless sensation roller-coaster riders get on that first small hump after coming down the big hill. As the fall continues 45 degrees downward, passengers begin to feel gravity, eventually peaking at nearly twice the normal force of Earth's gravity.

*At 1.8 Gs, people who weigh 200 pounds would feel like they weigh 360 pounds.



GNS

flying laboratory for NASA's Reduced Gravity Program, operated out of Lyndon B. Johnson Space Center in Houston.

More than 80,000 times, the airplane has replicated zero-G flight for the purpose of preparing NASA's astronauts for space, testing the limits of hardware and human reactions in a weightless environment.

The experiments of the students on board for this July flight would follow in that tradition, testing everything from hand-eye coordination to space-mining techniques.

Everyone takes a deep breath as the plane's crew calls out, "Going up," and the airplane begins to zoom up from its cruising altitude of 24,000 feet. The drone of the jet engines kicks into a crescendo as the plane noses up at a 45-degree angle, climbing 8,000 feet in 20 seconds.

Logic insists that we should slide down the body of the plane to the tail section, rolling into a tangled clump of arms and legs. But sometimes physics is as simple as a child's trick.

Hold a bucket of water by the handle and spin around fast so the bucket flies out horizontally. Where does the water stay? In the bottom of the bucket.

In this case, we are the water in the bucket, plastered to the floor by almost twice Earth's normal gravity.

It glues us down. Breathing takes conscious effort to expand the rib cage. Around our mouths, the skin stretches down and pulls at our lips. The weight of each toe is clearly discernible inside our Nikes and Reeboks.

Just when the pressure seems unbearable, the plane hits the top of its big, bell-shaped parabola and the nose tilts down 45 degrees.

We began to float.

We watch in amazement as our arms start to rise up with absolutely no effort. Suddenly there is an inch or two of clear space between the floor and our backsides as our bodies strain up against our nylon lap straps.

Then we rip open the Velcro fasteners and stand up. It is way too easy.

With just the gentlest push of leg muscles, we find ourselves propelled upward and grabbing for the ceiling straps. The first impulse is to deny that we could be floating, to flail in an effort to keep our feet on the floor. Our brains click along in overload, trying to process how it could be that suddenly our feet are dangling and why keeping our balance in a vertical position is so difficult.

Tennessean reporter Diane Long fills out a questionnaire to test her alertness during a low-oxygen test in NASA's altitude chamber.

In 25 seconds, which seems more like five or six, the crew calls out, "Feet down, coming out." That's the signal that the plane has fallen 8,000 feet to the bottom of its parabola and is about to start another climb.

The next instance of double gravity — 2G in NASA lingo — plops us down like rocks, with enough force to snap a neck or crack an arm if we hadn't already positioned our feet and backsides toward the floor.

And so it continues, like a space-age roller coaster: 20 seconds of 2G, 25 seconds of weightlessness, 2G, zero G, up,

down, up, down, up, down, 30 times.

That's why the plane has another nickname: The Vomit Comet.

Flight notes: For NASA, paperwork must be completed to a T.

All the team members, including the reporter, had to pass FAA Class 3 medical exams. I faxed a copy of my certificate, but NASA wanted more: The handwritten doctor's note showing that I had recovered without complications from my drippy sinuses in January; the specification that my blood pressure was 114/68, not just "normal."

And because I'm an old person, over 35, NASA wanted an EKG. To be safe, I faxed over the whole printout of my normally thumping heart.

Serious science

Back about 1995, the KC-135 flew 634 parabolas just so Tom Hanks and his fellow actors could film the weightless scenes in the hit movie *Apollo 13*.

But there's more to the KC than the novelty of weightlessness.

For four decades, it's provided zero-G training for astronauts, and it's been the lab for hundreds of university researchers whose experiments interest NASA. The costs are steep: To get on the KC, scientists pay $6,500 per hour of flight time.

Six years ago, the program expanded to include college students: up to 96 teams of four students and a professional journalist each. NASA picks up the tab, creating an opportunity for young astronaut wannabes and budding engineers to get their first taste of space.

"We're providing them with a capstone experience," says Don Sickorez, university affairs officer for Johnson Space Center.

"They've done pieces of this all through their college career: They've done analysis, they've done tests, they've done design, they've done implementation," he says. "But they've never pulled it all together like this. The kids work harder than they ever thought they would, and they don't mind."

During the July-August summer campaign, students from 34 universities throughout the country made their pilgrimage to Houston to test their experiments.

At the University of Alabama-Huntsville, the process began this past September in the UAH chapter of Students for the Exploration and Development of Space.

Of the 15 or so interested students, one team missed the proposal application deadline in March. Another team's proposal was rejected.

But a team of five engineering students, representing Tennessee, Alabama, California and Texas, had the right stuff as they concocted an experiment to test human coordination in zero G.

Don't be surprised if, in 20 years, newspapers report that humans have landed on Mars and among the astronauts are:

• Chris Brown, an aerospace engineer and spacecraft pilot from Birmingham, Ala.

• Russell Meyerriecks, an aerospace computer engineer from Fayetteville, Tenn., in Lincoln County.

• Elizabeth Lampkin, an aerospace electrical engineer from Petersburg, Tenn., a tiny town near Fayetteville.

• Lauren Meisenheimer, an extra-vehicular activity and spacesuit engineer from Big Bear Lake, Calif.

• George Olden, an aerospace propulsion engineer from Austin, Texas.

Right now, these five still are UAH students who must collect the necessary expertise while chomping at the bit to help design and then fly the first craft to Mars.

"Didn't you know?" asks Chris in the most matter-of-fact manner. "I'm going to be the first man on Mars."

But you'd never know you were meeting a potential Mars crew if you met these young adults on the street.

Chris, 20, probably will be bald by the time he gets to space. But he'll undoubtedly have the same, quiet, laid-back manner, and his quick brown eyes will still catch all the action as he steps in easily to assume the duties of team leader.

With her long, black hair and easy, outdoorsy manner, 22-year-old Elizabeth would look right at home galloping across the range. Animals are her second love, and her two horses are waiting patiently on her parents' farm.

A merry but gentle mischief lights up 18-year-old Russell's twinkling green eyes as he flaps up in his unbuckled brown sandals, taps someone on the shoulder and quickly sneaks to the person's other side.

Lauren, 18, talks at a quick California click about off-roading in her Jeep or the ever-growing tattoo on the small of her back, now featuring her Leo zodiac sign and Chinese wave symbols.

Towering above everyone at 6-foot-3, 19-year-old George could easily parlay his guitar talent, black wrap-around sunglasses and hip mustache and goatee into a rock star's role.

But since childhood, all five have been dabbling in astronomy, shooting off model rockets or just taking things apart. At lunch, it takes only a casual comment to turn the conversation into a hot discussion of different types of aircraft, Newton's law or Einstein's theory of relativity.

That burning interest is pushing them through the rigorous engineering program at UAH. They're each dedicating at least five years to get all the necessary classes, and there are master's degrees and even

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So, you want to be an astronaut

Millions of American children have dreamed of soaring into space, but only a few end up with the right stuff to become an astronaut.

Since 1959, just more than 38,200 people have applied to fill 310 slots in NASA's astronaut program, a selection rate of 0.8%. That shouldn't necessarily discourage folks from applying, says Duane Ross, head of astronaut selection since 1978.

"Your chance of getting selected is less than 1%," Ross told a group of college students with the reduced-gravity research program last month in Houston. "It's a very competitive process, but you've got to try, because we're not going to take anybody who doesn't apply."

He was quick to dispel myths about the glamour of space duty, which is open to all U.S. citizens of any age who meet the rigorous educational and medical qualifications and have the professional experience.

"What most people know is what they see on television," Ross says. "What you see on television is all the fun stuff. A lot of it's not much fun. It's sitting around in hangers ... listening to people drone on about stuff you're not interested in, though it's needed and all that kind of stuff. So we want to make sure (astronaut candidates) understand what the job is all about."

Astronauts and their families make a huge commitment when it comes to hours on the job. Ross makes sure that candidates understand the norm is 80 hours a week, extending to 120 as the flight draws near.

"When we offer them a job, we don't want them to go into it blindly," he says. "We want them know exactly what they're getting into. We've had people turn us down in the past. We've had like three people we offered the job to ... and they said, 'Hey, it's probably not for me.' You want to know that up front, not after you've spent a million dollars training them."

If most of the long hours on the job aren't very glamorous, neither is the salary.

"Astronauts are government employees ... and they make a standard government employee wage," Ross says. "Most of them start at about GS-13, about $70,000-$75,000 year. There's no overtime. No premium pay of any kind. No hazardous duty pay. The highest-paid astronaut we have right now makes about $120,000. You can go work for Dell or Microsoft and make a lot more money than that. As a matter of fact, the person who runs the Houston Public Library makes more than our senior astronaut."

Astronauts are selected and trained at Johnson Space Center in Houston. Applications are accepted continuously and selections are made every two years. The next scheduled selection was set for August 2002 but has been delayed until at least the summer of 2003 for budget reasons, Ross says.

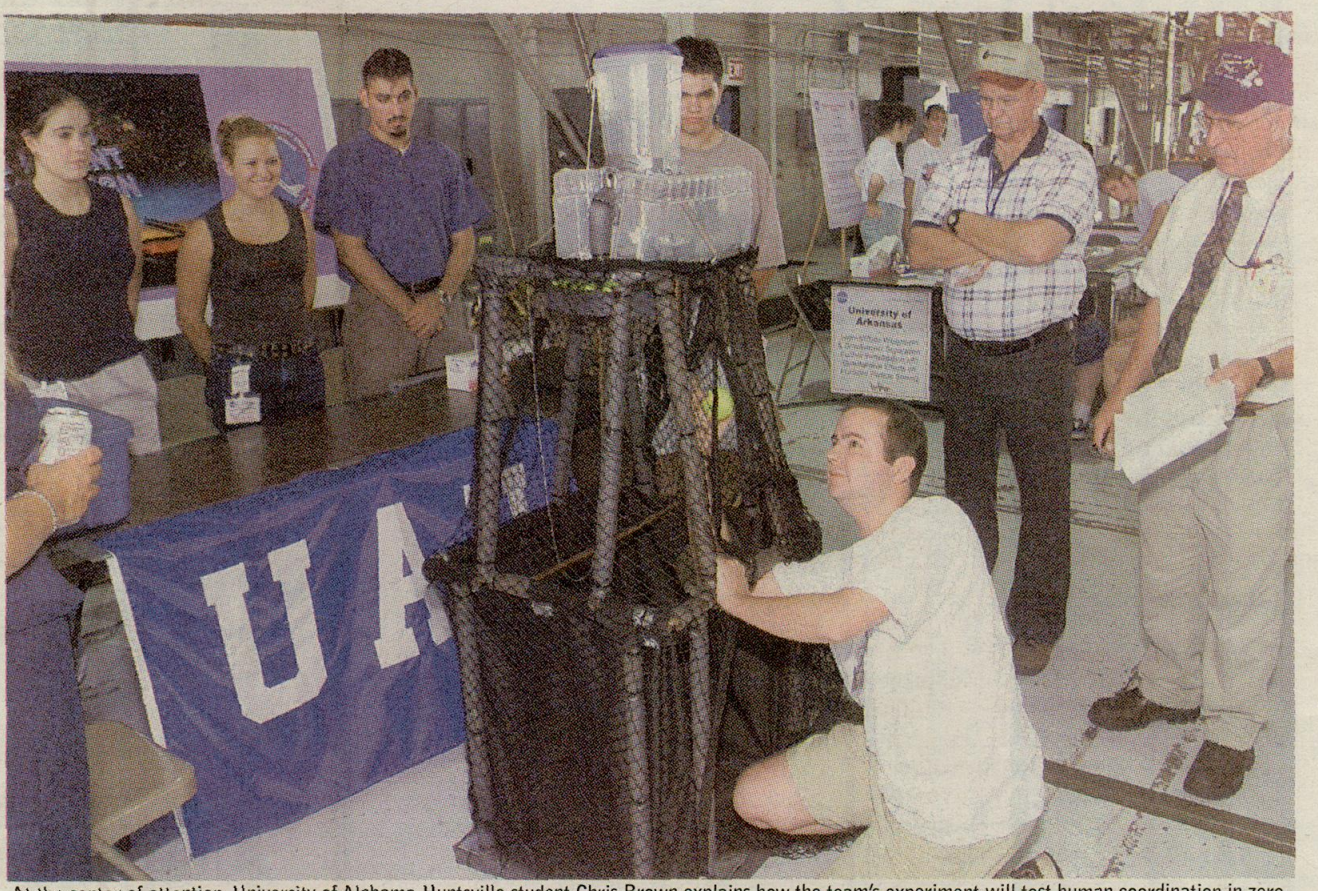
In the 2000 astronaut class, 3,015 applicants were narrowed down to 123 interviewees, a painstaking task performed by a rating panel mostly composed of senior astronauts.

"Bless their hearts, they do a very conscientious and thorough job in looking at all those applications," Ross says. "Our position is that every package of paper we get is from some mother's son or daughter and they deserve a fair shake."

The 123 semifinalists came to Houston for a week of comprehensive medical tests and an individual interview with panel members before the final 17 were selected.

"It's not a technical grilling. It's not a test. It's just an interview to find out what kind of person you are," Ross says. "The question is, would you want to go into space with this person?"

— DIANE LONG, STAFF WRITER



At the center of attention, University of Alabama-Huntsville student Chris Brown explains how the team's experiment will test human coordination in zero gravity. From left are team members Elizabeth Lampkin, Lauren Meisenheimer, George Olden, Russell Meyerriecks and NASA staffers John Lamb and John Yaniec.

doctorates ahead as they prepare for a future of flight.

And now, in just days, they would find out first-hand if their dreams mesh with the reality of space.

Flight notes: NASA loves acronyms. Here's a typical conversation that any NASA staffer in Houston would understand:

"Let's start at JSC with a check on EVA before we go over to the MCC. If the ASCANs don't need us at the NBL, we'll swing by Ellington to catch the students' TRR. And we might get to see the KC if it's not out for HAT."

Translation: "Let's start at the Johnson Space Center with a check on extra-vehicular activity systems (suits used for space walks) before we go over to the Mission Control Center (where all space flights are monitored). If the astronaut candidates don't need us at the neutral buoyancy lab (the giant pool where astronauts train underwater), we'll swing by Ellington (Field, an airport) to catch the students' test readiness review (to make sure experiments are safe). And we might get to see the KC-135 (airplane) if it's not out for heavy aircraft training."

Unconfirmed rumor: Somewhere in NASA-land, there's a manual that lists all the acronyms used by the agency, a book that's supposedly two or three inches thick.

The ground rules

It's just before 10 a.m. on July 12, and the temperature already is soaring above 90 degrees. Ten teams of students are settling into Hanger 990 on Ellington Field, about 10 miles from Johnson Space Center at the southern edge of Houston's city limits.

In the shade of the soaring walls and roof, on a spotless concrete floor, sits the KC-135, white body and blue racing stripe gleaming from a full-body wash in Oklahoma just days before.

The mere sight of our ride to weightlessness ratchets up the excitement. In the next six days, we will need that adrenaline to jump through NASA's safety hoops and procedures that start just after sunrise every morning.

If NASA folks are sticklers for paperwork, they're positively rabid about safety.

"It almost goes without saying," university director Sickorez says. "It is priority one. We know we can hurt somebody if we're not careful."

Hanger 990 is a "safe workplace and a hazardous playground," we're told. "Keep your head on a swivel" to watch for danger, we're warned.

And then John Yaniec, chief test director of the plane, gets really serious.

"You break my rules in this house and you go home," Yaniec says.

It's a three-prong obsession: Earthbound equipment concerns, in-flight equipment worries and medical safety in the air.

To start with, Yaniec says the plane is loaded with 50,000 pounds of fuel. If there were any sort of fire in the hanger, the entire 10-story structure would fill with foam in less than five seconds.

He warns us about FOD: foreign object damage. Trash or tools can become windborne weapons if they're hurled by jet exhaust. And such loose objects can be sucked into the plane's jet engines, which cost $350,000 a pop to replace.

All the staff is compulsive about tools. Students are allowed to use the hundreds of tools in two locked cabinets, but they have to sign out each item and then sign it back in.

"This is a hot issue for us," Yaniec says. "All tools are shadowed. If a tool is missing, that airplane does not leave the ground."

But even while being stern, Yaniec and all the other NASA staffers are quick with a sharp sense of humor.

"We're going to have some fun if you play by the rules," Yaniec says.

Before the fun, the UAH students

must finish building their ticket to space.

Their apparatus is simple: an odd-looking, 5-foot contraption of half-inch copper water pipe, a PVC disk cut to hold 10 tennis balls and a spring-loaded plunger to whack the balls loose one by one.

In zero G, a student wearing a black glove dotted with white spots will sit at the bottom of the apparatus, poised to catch a falling ball. Back in their Huntsville lab this fall, the moving dots captured on video tapes from two cameras will help the students analyze how the ball-catcher adjusted his or her reflexes.

"The basic concept here is that the brain is programmed from birth to realize that there is constant acceleration on Earth," Chris says. "Now, obviously, in microgravity, you have your initial velocity and no acceleration added to that."

Disoriented by zero G, the brain must adapt to the new environment.

"We're testing how long it takes to get back to your original coordination, for the brain to compensate," he says.

The students, who had shipped their apparatus to Houston in two over-size boxes, swelter as they weld it together with tin-based solder outside Hanger 990 in 95-degree heat.

They add the PVC disc they had made in a UAH machine shop. The disc has holes just large enough to snugly hold tennis balls, Above that is a plunger, fashioned from two springs and the round metal washer scavenged from a caulk gun.

Total cost: less than $150. It definitely isn't fancy, and it looks entirely different from the students' first sketch.

"You sit down and think about how you're actually going to make it and you realize there is just no way on God's green earth with the money you have," George says. "So then you start going through and methodically cutting out what isn't terribly necessary."

When it's finished, the contraption is space-worthy enough to withstand the pressure of 9G. It sails through the rigorous test readiness review as eight NASA experts poke and prod to find anything that would be a safety hazard in zero G.

To the common eye, it isn't pretty, but that perception is easily colored by the eye of a potential engineer and astronaut.

"It's beautiful," Chris says.

Flight notes: When the students first got their apparatus assembled, KC crew member Dominic Del Rosso fretted over the plunger part, worrying that a hand could get pinched or that all the stored-up energy in the spring could turn the plunger into a space dagger in zero G. The whole area needed a shield, he said.

So I loaded up Russell and George in my rented Saturn and took them to Target for engineering supplies.

University of Alabama-Huntsville student Russell Meyerriecks, of Fayetteville, Tenn., claps his hands together as he plays patty-cake to test his reflexes during five minutes of low oxygen in an altitude test chamber.

We wandered through the home-supply isles until they found a clear, over-size shoebox and a transparent, half-gallon Rubber Maid Seal and Save container. Back at the hanger, the students sawed, clipped and punched until they fitted the plastic over the top of their apparatus.

Such adaptations are a basic fact of the profession, Chris said.

"You go as simple as you can to get the data you want," he said. "Half of engineering is building the simplest, cheapest thing you can and still do it right."

Space perils

No one ever just steps onto the KC-135 and takes a joy ride in zero G. NASA's price for adventures in weightlessness is a basic version of what real astronauts get: lessons on hypoxia, hyperventilation, decompression sickness and spatial disorientation.

We start at 7:30 a.m. in Building 30 of Johnson Space Center, the windowless home of the famous mission control center.

We walk past the three, heavy stainless-steel doors, where NASA is monitoring the July flight of the shuttle *Atlantis*, to an amphitheater where the overload of space information begins.

We follow along in our 33-page handbook as NASA experts explain the hazards. We start with the percentages of nitrogen, oxygen, carbon dioxide and trace gases in the atmosphere and their effects on human respiration and circulation. We learn about Dalton's Law, which explains

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hypoxia, a deficiency of oxygen to the brain. We study lung diagrams to understand hyperventilation, an abnormal increase in the rate and depth of breathing.

We spend almost an hour on decompression sickness and trapped gas.

At high altitudes, nitrogen in the blood can bubble up in joints or under the skin, causing excruciating pain. The agony from trapped air in the ear canals or sinuses can knock a pilot or astronaut out cold. And trapped gas in the stomach expands to three times its normal size at 25,000 feet, and keeps expanding as you go higher. Luckily, the instructor says, nature has provided humans with two natural vents for this gas ... one pointing forward and one to the aft.

In a session on spatial disorientation, we learn how it's impossible for the brain to be sure of up, down, left or right under certain conditions. That's the bane of pilots such as John F. Kennedy Jr., who probably was disoriented when he crashed his small plane into the Atlantic Ocean.

There's a big lecture on the causes of motion sickness. Upshot of that: No one knows for sure why people get sick, although stress, lack of visual clues and erratic head movements play a big role. Short people get sick more often than tall folks. A prescription-strength dose of scopolamine and dexedrine makes you 15% less likely to throw up. Eat before you fly, but make it light and nongreasy.

After lunch, we meet in small groups at Sonny Carter Training Facility, where the 40-foot-deep astronaut training pool is housed, for first-hand lessons on oxygen and hypoxia.

After 45 minutes of details on different air tanks and masks, we are fitted with olive green cloth "helmets" and stiff, black rubber masks that cover our faces from just below the eyes down to our chins.

With each of us looking like a bizarre Rocky the Squirrel, we sit in a narrow decompression chamber, sealed with a five-inch-thick door, along with three NASA guys who guard us against crazy behavior when we are deprived of oxygen at a simulated 25,000 feet.

With five more NASA safety personnel watching us through narrow, thick windows, we breath pure oxygen for 30 minutes to reduce the nitrogen levels in our blood. Then in just five minutes, the pressure — and oxygen — in the chamber drop and we take off our masks for five minutes.

To visualize the scene, think of the scene from *An Officer and a Gentleman*, when the Navy pilot trainees giggle, trying to play patty-cake while giddy from oxygen deprivation, and Richard Gere rushes over to save his buddy by replacing his oxygen mask.

No one in our group gets that silly or desperate, but after five minutes, thinking is real work. And it is easy to understand how the fuzzy-headed feeling could sneak up on astronauts, impair judgment and befuddle simple decisions.

After a slow "descent" to avoid decompression sickness, we debrief, take an open-book test on the day's information and receive our little blue cards that certify us for hazardous duty for the next three years.

After a sweaty day of experiment assembling and then nine more hours of medical training, we are clear for take-off. Next stop: zero G.

Flight notes: During chamber training, we filled out a simple questionnaire that got harder with each passing moment of low oxygen. At first, I made it through five simple math problems and I signed my name very legibly. But with a minute to go, my brain slowed down. Asked to list U.S. presidents in reverse order, I could only remember Bush and Clinton. Trying to write what NASA stood for, I put down "national space aerno" and couldn't get any further. And my last two signatures were sloppy imitations of the first.

If you have a low gag reflex, skip these next notes on motion sickness.

It's just a fact of life that people throw up during the up-and-down parabolas of the plane, a k a The Vomit Comet. In almost every session, all the staff members tried their best to take the embarrassed snickers out of the subject.

"If you're over 21, don't drink alcohol the night before," said test director Yaniec. "If you get sick, I guarantee I can tell you what kind (of alcohol) you were drinking. A good breakfast is an English muffin, a bagel or toast. Stay away from the bacon and eggs. And Cheerios and milk doesn't look too good the second time up. Remember, there is no gravity, folks. If you miss the bag, it becomes projectile, and it goes forever."

But he reassured us that throwing up wasn't a disgrace.

"I have been baptized nine times, and that's not with holy water," Yaniec said. "Up there, you're family. If you get sick, we're going to take care of you. We're going to give you bags, we're going to give you tissues, we're going to clean you up if we have to. Don't even worry about it."

University officer Sickorez summed it up.

"We're trying to make vomiting a pleasant experience," he said.

Leaving gravity behind

The day already is hot as we zip into our olive-green flight jumpsuits just after 7:30 a.m. on July 19.

With all the prerequisites completed, each college team is divided into two groups and assigned to one of four flight days. UAH students Chris and Russell go up the third day, with Elizabeth and George scheduled for the fourth. Lauren is an alternate in case any one of the four can't fly.

In the flight briefing, we sit with 12 other flyers for one last lesson on motion sickness, including specific instructions on how to tuck one white, plastic motion-sickness bag into each breast pocket of our suits where it would be handy at a moment's notice.

University of Alabama-Huntsville student Elizabeth Lampkin grabs the apparatus to keep from floating away while she tried to conduct a human coordination experiment in zero gravity with team member George Olden.

Motion sickness medication is optional, and none in the UAH team takes it because the drugs can affect the hand-eye coordination that is crucial to the experiment.

Next, pilot Stephanie Wells guides the plane through a smooth takeoff and a 15-minute flight to get out over the Gulf of Mexico into the restricted zone that prohibits other aircraft from flying nearby.

Now, the students are about to get their first taste of weightlessness.

How can a blind person get the concept of red? How can a person who has never escaped gravity understand the feeling of zero G?

Back on the ground after the flight, Russell and Chris struggle to describe the experience.

"It's like you're swimming and you don't have to come up for air," Russell says. "I figured it would be like, just smooth, but there I was floating and it was kind of dizzying."

"I had to remember to hold onto the straps to keep from floating straight to the ceiling," Chris says. "You just have to remember that if you push yourself in any direction, there is nothing substantial to stop you from moving, except for the side of the plane or the other fliers."

Up in the plane, all the students are busy with their experiments during most of the parabolas, which give them 25-second windows of zero G.

For the UAH experiment, Chris stands with his feet under nylon straps to anchor him down as he operates the plunger. Russell has a strap across his lap, holding him down as he tries to catch the tennis ball in his gloved hand.

The biggest surprises: It is almost impossible to plug in the catch pin of the plunger while struggling to stand upright. Chris just gives up and lines up the plunger by sight. And the ball is tough for Russell to catch, because with no gravity, it bounces off his palm before he can get his fingers to curl up to grab it.

But after 20 or 25 parabolas, most of the students polish off their experiment requirements and have time to play.

With his hands on the overhead strap and his feet dangling six inches off the floor, Chris "walks" down the cargo bay. Russell pulls his feet up and bounces his back off the ceiling.

The trick is getting the brain to realize that floating is OK, that we won't tumble down if we aren't upright. The crew members have it down pat and pull all kinds of stunts. One goes sailing past us down the cargo bay, stretched out on his back perfectly horizontal to the floor.

Despite refusing the medication, all four UAH students make it without motion sickness. But three students on our flight don't have much fun, even though the eight crew members constantly move up and down the cargo bay, handing out bits of hard candy to help settle our stomachs while checking to see if any one is pale green.

The reason for the nausea is the 2G force at the beginning of each parabola. The ride seems cool during zero G, but in 2G, breathing takes so much work that sweat dribbles down our rib cages. The only way to survive is to sit or lie down perfectly still.

"It really felt strange, much like the bottom of the big hill on a roller coaster, but prolonged," Chris says.

"I had never felt my stomach more than on this flight," Russell adds. "I knew where it was the whole time. It was like my stomach was saying, 'Hey, don't forget me. I can make you miserable if I feel like it.' "

With the benefit of some after-flight coaching from their teammates, Elizabeth and George fare better on their flight the next day.

They knock off their experiment in just about 15 parabolas, and then get the crew to help them do weightless somersaults.

"At first, it was almost an uneasy feeling because he just said, 'Curl up in a ball,' " Elizabeth says. "Your first reaction is, as soon as you curl up in a ball, you're going to fall straight to the floor. And so you curl up in a ball and you don't fall on the floor. Then it's just really neat because you really had the feeling you were weightless because you just spun, spun, spun right in the same place."

George notes a major body change in zero G.

"The one thing I really noticed was the strange feeling in my head," he says. "I was lightheaded, but not in the normal sense. It's not just that I was dizzy or about to pass out. Elizabeth said my face looked a little more flushed, but that's just because the gravity was not pulling all the blood from my head."

And then Elizabeth struggles to describe the 2G experience.

"It's like you're plastered up against something in a carnival ride, or like you're covered with a really thick mat or you've been dunked in a swimming pool and you've got really heavy clothes on and you can't move very fast. That's the best I can describe it."

"It's like being completely covered with that lead apron that they use when they take X-rays at the dentist's office," George adds. "If you were lying down flat, your cheeks kind of slide

TO LEARN MORE

Student teams from any college or university can apply to fly their zero-gravity experiments aboard the KC-135.

For information about NASA's overall reduced-gravity program, check the Internet at jsc-aircraft-ops.jsc.nasa.gov/ rgpindex.htm.

Specific information about preparing a student team proposal is on the Web at www.tsgc.utexas.edu/floatn.

Midstate students can get help from the Tennessee Space Grant Consortium, based at Vanderbilt University and dedicated to promoting aerospace and general scientific education to students of all levels.

"We can do the legwork for them," says Alvin Stauss, consortium director and a professor of mechanical engineering.

For more information, check the Internet at www.vanderbilt.edu/~ruby/HomePage.html or call Ellie Weiss-Rosenbloom, program coordinator, at 343-1148.

— DIANE LONG, STAFF WRITER

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back. That was an interesting feeling. It was a lot harder to lift up your arms and your legs. Even trying to sit up was a chore."

For the UAH students, the flights cement their desire to work in some phase of aerospace.

Lauren, the alternate, is determined to fly with a team next year.

Russell still is pinching himself to verify a dream come true.

"I first heard about the KC in eighth grade, and I thought, 'Oh, my gosh, that is so awesome,' " he says. "And here I am, becoming one of the very, very, very, very few who have experienced zero gravity for any length of time."

"It definitely nailed down engineering for me," Elizabeth says. "I've always had a lot of respect for NASA, but this gave me even more a sense of awe for astronauts."

"Now I'm even more motivated to find out what the real thing is like," Chris says.

"That's why this is just a good program," George adds. "You give a lot of people the opportunity to experience something that is truly beyond words."

Flight notes: Old people like me look 10 years younger in zero G, where there's no gravity to stretch down our sags and bags. My chin-length hair was too short to float like Elizabeth's long locks, but it puffed up to a really nice imitation of a '60s bouffant.

During the first few parabolas, I struggled to stay upright as my brain desperately tried to adjust to a completely new set of directional rules. Finally, I forced myself to release the overhead strap, pushed gently with my legs and staggered 10 feet across the cargo bay. Catching myself on the far side, I clung to the overhead strap and managed a very nice Spiderman imitation as I hovered above the UAH experiment.

Later, I had to change the film in my camera, which I figured had to be done while I was sitting in 2G so things wouldn't float away. The camera was heavy, the tiny film canister was heavy, my fingers were heavy and I was literally panting from the effort by the time I was done.

I brought home a few mementos of the trip: my official NASA name tag, my temporary pass to enter certain buildings at Johnson Space Center and a Weightless Wonder decal with the plane soaring through a parabola.

But my best souvenirs are right here on my desk: two shiny, white — and unused — motion-sickness bags. ■

Diane Long covers education for *The Tennessean*. Contact her at 726-5931.

DIANE LONG / STAFF

University of Wisconsin-Madison student Stephen Steiner bends over his plastic bag as he becomes the third motion-sickness casualty on the July 19 flight.

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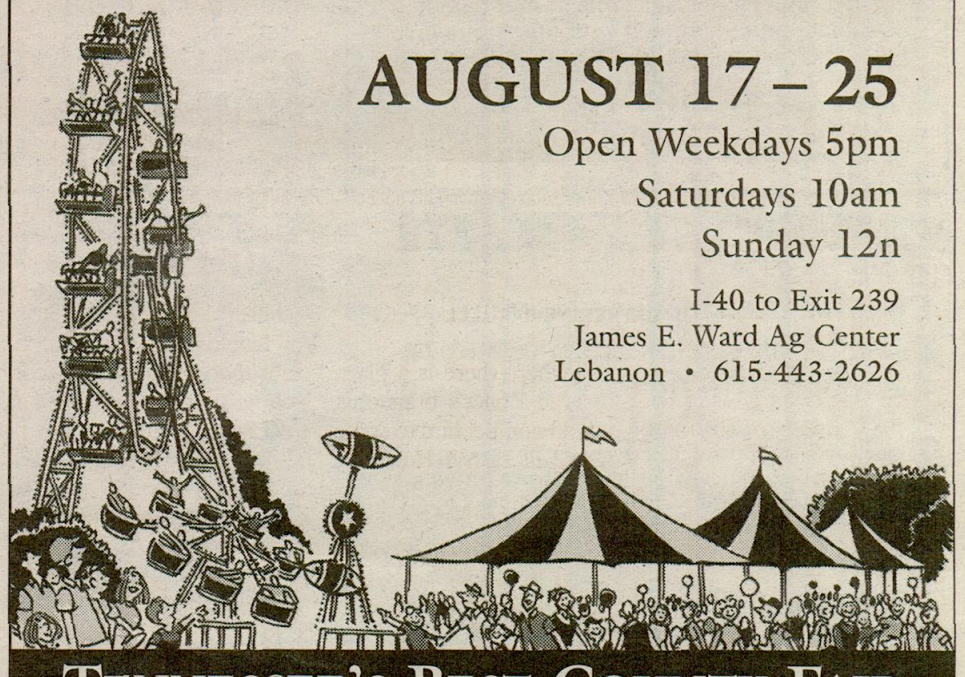

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DREXEL

The Alumni Magazine of Drexel University Vol.12/No.3, Summer 2001

Zero Gravity!

Engineering students Lauren Shor and Gary Walls perform an experiment on NASA's "Vomit Comet."

Blue and Gold Days: Catch the Spirit!

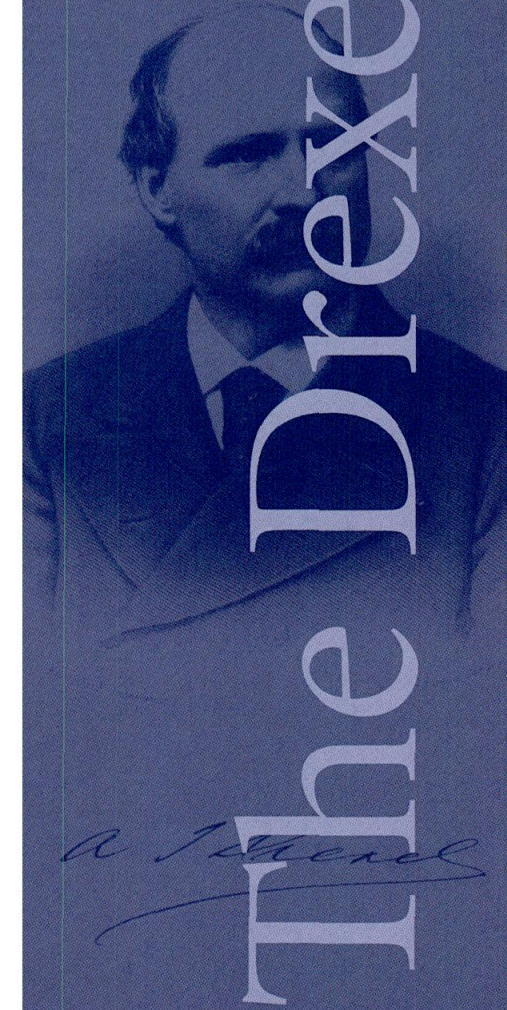
You and

Your Family

are Invited

to be Part of

The Drexel Legacy



Jalyn A. Sheppard '03 received an 2001 Alumni Board of Governors Legacy Scholarship for her overall scholastic achievement and community involvement. Jalyn has a dual major in accounting and retail marketing and expects to receive a BS/MBA in June 2003. She is a member of Phi Mu sorority and the Varsity Crew team, and received an Anthony J. Drexel Scholarship. Jalyn's parents are W. Keith Sheppard '73 and Lauri Fetteroff Sheppard '73.

Great Ways to Help Others Get a Drexel Education

Drexel alumni such as the Sheppards now have a range of special opportunities to help their children, grandchildren and friends advance the legacy of a Drexel education. Here are some of the ways:

Alumni-Trustee Endorsement Grants

Students whom you refer are eligible for a $1,000 grant toward their first-year tuition for full-time undergraduate or graduate studies at Drexel or MCP Hahnemann Universities. To benefit from this grant program, students must submit an alumni endorsement by the application deadline.

Children of Alumni Grant

Your children are eligible for an additional $1,400 grant toward their full-time undergraduate tuition at Drexel. And, yes, children of alumni automatically qualify for the Alumni-Trustee Endorsement Grant.

Grad Grant

Bachelor's degree graduates of the classes of 1998, 1999, 2000 or 2001 can benefit by continuing their education at the University. For every credit hour students earn during their first post-graduate year, they will receive a $100 grant from the University.

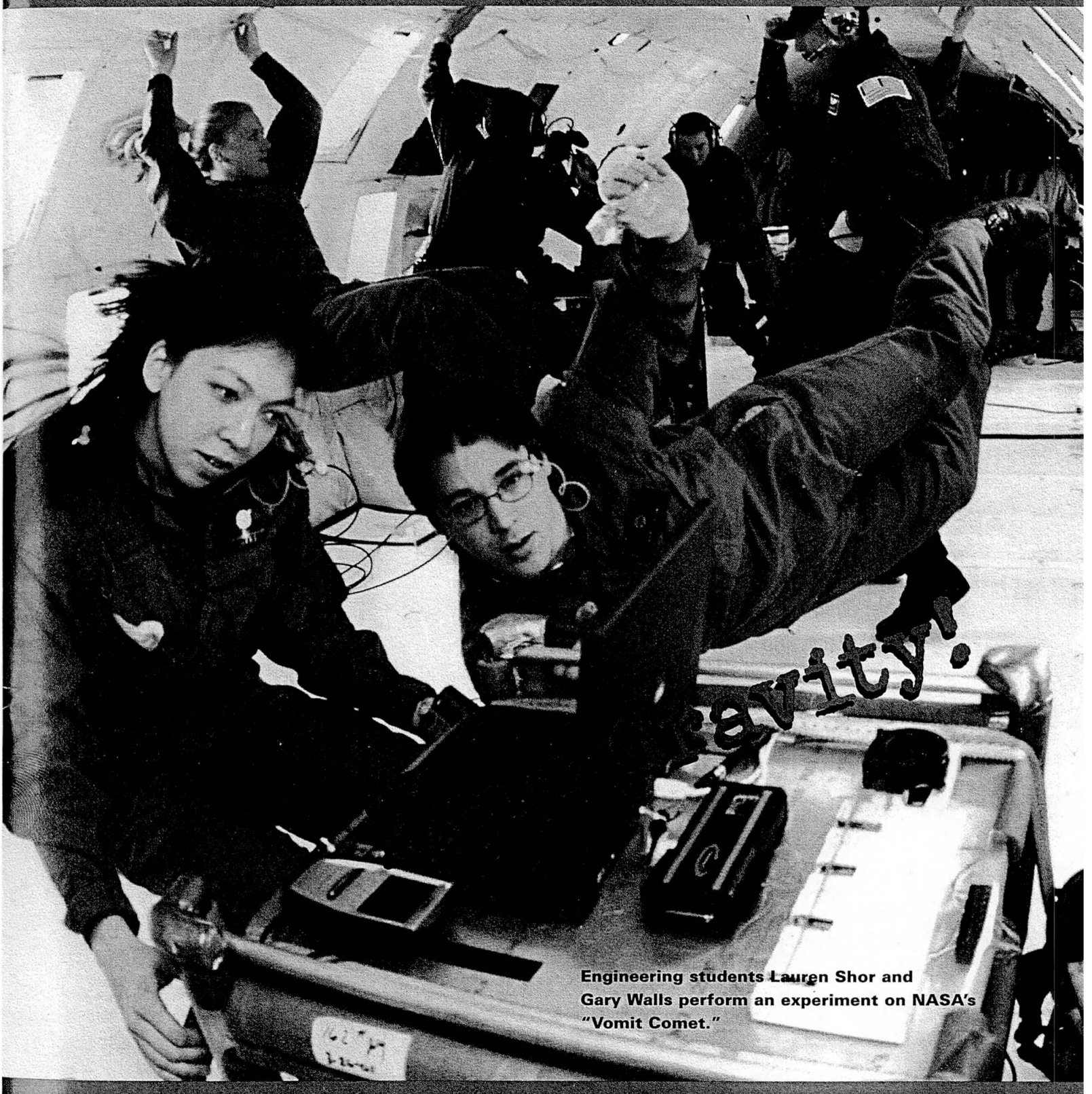
For more information about these Legacy grants, contact the Office of Enrollment Management at 1-800-2-DREXEL.

SAGE College Insight Program

Sage Scholars, Inc., Harris Insight Mutual Funds, and Drexel have joined to create an innovative program that allows alumni to save for their children's education while reducing the cost of tuition. Through this program, sponsors investing in a Harris mutual fund earn tuition credits worth up to one year's tuition, or $13,800, whichever is less, per child that enrolls at Drexel. *Rewards are based on the aggregate assets in a sponsor's account.* For more information about this program, call 1-800-982-8782.

DREXEL

The Alumni Magazine of Drexel University Vol.12/No.3, Summer 2001

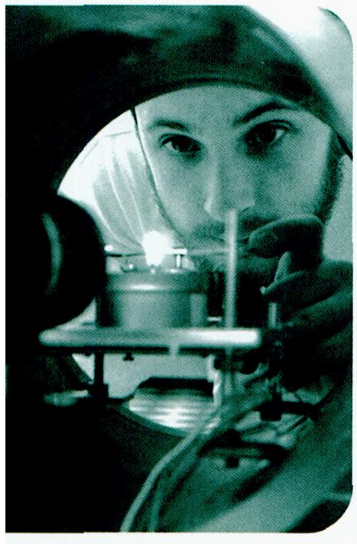


Engineering students Lauren Shor and Gary Walls perform an experiment on NASA's "Vomit Comet."

Blue and Gold Days: Catch the Spirit!

OUTSTANDING STUDENT ACCOMPLISHMENTS IN Zero

- In March, they conducted experiments aboard NASA aircraft KC-135A in zero gravity conditions.
- They met Paul Richards '87, the navigator on NASA's most recent Space Shuttle Discovery mission.
- They received a first place award for the poster on their zero gravity work at Research Day 2001, an event that showcases and rewards Drexel and MCP Hahnemann faculty and student research.



Freshman Mac Haas sets up the apparatus the students used to study candle flame soot in zero gravity.

"They" are five Drexel engineering students who are members of the first Drexel team to participate in the NASA Reduced Gravity Student Flights Opportunities Program (RGSFOP) in Houston. The Drexel team's project studied how reduced gravity conditions affect the aerosol properties of candle flame soot aboard the modified KC-135 jet, nicknamed the "Vomit Comet," that performed dozens of zero gravity parabolic trajectories. Each parabola gave the students 25 to 30 seconds of zero gravity to conduct their experiment, which will have applications for preventing and detecting fires in space.

Members of the team are: Lauren Shor, a mechanical engineering student who graduated in June and served as team leader; Mac Haas, an environmental engineering student who just completed his freshman year; Michael Newcomer, a mechanical engineering senior who also graduated in June; George Cartwright, an electrical engineering student who was working on the project with a high school class in Houston at the time this interview was conducted, and Gary Walls, a June mechanical engineering graduate. Cartwright and the Houston high school class were analyzing the data the Drexel students collected in zero gravity and comparing it with control data collected by the high school students under Earth gravity conditions.

"Remember the fire on the Mir Space Station?" asked Haas. "That was frightening for a couple of reasons. First, there aren't any intergalactic fire departments that can pull up and put out the fire. Second, because there is no gravity, the smoke from a fire goes everywhere, so it's difficult to detect where the fire is."

After collecting the candle flame soot in zero gravity, the team is analyzing the particles to determine their size and fractal dimensions.

"Certain sizes and formations are harmful to people," said Shor. "So this will help determine the environmental and health implications of the soot."

After floating in space, what's next for the five talented students?

"I'd love to be an astronaut," said Shor. "The last co-op I had was with a company that worked with NASA. The RGSFOP was a great opportunity. To be an astronaut, you almost always need a graduate degree, so I'm thinking about graduate school. I've applied for some fellowships at Drexel."

For Haas, a Drexel Vanguard Scholar, completing his Drexel degree is a certainty and he hopes to participate in several more zero gravity experiments.

"I'm only a freshman and I'm getting exposure to research – it's a wonderful experience. I've done two of these flights before and I'm hoping to participate in a few more. It opens your eyes to lots of opportunities.

"I'm from Houston and my dad works for a NASA contractor," Haas continued. "Being an astronaut has definitely crossed my mind."

"I hadn't done any research before this," said Newcomer. "I'd like to work with NASA or something in aerospace. This project allowed me to meet people at NASA and learn more about the organization. I want to go to graduate school and get back to NASA."

"We've definitely got plans," Haas said.

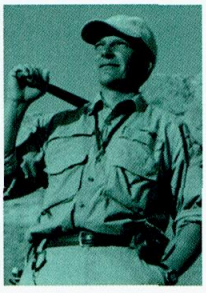
DREXEL'S Research Enterprise

***Paralititan stromeri* (see Lacovara highlight below)**
Courtesy of Cosmos Studios and MPH Entertainment

Drexel researchers from a range of disciplines have been making headlines locally and around the world in recent months.

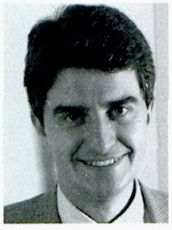
"To have Drexel work published in magazines of the stature of *American Scientist, Nature* and *Science* is a hallmark of the very best universities in the country," said Dr. Harvill Eaton, senior vice president for research and graduate studies. "These are some of the most widely circulated publications in the world. We're very proud. To me, it says an enormous amount about the individual researchers and the quality of the work being done at Drexel."

Here is a small sampling of some recent Drexel research highlights:



Dr. Kenneth Lacovara

Visiting associate professor of engineering geology Dr. Kenneth Lacovara, is chief geologist on the Bahariya Dinosaur Project, the group of scientists that unearthed a new genus of dinosaur on its Egyptian dig. Lacovara found evidence of extreme environmental change; 95 million years ago the Sahara Desert was a rich, tropical coast. Lacovara also coined the name of the new genus: *Paralititan stromeri*, which means "tidal giant." The research findings have been featured in *Newsweek, The New York Times, Science, Der Spiegel,* the *London Times* and the *Times of India,* among others.



Dr. Yury Gogotsi

Dr. Yury Gogotsi, professor of materials engineering, was published in the May issue of *Nature* and featured in news stories around the world for his work on the creation of synthetic diamonds. Gogotsi headed a research team with the University of Illinois that created industrial diamonds from silicon carbide, an inexpensive, abundant material used in sandpaper. By pulling out the silicon, the carbon is left in the form of tiny diamond crystals. This new methodology is much easier and less expensive than the high heat and pressure treatments used in traditional processes.

Dr. Barsoum accepts his award from President Papadakis

Dr. Michel Barsoum, professor of materials engineering, received the Drexel 2001 Research Achievement Award, which recognizes faculty for outstanding scholarship and research in their field. The winner receives an honorarium and $10,000 in research support. Barsoum was honored for his breakthrough work on a newly-patented layered ceramic material, which combines the best qualities of metal and ceramics — MAX phases. Barsoum worked with Tamer El-Raghy, a Drexel research associate professor, on the project.

Metals are durable, perform well in extreme environments, serve as thermal and electrical conductors and are damage-resistant and capable of withstanding high temperatures. Ceramics, which are rigid, lightweight, fatigue- and oxidation-resistant, are even better than metal at enduring high temperatures.

The resulting compounds exhibit incredible machinability that could dramatically increase automobile and jet engine fuel efficiency, just one of the applications of MAX phases. A jet engine made from MAX phases would be 50 percent lighter and able to run 200 to 300 degrees hotter. If the average jet engine temperature can be increased by one degree Celsius, the subsequent annual fuel savings would be nearly $1 billion. Increasing the efficiency of automobiles in a similar manner would improve gas mileage three miles per gallon, saving roughly 1 million barrels of oil daily.

Barsoum and El-Raghy's work was the cover story in the July-August issue of *American Scientist.*

Dean Kamen

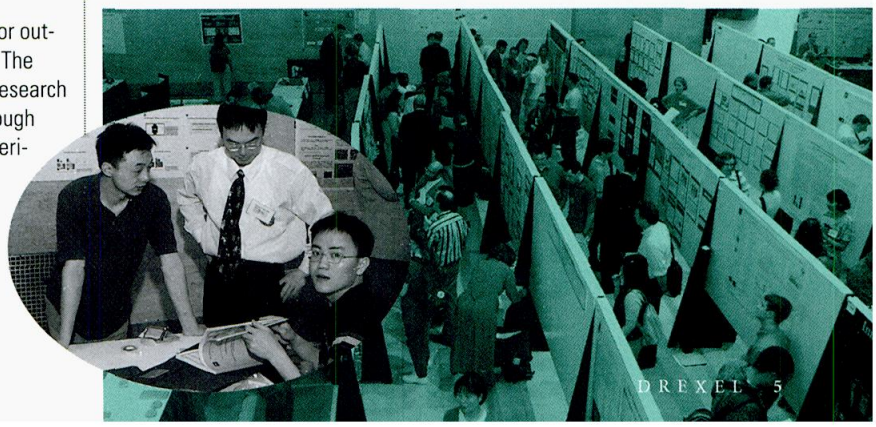
Research in building urban infrastructures, learning and working in the global information age, and engineering health were in the spotlight at Research Day, "Building the Research Enterprise" on May 1 at Amtrak's 30th Street Station. The event is sponsored by the Office of Research and Graduate Studies.

Dean Kamen, one of America's leading inventors and founder of FIRST (For Inspiration and Recognition of Science and Technology), presented the keynote address at the event. Drexel annually hosts the FIRST Regional Robotics Competition for high school students, an event created by Kamen in 1990.

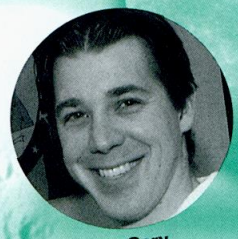
More than 1,500 attended Research Day 2001 and saw live demonstrations of several exciting research initiatives. Among them were the AbioCor™, the newly developed artificial heart that will be tested in clinical trials at Hahnemann University Hospital and other medical institutions this year; wireless communication networking from Project ACIN (Applied Communications and Information Networking); and sensor networking from the Sarnoff Corporation.

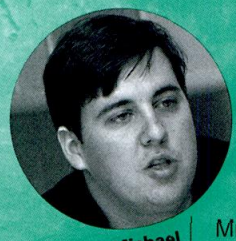
Seventy prizes were awarded, including best student poster awards, research achievement awards, and patent awards. Thirty-three faculty members were inducted into the 10^6 Club, a group that represents more than $50 million in annual external funding grant dollars.

More than 1,500 members of the Drexel/MCP Hahnemann communities attended Research Day on May 1.



Gravity


Gary


Michael

Lauren

Mac

Dr. Mun Young Choi, professor of mechanical engineering and mechanics and the students' RGSFOP advisor, has been doing research with NASA since 1987. He came to Drexel in 2000 and wanted to get students here involved with the program.

"This program is very important," he said. "It expands the students' minds. They're given an opportunity to implement fundamental knowledge gained in the classroom and apply it to their research. Lauren Shor wanted to do work on a project that was space-related. We talked and decided to apply for this program. She ended up going to Houston and meeting NASA scientists and astronauts. It's an excellent opportunity."

Dan Dietrich '83, '87, '90, a research scientist with NASA in the microgravity combustion science group, said the program benefits both student participants and NASA in a number of ways.

"For the students, it's a chance to design and build something that actually works," he said. "Many design projects are just done on paper, but this requires a product. It also gives the students a chance to travel to Houston and visit NASA and work with the scientists here. The program gives them an advantage over other students. NASA benefits because we get to see the best and brightest students. There are a number of people at NASA who worked here as students."

Dietrich has worked at NASA since 1989, returning to Drexel in 1990 to defend his dissertation and receive his doctorate in mechanical engineering. He served as the principle investigator for candle research on the Mir Orbiting Station and anticipates performing similar research aboard the Space Shuttle or the International Space Station.

"People continue to be amazed by how fluids act in the absence of gravity," said Dietrich. "This type of research gives a different perspective. Microgravity offers some unique design challenges. The students have to design and build their experiment within the constraints of zero gravity while not overusing resources because of safety restrictions. It exercises your mind."

Sponsored by NASA and administered by the Texas Space Grant Consortium, the RGSFOP is designed to give undergraduate students a chance to propose, design, fabricate, fly and evaluate a reduced-gravity experiment over the course of six months. The Johnson Space Center's Reduced-Gravity Program has operated since 1959, but only became available to college students in 1995.

Students and their advisors submit research proposals to RGSFOP officials who choose the teams that will fly aboard the KC-135 aircraft and conduct their experiments.

Choi hopes to field two Drexel RGSFOP teams next year and open the program to students from more departments.

"This year, I worked with the mechanical engineering and mechanics student organizations, the Vanguard Program and the National Action Council for Minorities in Engineering to recruit students for the KC-135 team," Choi said. "So many students were interested that we did have to turn some away.

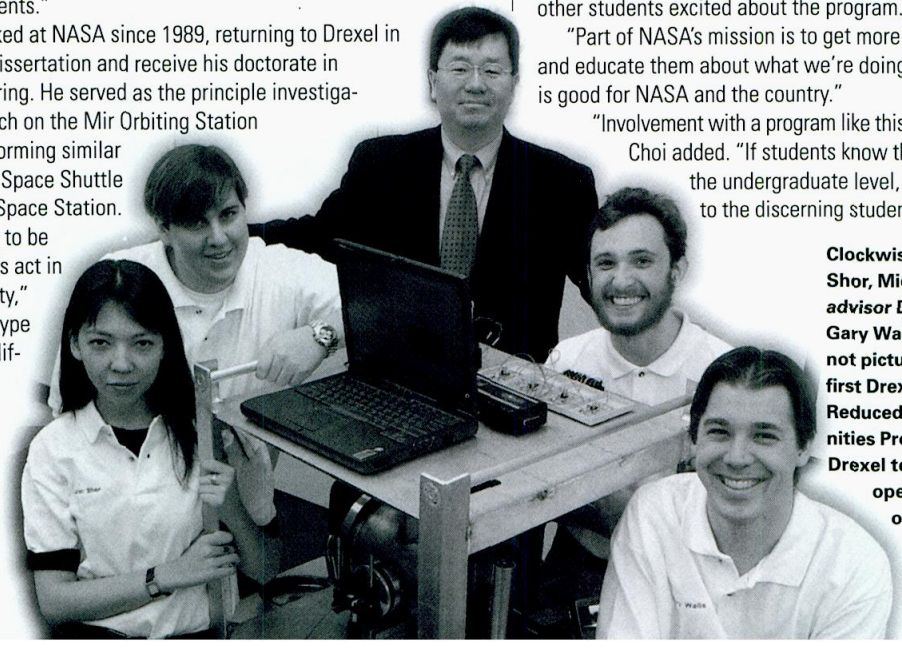
"Next year, I plan to ask faculty members from all engineering departments to submit proposals for the program," he continued. "This year it was just mechanical engineering students and faculty. It's a wonderful way to get undergraduates attracted to and participating in research and then interested in graduate school."

Choi said this year's student team members have been outstanding ambassadors for the program.

"They've been wonderful. They're excited about the program and have other students excited about the program."

"Part of NASA's mission is to get more people interested in aerospace and educate them about what we're doing," Dietrich added. "This program is good for NASA and the country."

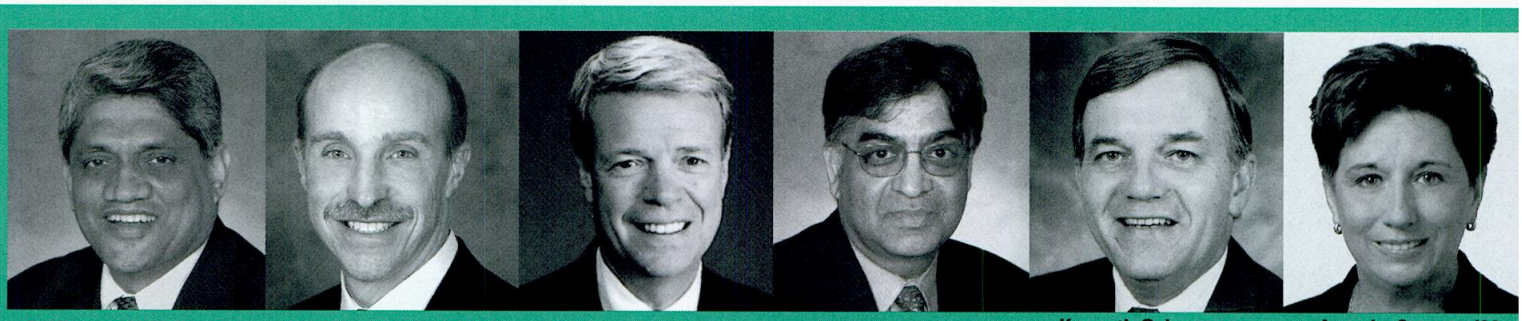
"Involvement with a program like this also helps Drexel recruit students," Choi added. "If students know they can participate in research at the undergraduate level, that makes Drexel more attractive to the discerning student."



Clockwise from left: team leader Lauren Shor, Michael Newcomer, faculty project *advisor Dr. Mun Young Choi, Mac Haas and* Gary Walls (student George Cartwright is not pictured) were the members of the first Drexel team to participate in NASA's Reduced Gravity Student Flights Opportunities Program. Choi hopes to have two Drexel teams participate next year and open the program to students from other departments.

Six New Trustees
Welcomed to Board

Drexel Board of Trustees Chairman C.R. "Chuck" Pennoni '63, '66, Hon. '92, announced the appointment of six new members at the Board's May 16 meeting. They are:



Dr. Ramani K.S. Ayer '71 | Dr. James P. Bagian '73 | Dr. James Lee Fisher | Rajiv L. Gupta '72 | Kenneth G. Lawrence | Anne L. Stevens '80

Dr. Ramani K.S. Ayer '71, '73, chairman and CEO of Hartford Financial Services Group, Inc. Ayer began his career with Hartford in 1973 and rose through the corporation to become chairman in 1997. He is a member of The Drexel 100 and serves as a trustee for the Mark Twain House in Hartford, Conn., a director of the Hartford Hospital and a board member of the Greater Hartford Chamber of Commerce.

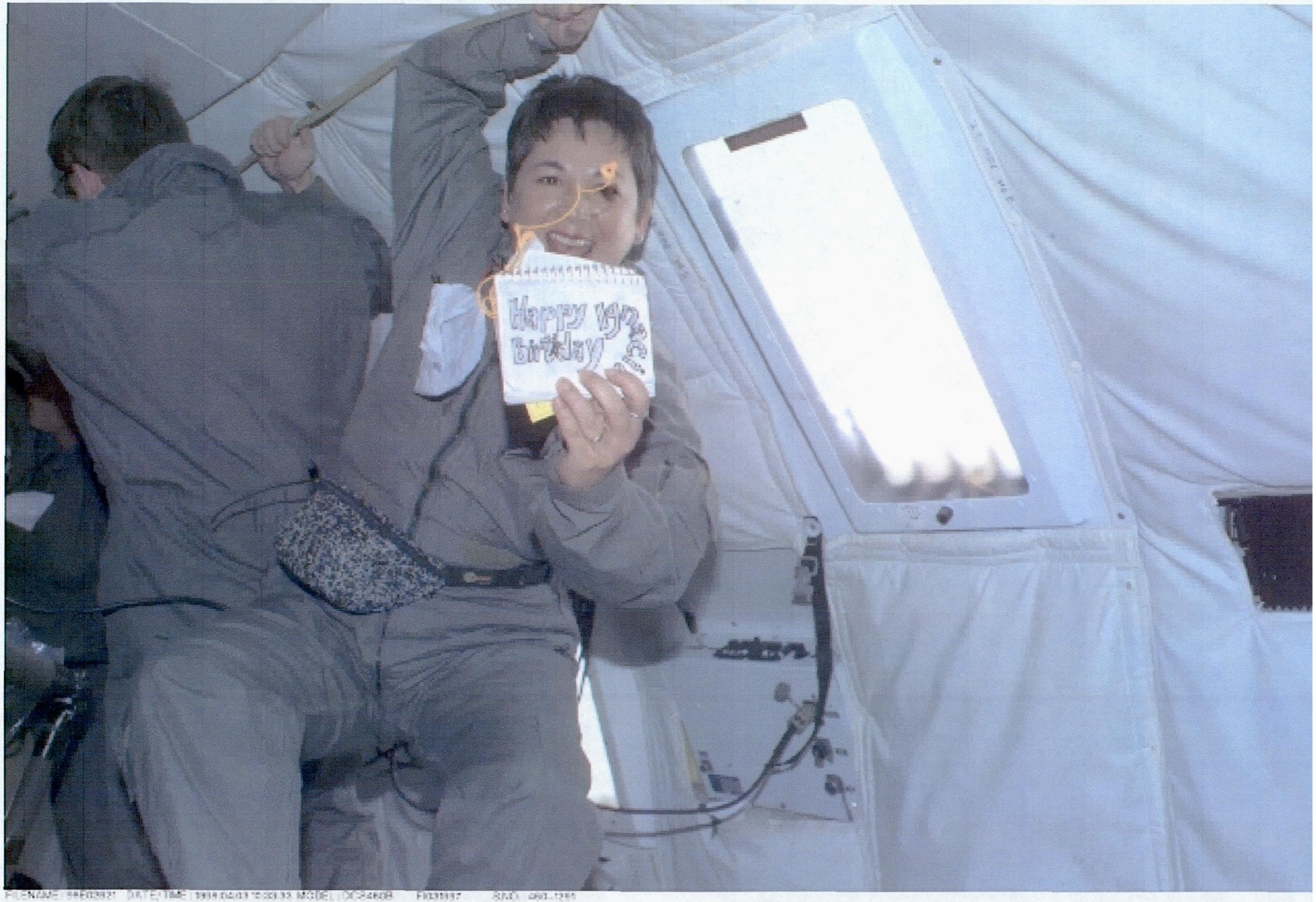
Dr. James P. Bagian '73, director of the National Center for Patient Safety for the U.S. Department of Veteran Affairs. A physician and former astronaut, Bagian has logged more than 337 hours in space and is credited with installing escape hatches to make the space shuttle safer. He is a member of The Drexel 100 and received Drexel's Engineering and Science Award in 1989 and an honorary doctorate in 1987. Bagian is a member of numerous professional associations, including the College of Emergency Physicians and the American Society of Mechanical Engineers.

Dr. James Lee Fisher, professor at the Union Institute for Advanced Studies in Cincinnati, Ohio and private academic consultant. He is a former president of the Council for the Advancement and Support of Education (CASE) and served as president of Towson State University for a decade. He has been a faculty member at Northwestern University, Illinois State University, Johns Hopkins University, the University of Georgia and Harvard University. Fisher has received awards for teaching, writing, citizenship and leadership and has been awarded 11 honorary degrees.

Rajiv L. Gupta '72, chairman and CEO of Rohm & Haas Company in Philadelphia. Gupta has worked for Rohm & Haas, a multinational specialty chemical firm, since 1971, starting in a financial management position and becoming chairman and CEO in 1999. He is a member of the Bennett S. LeBow College of Business Advisory Council and serves on a number of other committees and boards, including the Eisenhower Exchange Fellowship, the International House and the American Chemistry Council Executive Committee.

Kenneth G. Lawrence, senior vice president of Exelon Corporation and president of PECO Energy Distribution. Lawrence has worked at PECO in various management positions since 1969 and continues to serve as president after the formation of Exelon Corporation, a merger of two major electrical utility providers, Philadelphia's PECO Energy and Chicago's Unicom. He serves as director of the Eastern Division of the Pennsylvania Economy League and is a member of a number of other professional groups.

Anne L. Stevens '80, vice president of North American assembly operations of Ford Motor Company. Ford's first female plant manager in Europe, Stevens has worked for the auto maker since 1990 and is its highest ranking female executive. Stevens, who earned her Drexel degree in metallurgical engineering, was a speaker at the 50th anniversary of the Drexel Society of Women Engineers in 1996. She received the Shingo Leadership Award in 2000 and the Outstanding Business Leader Award from Northwood University in 2001. Stevens' husband, William, is a Drexel alumnus, having earned a bachelor's degree in chemical engineering in 1979.


Happy
Birthday

VOL. 8 NO. 1 SPRING 2001

MICROGRAVITY NEWS

MICROGRAVITY RESEARCH PROGRAM

NASA Helps Students Get Their Experiments Off the Ground

NASA's Reduced Gravity Student Flight Opportunities Program provides a chance for undergraduate students like David Halaas (left) and Justin Reed (right), of the University of Washington, to fly their physics or other science research in short spans of microgravity on a KC-135 jet.

NASA is launching nearly 400 students closer to their career goals and dreams this year during the 2001 Reduced Gravity Student Flight Opportunities Program run by Johnson Space Center (JSC) in Houston, Texas. The program provides an opportunity for undergraduate students nationwide to fly their experiments in microgravity conditions for short time periods on a KC-135 jet. In addition, high school and graduate students can participate in the ground crews for the experiments. The experience lets young researchers team up with NASA scientists to solve real scientific problems. It also gives them a taste of the procedures investigators must put their research through before they fly their investigations on a space shuttle or on the International Space Station (ISS).

The NASA program, which began in 1995, is administered by the Texas Space Grant Consortium (TSGC), a group of 34 academic and industrial organizations that develops projects in higher education, research infrastructure, and public service. It has grown from a pilot project of four student teams from Texas universities to a nationwide program involving 96 teams (48 in the spring and another 48 this summer).

In the Shoes of a Scientist

"This is a great way for students to have firsthand experience with how science actually works," explains Wesley Tarkington, of JSC's University Affairs Office.

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National Aeronautics and Space Administration
Physical Sciences Division

From the Director...

Recent microgravity research in condensed matter and atomic physics has allowed us a macroscopic glimpse of the workings of the atomic world. Imaging and manipulation of the submicroscopic building blocks of all matter are improving our understanding of fundamental processes involved in the assembly and evolution of complex physical and biological systems and are drawing us closer to the interface between these systems. At this interface, a transition takes place from purely thermodynamically driven physical processes to biologically programmed mechanisms, and we converge upon a finite combination of circumstances from which life emerges.

The low-gravity environment offers the potential for significant advances in understanding these circumstances because the environment can be used as a theoretical AND experimental tool to alter the evolutionary paths along which complex systems develop. When we remove the gravitational bias, we can observe how physical and biological systems evolve, altering their detailed processes to arrive at a different final equilibrium configuration. These observations will not only allow scientists to develop new insight into the inner workings of nature, but perhaps to also witness the emergence of new natural constructs conforming to the gravity-free environment.

Results of past microgravity-based research provide vivid examples of new observations that have been enabled by this unique environment. For example, evidence has been gathered to show that self-assembling mechanisms in model colloidal suspensions are altered. The theoretical understanding of these self-assembling models is prerequisite to the successful study of more complex self-assembling systems such as lipid bilayer membranes, nano-structures, and surface proteins. Removing the gravitational bias also has been convincingly shown to alter the fluid shear flow environment, directly affecting crystallization, cell assembling, and gene expression processes. The ultimate application of these discoveries will depend greatly on our securing a detailed theoretical understanding of the various causes and effects associated with these empirical observations.

Past ground-based and flight research has also allowed us to make much more accurate measurements related to specific scientific problems. For example, we can determine more precisely the temperature dependence of the specific heat of Superfluid Helium closer to the Lambda Point transition.Our investigators also have conducted benchmark experiments on dendritic solidification.

The challenge of developing a rigorous and world-class research program that helps eliminate barriers to the understanding of significant scientific issues is OBPR's major responsibility. No less of a challenge, however, is focusing on the efficient implementation of effective but reductionist theoretical and experimental tools of physical sciences, to resolve fundamental biological issues that are largely based on a holistic approach. Overall, OBPR's primary goal should be to develop and apply powerful theoretical and experimental tools to identify and tackle the primary questions raised by the removal of gravity. These primary questions have already been raised in disciplines as diverse as Condensed Matter Physics, Fundamental Biology, Materials Science, Biotechnology, and Human Physiology. However, important scientific issues of the new century will require effective inter-disciplinary approaches and will benefit from a new viewpoint. OBPR can provide a solid interdisciplinary research community and will employ gravity as a controlled, adjustable variable.

Eugene Trinh

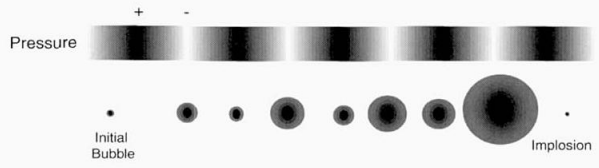
"The process that the students follow is very similar to what NASA scientists follow as they prepare their experiments that were first conducted in normal gravity to be flown on an upcoming mission."

Just as NASA researchers begin by asking a question, so do the student scientists. Would a cardiopulmonary resuscitation device used on Earth work on the ISS? Would a nonflickering flame behave differently without the effects of gravity? Or, as Justin Reed, a sophomore in physics at the University of Washington (UW) asked, would minimizing the effects of gravity allow researchers to control the size and quantity of nanoparticles formed from collapsing bubbles in a metallic solution?

Reed and fellow UW team members David Halaas (sophomore), Andrew Cook (senior), and Paul Parazzoli (senior) posed this question last fall in their proposal to NASA and TSGC to participate as a Spring 2001 team. The students had been assisting with the research of their professor Thomas Matula, also a microgravity fluid physics principal investigator, who was using sound waves to create bubbles in a metallic solution (metallic salt dissolved in solution). Matula was investigating the effect of gravity on the intensity of light emitted by the bubbles as they collapsed, and working on this project led the students to form a new hypothesis.

The students had observed that when they directed a sound wave through a metallic solution, hundreds of bubbles would form in the cavitation field, the region where the lower part of the wave created negative pressure. In the span of picoseconds (trillionths of a second), the bubbles would expand with gas absorbed from the surrounding liquid until they were large enough to resonate from the sound wave. Once the bubbles began resonating, they would absorb acoustic energy. They quickly grew over the course of one acoustic cycle until inertia would dominate the expanse. The bubbles couldn't sustain themselves, and they would implode suddenly. Reed explains, "Imagine blowing up a balloon very quickly in a swimming pool. If you blow really hard to increase the inflation of the balloon, the water will push back on the walls of the balloon, causing you to get a mouth full of air!"

When the bubbles collapse, they cause rapid heating and then cooling rates, creating a unique chemical environment. "The liquid as a whole does not heat that rapidly," says Reed. "It will increase about [36°F] from room temperature [73°F] in 10 minutes. But the interior of some of the individual bubbles can increase up to



Bubbles in the path of the negative pressure portion of a sound wave expand with gas absorbed from the surrounding liquid until they are large enough to resonate. Once this resonance is achieved, inertia dominates the expanse, and the bubbles implode suddenly.

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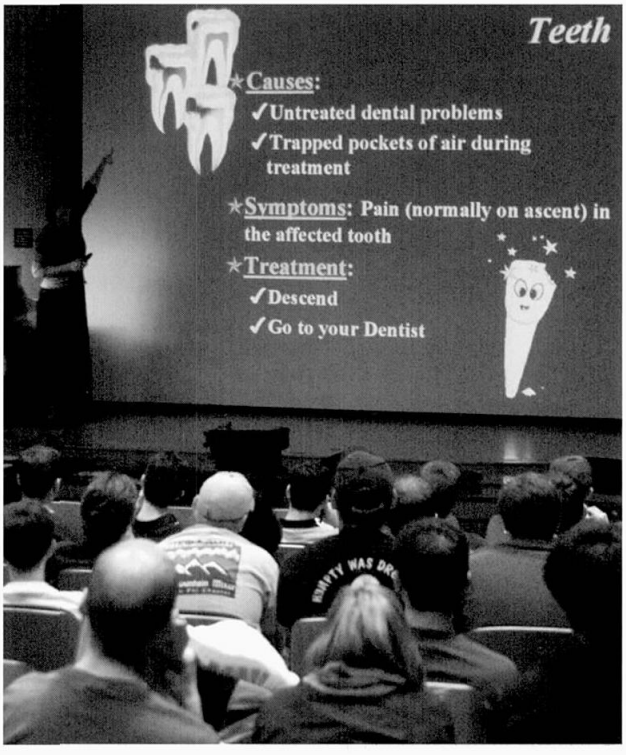
The team believes that in normal gravity, buoyant convection (the tendency of less dense particles to rise) may limit the rate of formation of these nanoparticles.



KC-135 training includes teaching participants how to avoid the possible physiological effects of parabolic flight, such as toothache and queasiness.

Space shuttle *Enterprise*, the dominant object to be displayed at the new center, is carefully nestled amidst vintage warbirds. The Spacelab module, in protective white plastic, is at bottom right.

Measurement System (SAMS) instrument flown on shuttles and on the Russian space station, *Mir*.

Shuttle-era science holdings are sparse because apparatus are often reflown or recycled. "We would like to have different kinds of experiments to show the public," she continues. "We will also need help from principal investigators in developing the explanatory material so we present an accurate as well as understandable story."

Not every donated artifact will go on immediate display. "We are still developing our exhibit plans and will consult with senior NASA scientists to help us choose," Neal explains. "We might rotate some artifacts so repeat visitors can see something new or lend some artifacts to other science museums around the country."

Microgravity investigators who have artifacts available should contact Neal at the following address:

Valerie Neal, Curator
Space History Division, MRC 311
National Air and Space Museum
Washington, DC 20560-0311
Phone: (202) 357-2099
Fax: (202) 786-2947
E-mail: *Valerie.Neal@nasm.si.edu*

For additional information about the Udvar-Hazy Center, visit the center's web site at *http://www.nasm.edu/nasm/ext/*.

Editor's note: This is the first of a new series of columns describing the Microgravity Research Program's outreach and education activities. Potential contributors should contact Dave Dooling, Outreach & Education Project Manager, by e-mail at *dave.dooling@msfc.nasa.gov*. µg

Deciding What to Donate

Not everything old makes a good museum artifact. "Donation is preceded by a fair amount of dialogue — conversations or correspondence — between donor and curator to decide what is an appropriate acquisition," Air and Space Museum Curator Valerie Neal cautions. "We evaluate donations on a case-by-case basis. In general, we place highest priority on objects that have flown on missions, then backups or flight-certified spares, then training units. The more intact and less cannibalized [i.e., stripped for parts] they are, the better. We also are interested in selected companion documents, such as operational data books, crew procedures, and end item specifications for the technical archives."

Donors should check with the property managers and historians at their home institutions and with program management at NASA to ensure that ownership of artifacts is clearly defined and the property transfer is legal.

Student flight crews learn to recognize the effects of hypoxia, or deprivation of oxygen, through simulations of cabin pressure drops during altitude chamber training.

Reed explains, "As bubbles move upward through the liquid, drag force distorts their spherical shape. As a consequence, the bubbles may not be spherical when they collapse. In this case, the amount of energy focused at the center of the bubble, and therefore its temperature, will be decreased." He and his fellow students hypothesized that in microgravity, the absence of buoyancy would allow the bubbles to be spherical when they collapse, allowing more of the collapsing bubbles to attain the extremely high temperatures needed to trigger the formation of nanoparticles. The near-absence of convection in microgravity would also lead to a change in the size of the formed nanoparticles.

The students determined on their own what hardware and procedures they would need to test their sonochemical idea and submitted their plans to NASA and TSGC last fall. Once their project was approved for participation during the spring flights, the students fine-tuned their experiment with the guidance of their faculty adviser, Matula, and their volunteer NASA adviser, David Smith, an aerospace technologist in structural materials at Marshall Space Flight Center in Huntsville, Alabama. The advisers offered insight to the team on technical aspects that would help them reach their objectives.

On a Roller Coaster With Wings

This spring they were ready to fly their experiment. They arrived in Houston on a Thursday in March for ground training. The first day involved setting up all their equipment and receiving official welcomes from program sponsors. Tarkington explains the rest of the schedule: "Friday morning they arrive here at Johnson Space Center at 7 o'clock, and we bus them over to mission control. One of our medical staff briefs them on the physiology they'll experience during flight so they'll know how to avoid getting flight sickness." The KC-135 flies in a roller coaster–like parabolic pattern, creating a microgravity environment during its almost 30-second freefall followed by a minute and 15 seconds of 1.8 g during its climb. The repeated changes in gravity force can cause queasiness, especially for first-time riders. Flight crews also learn to recognize the effects of hypoxia, or deprivation of oxygen, through simulations of cabin pressure drops during altitude chamber training. The training teaches crewmembers the conditions during which they would don oxygen masks on the KC-135.

Tarkington continues, "Then we start Monday with the test readiness review. All the students demonstrate their hardware while operations staff assess the

safety of the experiment itself and the hardware. Although the experiments have been deemed safe during the proposal process, our staff ask questions like 'How will this be bolted down?' and 'How is this going to move?' because things do tend to shift a little during the 1.8-g climbs, and we want everyone aboard the plane to be safe."

The next day, teams send two of their crew up to conduct the experiment. The pilot makes numerous parabolic dips and climbs, giving young researchers several opportunities to run their experiments. After about two hours of flying, the teams return to the ground to meet with their ground crews and go through debriefing. The next day, two other flight crew members from each of the teams fly the same experiments.

Back in the Lab

Once the flights are over and the students have gone home, the next stage of research begins: analyzing the data. Reed and his team are reviewing the data taken during both days of flight. Images of the nanoparticles taken with a transmission electron microscope will show in depth the effects that microgravity had on the formation of the particles. What they learn from the images will be compiled into a final technical report that they will send to NASA and TSGC. The report will also be posted on their web site, *http://depts.washington.edu/sonochem/*. Their information may be made available to NASA scientists and engineers and other members of the professional community.

Tarkington explains that some of the results may be useful to NASA: "We typically are researching some of the same types of things the students are. Universities tend to be on the forefront of scientific research, as is NASA, so the program makes a perfect match for us."

Reed's team also will share their findings through presentations at local high schools to encourage youth to get involved in the growing fields within science and technology. And as Tarkington sees it, inspiring more young people to become scientists is precisely the aim of the program: "We really do change a lot of lives. A lot of the students that come here, especially from the community college and high school programs, leave here saying, 'I wanted to be an auto mechanic, but forget that. I want to be an engineer.' Or 'I want to be a life scientist.' The Reduced Gravity Student Flight Opportunities Program is a great way to experience what science is all about." μg

Once the flight is over, students go back to their home universities to analyze the data, compile reports, and share their experiences and findings with other students in the hopes of inspiring more young people to become scientists.

Flight Update: Destiny *continued from page 5*

in microgravity. At this time, both STES units are in EXPRESS Rack 1 aboard the ISS and are housing PCAM cylinders. In mid-May, the PCAM cylinders, with protein samples in solution, were activated. In these experiments, a precipitant attracts the water away from the protein solution. As water is removed from the solution, the proteins can begin to crystallize. At the end of the experiment, the system will be deactivated to isolate the crystals for transport back to Earth for subsequent study.

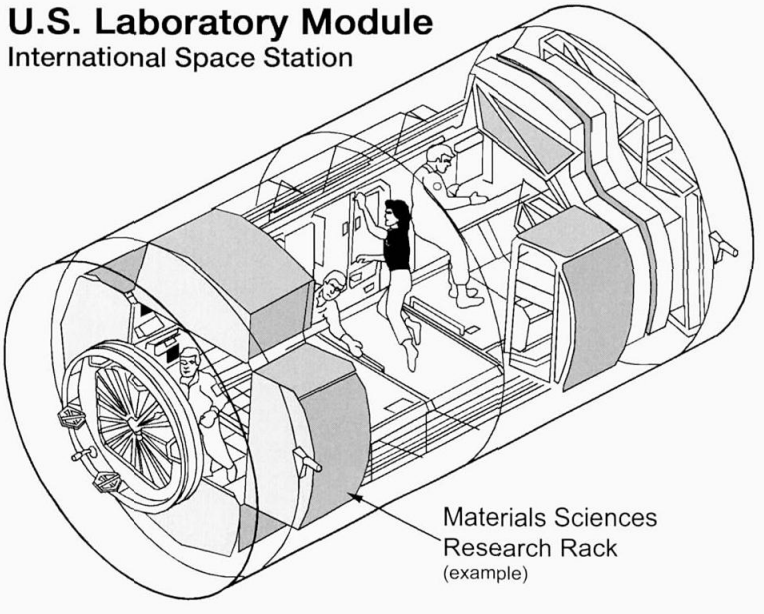
Also flown to the ISS aboard STS-100 were the Space Acceleration Measurement System (SAMS) and the Microgravity Acceleration Measurement System (MAMS). SAMS collects, processes, records, and delivers acceleration data aboard the ISS so that researchers can assess the effects of acceleration on their microgravity experiments. MAMS measures frequencies and provides the data to researchers so they can assess the effects of frequency changes as a result of acceleration on their experiments.

Later this summer, STS-105 will transport to the ISS two more EXPRESS racks for research use, U.S. stowage racks, and International Standard Payload Racks, carried in an MPLM.

To learn about future shuttle missions, visit NASA's Human Spaceflight web site at *http://spaceflight.nasa.gov/shuttle/future/index.html*. For information on progress of the assembly of the ISS, visit *http://spaceflight.nasa.gov/station/assembly/index.html*. To track where the ISS will be visible in the night sky, visit one of the following web sites: *http://liftoff.msfc.nasa.gov/temp/StationLoc.html* (from Marshall Space Flight Center [MSFC]) or *http://spaceflight.nasa.gov/realdata/sightings/* (from Johnson Space Center [JSC]). The MSFC site gives the station's location in relation to the globe, provides latitude and longitude information, and has an automated mailing list option. The JSC site has a listing of sighting opportunities. µg

On the Racks

Much of the research conducted on Destiny will be housed in racks, which are refrigerator-sized structures that hold experiment hardware or computers designed to control experiments or perform other functions. Destiny will eventually house a total of 23 racks, 12 of which will be designated for scientific research. They are modular in design so that the racks themselves or the hardware within them can easily be removed and exchanged as research needs or technology changes. The size and weight of the racks precluded them from all being transported onboard Destiny for its flight aboard *Atlantis*, although a few of the control systems racks were included. Racks will be added during subsequent shuttle flights, and research capabilities aboard Destiny will continue to expand.



This cutaway line drawing depicts the size of the Destiny laboratory module relative to the ISS crewmembers. The shaded sections represent some of the refrigerator-sized research racks. Eventually Destiny will house a total of 23 racks.

How to Participate

Students interested in participating in the Reduced Gravity Student Flight Opportunities Program must go through a rigorous application process. First, the idea for a project is developed by a team of undergraduate students, either as part of a class project or as independent research. The team submits a letter of intent to the Texas Space Grant Consortium. Soon thereafter they submit a detailed proposal that includes technical information about the experiment, an explanation of why it should fly in microgravity, and a safety assessment of its operation. The proposal also must include the names of the team's flight crew members (at least four undergraduates) and optional ground crew members, who may be graduate, undergraduate, or high school students, and the team's plan for educational outreach after the flight.

Scientists and engineers from NASA and TSGC review the applications for their technical merit, their experiment safety evaluation, their outreach plan, and their administrative detail. Teams whose proposals are selected receive comments and suggestions from reviewers. The teams may be asked to supply additional information, and all flight crew members must complete a medical exam performed by an aviation medical examiner who is certified by the Federal Aviation Administration. Teams whose proposals are not selected also receive reviewer comments and suggestions for improving the experiment so the project has a better chance of being selected in future competitions.

For more information on the program, including deadlines for submitting proposals and more detail about selection criteria, visit the program's World Wide Web site at *http://www.tsgc.utexas.edu/floatn/*.

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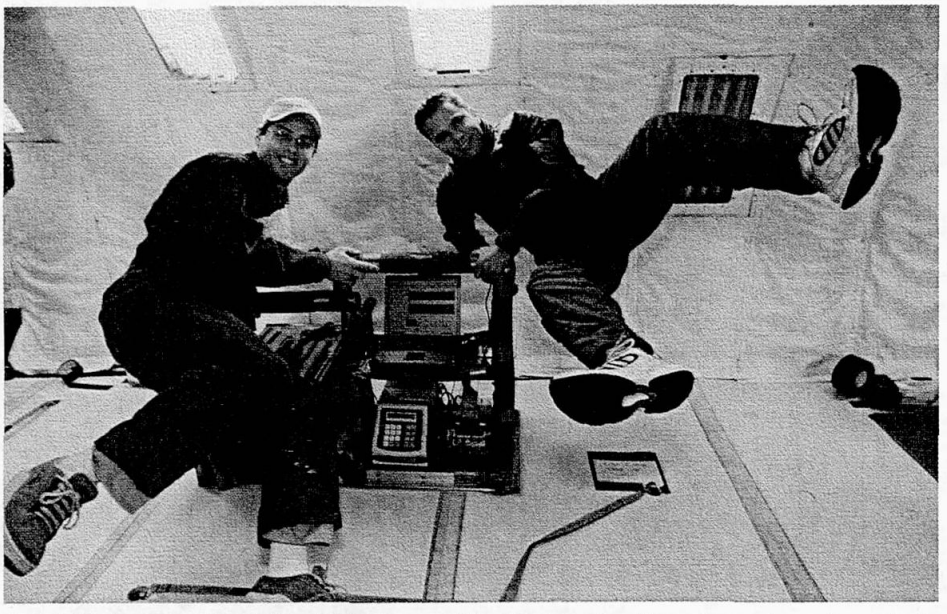
VOL. 3 NO. 1 SPRING 2001

MICROGRAVITY NEWS

MICROGRAVITY RESEARCH PROGRAM

NASA Helps Students Get Their Experiments Off the Ground



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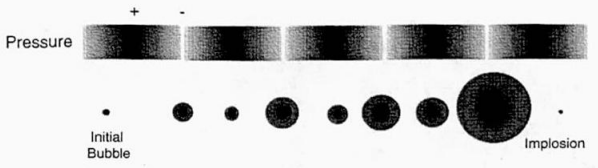

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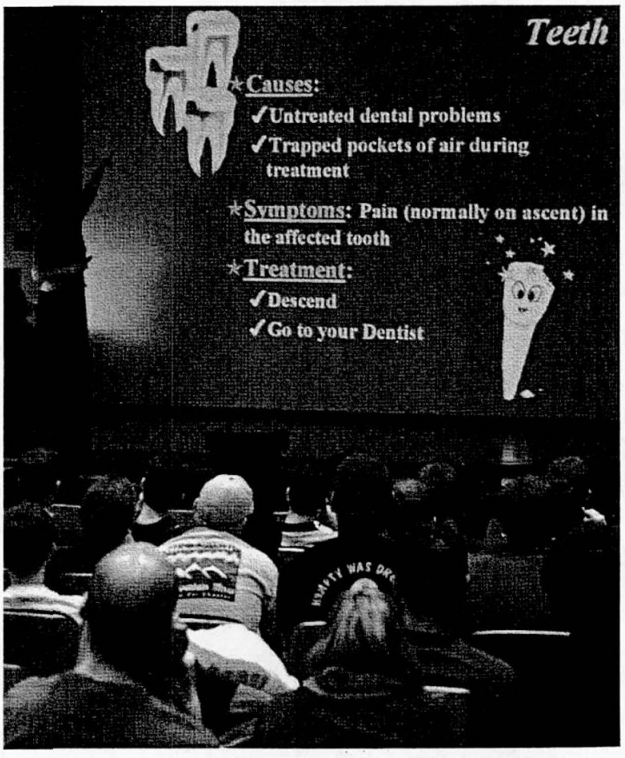
10,000 kelvins," (about 18,000°F, or three times the surface temperature of the Sun). This rapid change of temperature releases hydrogen and oxygen-hydrogen free radicals that may then react with the metal particles in the solution to form metal particles on the order of nanometers (billionths of meters) in size. The result is a colloid, which is a system of fine particles suspended in a fluid. The metal particles in the colloid are very much in demand. Reed illustrates, "They have many different applications ranging from medical research to electronic circuits. They can be used in such studies as DNA identification, drug delivery, and surface treatments."

The team believes that in normal gravity, buoyant convection (the tendency of less dense particles to rise) may limit the rate of formation of these nanoparticles.



KC-135 training includes teaching participants how to avoid the possible physiological effects of parabolic flight, such as toothache and queasiness.

Student flight crews learn to recognize the effects of hypoxia, or deprivation of oxygen, through simulations of cabin pressure drops during altitude chamber training.

Reed explains, "As bubbles move upward through the liquid, drag force distorts their spherical shape. As a consequence, the bubbles may not be spherical when they collapse. In this case, the amount of energy focused at the center of the bubble, and therefore its temperature, will be decreased." He and his fellow students hypothesized that in microgravity, the absence of buoyancy would allow the bubbles to be spherical when they collapse, allowing more of the collapsing bubbles to attain the extremely high temperatures needed to trigger the formation of nanoparticles. The near-absence of convection in microgravity would also lead to a change in the size of the formed nanoparticles.

The students determined on their own what hardware and procedures they would need to test their sonochemical idea and submitted their plans to NASA and TSGC last fall. Once their project was approved for participation during the spring flights, the students fine-tuned their experiment with the guidance of their faculty adviser, Matula, and their volunteer NASA adviser, David Smith, an aerospace technologist in structural materials at Marshall Space Flight Center in Huntsville, Alabama. The advisers offered insight to the team on technical aspects that would help them reach their objectives.

On a Roller Coaster With Wings

This spring they were ready to fly their experiment. They arrived in Houston on a Thursday in March for ground training. The first day involved setting up all their equipment and receiving official welcomes from program sponsors. Tarkington explains the rest of the schedule: "Friday morning they arrive here at Johnson Space Center at 7 o'clock, and we bus them over to mission control. One of our medical staff briefs them on the physiology they'll experience during flight so they'll know how to avoid getting flight sickness." The KC-135 flies in a roller coaster–like parabolic pattern, creating a microgravity environment during its almost 30-second freefall followed by a minute and 15 seconds of 1.8 g during its climb. The repeated changes in gravity force can cause queasiness, especially for first-time riders. Flight crews also learn to recognize the effects of hypoxia, or deprivation of oxygen, through simulations of cabin pressure drops during altitude chamber training. The training teaches crewmembers the conditions during which they would don oxygen masks on the KC-135.

Tarkington continues, "Then we start Monday with the test readiness review. All the students demonstrate their hardware while operations staff assess the

safety of the experiment itself and the hardware. Although the experiments have been deemed safe during the proposal process, our staff ask questions like 'How will this be bolted down?' and 'How is this going to move?' because things do tend to shift a little during the 1.8-g climbs, and we want everyone aboard the plane to be safe."

The next day, teams send two of their crew up to conduct the experiment. The pilot makes numerous parabolic dips and climbs, giving young researchers several opportunities to run their experiments. After about two hours of flying, the teams return to the ground to meet with their ground crews and go through debriefing. The next day, two other flight crew members from each of the teams fly the same experiments.

Back in the Lab

Once the flights are over and the students have gone home, the next stage of research begins: analyzing the data. Reed and his team are reviewing the data taken during both days of flight. Images of the nanoparticles taken with a transmission electron microscope will show in depth the effects that microgravity had on the formation of the particles. What they learn from the images will be compiled into a final technical report that they will send to NASA and TSGC. The report will also be posted on their web site, *http://depts.washington.edu/sonochem/*. Their information may be made available to NASA scientists and engineers and other members of the professional community.

Tarkington explains that some of the results may be useful to NASA: "We typically are researching some of the same types of things the students are. Universities tend to be on the forefront of scientific research, as is NASA, so the program makes a perfect match for us."

Reed's team also will share their findings through presentations at local high schools to encourage youth to get involved in the growing fields within science and technology. And as Tarkington sees it, inspiring more young people to become scientists is precisely the aim of the program: "We really do change a lot of lives. A lot of the students that come here, especially from the community college and high school programs, leave here saying, 'I wanted to be an auto mechanic, but forget that. I want to be an engineer.' Or 'I want to be a life scientist.' The Reduced Gravity Student Flight Opportunities Program is a great way to experience what science is all about." μg

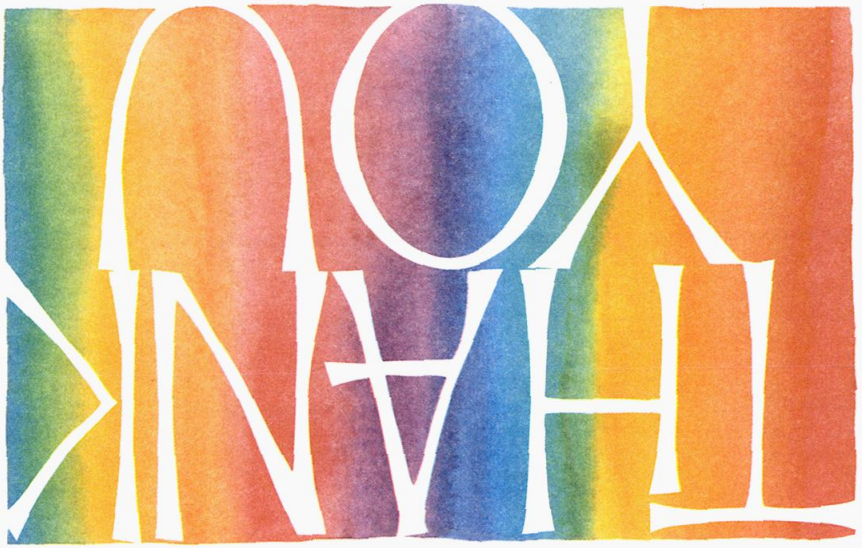
Once the flight is over, students go back to their home universities to analyze the data, compile reports, and share their experiences and findings with other students in the hopes of inspiring more young people to become scientists.

K
MIGHTY
BRAHMAS

Dr. Sickorez -

I had the greatest time at NASA's Fly High 2001. I don't know if you remember, but I'm one of the guys that just knows I'm going to fly. That whole trip was a huge WOW!! because of all the jets and even the environment itself. Thank you for all you've done for me and my team! Look out for my name in the future!

Jon - Michael Gram



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The unbearable lightness of flight A wild ride on 'Vomit Comet' helps launch the scientists of tomorrow

USA Today; Arlington; Mar 30, 1999; Tim Friend;

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Cardwell, George, Richard Ashmore and Kim Riley are participating in what some call the greatest science fair on Earth. It's the NASA Reduced Gravity Student Flight Opportunities program, administered by the Texas Space Grant and National Space Grant consortia. It is taking place at Hangar 990 at NASA's Ellington Field and in the skies above the Gulf of Mexico, where college students have a chance to conduct microgravity experiments just like astronauts and scientists.

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Full Text:
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HOUSTON -- Brett Cardwell has just been swept off his feet by science. Literally.

Aboard NASA's flying microgravity laboratory, the college student is conducting his first experiment in a weightless environment.

A few seconds after he begins floating, Cardwell pushes the trigger on an open-face fishing reel. That frees a Kevlar line, allowing a spring on a plastic platform to launch a 1-pound model satellite into near-zero gravity.

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Since the program first began in 1995, nearly 500 college students have flown on NASA's KC-135A, best known as the Vomit Comet.

This year, more than 90 colleges are participating. And by all accounts, these students are having the time of their lives.

"This is the most fantastic thing I've done," Cardwell says. "Before, I wasn't really sure what I wanted to study in graduate school. Now I'm thinking about planetary geology and maybe designing equipment to go to other planets."

That is exactly the result NASA is striving for with this program, which is costing the agency nearly $700,000 this year, mostly for aircraft fuel, personnel and training.

"We touch the future with this program," says George Abbey, director of the Johnson Space Center (JSC). "These students represent the best of what we are and what we can be. We hope to stimulate their imaginations, their dreams and their education by using our unique resources."

For the past three years, NASA has invited college students to pitch microgravity experiments to the Texas Space Grant Consortium. JSC scientists review the proposals, and the teams whose experiments are selected get two flights on the microgravity aircraft.

Last year, JSC selected 48 college teams. This year, Abbey doubled the number. Half the teams fly in March, half in August. Some teams, like the one at the University of Texas at Austin, have won competitions two years in a row. The UT-Austin team has been studying how cancer cells react to chemotherapy drugs in zero gravity. The same cells that pump out chemotherapy in normal gravity, rendering it ineffective, keep the chemotherapy inside in a weightless environment, says UT team member Emily Hueske.

This year's experiments covered a broad range of scientific subjects, from materials science to life science to physics. Five-time space shuttle astronaut Bonnie Dunbar oversees the program at JSC. She says she was particularly impressed this year with the level of sophistication of the experiments.

Any that have value to NASA will be followed up on, giving the students who created them an even greater opportunity. Dunbar says that having a chance as an undergraduate student to design an experiment and fly it on the KC-135A should encourage more young people to become aerospace engineers, mathematicians, scientists and perhaps astronauts.

"We hope we can get them into the aerospace industry, whether that is private industry or at NASA," Dunbar says. "By making this program visible, we actually encourage high school students to stay in math and science and be part of the future generation that will continue our quest of space exploration."

Dunbar believes that if younger students could see the university teams working together, training, flying and hanging out over the two-week period at JSC, many would be motivated to study math and science and would understand why it is important. One of the agreements the students make with program officials is that they will present their experiments and experiences to local elementary and secondary schools.

The countdown

During the two weeks at JSC, the students are responsible for their own food and lodging and for the costs of building the experiments.

Richard Ashmore of the Lamar University team says he and his classmates have been preparing and saving for the competition for nearly a year. Each of the Lamar students has spent about $300 for the two weeks. The four share one hotel room and even brought a hot plate to save on dining out.

On Day One at Hangar 990, with trainer jets and experimental aircraft as a backdrop, the students collect their security badges and begin setting up their experiments. Groups from different schools introduce themselves and explain their experiments to one another. One all-female team from Wellesley College wears T-shirts that read "Chicks in Space."

During the first week, the teams have to demonstrate their experiments to the zero-gravity test directors and prove they will be safe and theoretically sound. This is called the Technical Readiness Review, and it is the same procedure any scientist would go through before being allowed to fly an experiment on the KC-135A.

Students also undergo extensive physiology training at JSC in an auditorium across the hall from Mission Control. The highlight of training is strapping on an oxygen mask and sitting in a hypobaric oxygen chamber, which is depressurized to simulate 25,000 feet of altitude. Students then remove their masks and fill out a simple questionnaire.

The idea is to learn what lack of oxygen feels like, recognize the symptoms and put the oxygen mask back on. Most of the students, however, attempt to see how long they can go without oxygen before passing out, says Mike Fox, director of physiology training at JSC. Fox is responsible for training everyone -- astronauts, scientists and students -- who flies on the microgravity aircraft.

Light-years ahead

Students also attend lectures and mingle with astronauts, including Dunbar and Apollo astronaut John Young, who walked on the moon. Each day that students are not flying, JSC provides behind-the-scenes tours not offered to the general public.

Program participants have their foot in the door for NASA's Cooperative Education Program and other graduate student research opportunities, says Donn Sickorez, university affairs officer. Sickorez is the contact for graduate students who want to conduct research at NASA.

The co-op program primarily provides students with entry-level engineering positions for two semesters and a summer. Anyone hired directly from college comes through the co-op program. Several of the students who have flown on the KC-135A are now in the co-op program. Dunbar says students interested in working in the space program should begin taking algebra in eighth grade and take as much math as possible during high school.

She predicts the job market for NASA and the private aerospace industry will explode over the next decade. Flying an experiment in microgravity as an undergraduate student provides a big head start.

Jim Jordan, professor of geology at Lamar University, was beaming when his students returned from their flights. Jordan had flown twice before, as well.

"Once you have the microgravity experience, it becomes clear to you what you can do and what you can't do. Then you can go back to the table and design a better experiment," he says. "For any of these kids who fly the KC-135 and go on into the aerospace industry, microgravity will not be just a concept."

Cardwell could be a poster boy for JSC's program. During his first microgravity flight, he turns to a colleague and says: "I just had a great idea. Instead of using a spring to launch the satellite, I think we should try using electromagnets. Then you can just add current or take it away to get the amount of force you need."

He already has begun writing a proposal for such an experiment for next year's competition.

[Illustration]
PHOTO, Color, Tim Friend, USA TODAY; Caption: Faster than a speeding bullet: Lamar University student Brett Cardwell plays Superman as he floats through the hold of the KC-135A.

Sub Title: [FINAL Edition]
Column Name: COVER STORY
Start Page: 01D
ISSN: 07347456
Subject Terms: Science education
Weightlessness
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College students
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Author(s): David L. Chandler, Globe staff **Date:** March 29, 1999
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It was all part of an innovative National Aeronautics and Space Administration program, now in its third year, to involve college undergraduates in space-related research. Last year, a team from MIT became the first from New England to participate, and this year six Massachusetts teams and one from Vermont joined. At least one more team hopes to fly in a second round this summer.

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As engineering students, Livieratos said most career opportunities for him and his teammates involve either commercial or defense-related research, but the kind of pure research being done by scientists and engineers at the space agency has a special appeal. "They're out there to discover," he said. The biggest thrill about the opportunity to perform an experiment at the Johnson Space Center was simply "even in the smallest way, to be part of that."

Not all the experiments involved pure research. For some teams, the primary goal was to provide educational experiences and motivation to other students. A team of students from Wellesley College, for example, videotaped a series of demonstrations of zero-gravity phenomena that they hope to use to show scientific principles in action to elementary and high-school students -- especially girls, who often find little support for such interests -- to try to get them excited about science.astronauts in Houston, including astronaut Pam Melroy, a Wellesley alumna, "opened our eyes to the opportunities that are available."

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"It was my hope that we could get two teams to write proposals, and that one of them would get accepted," Smith said. "It was an embarrassment of riches when both teams got accepted," leaving him scrambling to come up with the money to support them, which grew to include not only four flying participants for each team, all seniors in mechanical engineering, but also four underclassmen as ground-crew members to help out and to share the experience.

Ann Sanders, leader of the Wellesley team, first found out about the program when she worked as an intern last summer at Johnson Space Center, where she met students who had participated last year. As soon as she got back to campus in the fall, she got three of her friends involved and together they came up with the idea for their educational project. It was only then that they drew in members of the physics department to act as their faculty advisors.

All of the members of that team, and many of their friends, said they remembered bad experiences from their early school years, in which teachers with old-fashioned stereotypes of sexual roles discouraged their budding interest in math and science. That gave them the motivation to try to develop educational materials that could be used to help inspire other youngsters to pursue such interests.

Aboard the KC-135, their team videotaped a candle burning in weightlessness, as well as a device that shot tiny air bubbles into a tank of water, and also filmed themselves tossing a heavy ball and playing with a slinky and a gyroscope. "Things didn't all quite work the way we expected," Campbell said last week, but "we got really good stuff. Everything went really well."

Within about a month, they hope to finish editing their videotape and be ready to start taking it around to elementary and high schools in the area and pass along some of the excitement and encouragement that they gained.

In fact, Campbell said, "we think we'd like to come back next year and do this again," perhaps even incorporating ideas contributed by the students they talk to about what to try out while they are weightless.

Livieratos was also delighted with the outcome of his flight, even though the results were not quite what he expected. His experiment on using a foam material to isolate another from the vibrations of a spacecraft produced data that might be useful for some work on the new space station, and he hopes to write a formal paper on the results and submit it to a NASA peer-reviewed journal.

As great as the zero-gravity experience was for him, he said the thrill of being able to submit this paper for publication is even greater. And

for him personally, the biggest thrill of all in the whole experience was getting to sit at the original mission control center where the Apollo moon missions were run.

"I got to sit at a place where history was made," he said last week. "I'm in Boston, so I'm surrounded by history," he said, "but I'm an engineer, so what I like most is technical history." When he and Smith, his professor, got to sit at the control consoles, "we were bouncing out of our seats."

Much as he would love to go to work for NASA someday, Livieratos feels that his academic record -- like many students at UMass-Lowell, he is in his thirties, and has been in and out of school -- may not make that possible. The time in Houston working on this experiment "was probably as close as I'll get," he said, "but this was enough, it was worth it."

As Smith put it last week, "if there's a better way to motivate students to work in the aerospace field, I haven't seen it.

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That's why he and Livieratos were so eager to grab the opportunity as soon as their professor, mechanical engineer David Smith, told them about the program. The two of them immediately began brainstorming, and within a few days each of them had come up with a detailed proposal to submit.

"It was my hope that we could get two teams to write proposals, and that one of them would get accepted," Smith said. "It was an embarrassment of riches when both teams got accepted," leaving him scrambling to come up with the money to support them, which grew to include not only four flying participants for each team, all seniors in mechanical engineering, but also four underclassmen as ground-crew members to help out and to share the experience.

Ann Sanders, leader of the Wellesley team, first found out about the program when she worked as an intern last summer at Johnson Space Center, where she met students who had participated last year. As soon as she got back to campus in the fall, she got three of her friends involved and together they came up with the idea for their educational project. It was only then that they drew in members of the physics department to act as their faculty advisors.

All of the members of that team, and many of their friends, said they remembered bad experiences from their early school years, in which teachers with old-fashioned stereotypes of sexual roles discouraged their budding interest in math and science. That gave them the motivation to try to develop educational materials that could be used to help inspire other youngsters to pursue such interests.

Aboard the KC-135, their team videotaped a candle burning in weightlessness, as well as a device that shot tiny air bubbles into a tank of water, and also filmed themselves tossing a heavy ball and playing with a slinky and a gyroscope. "Things didn't all quite work the way we expected," Campbell said last week, but "we got really good stuff. Everything went really well."

Within about a month, they hope to finish editing their videotape and be ready to start taking it around to elementary and high schools in the area and pass along some of the excitement and encouragement that they gained.

In fact, Campbell said, "we think we'd like to come back next year and do this again," perhaps even incorporating ideas contributed by the students they talk to about what to try out while they are weightless.

Livieratos was also delighted with the outcome of his flight, even though the results were not quite what he expected. His experiment on using a foam material to isolate another from the vibrations of a spacecraft produced data that might be useful for some work on the new space station, and he hopes to write a formal paper on the results and submit it to a NASA peer-reviewed journal.

As great as the zero-gravity experience was for him, he said the thrill of being able to submit this paper for publication is even greater. And

for him personally, the biggest thrill of all in the whole experience was getting to sit at the original mission control center where the Apollo moon missions were run.

"I got to sit at a place where history was made," he said last week. "I'm in Boston, so I'm surrounded by history," he said, "but I'm an engineer, so what I like most is technical history." When he and Smith, his professor, got to sit at the control consoles, "we were bouncing out of our seats."

Much as he would love to go to work for NASA someday, Livieratos feels that his academic record -- like many students at UMass-Lowell, he is in his thirties, and has been in and out of school -- may not make that possible. The time in Houston working on this experiment "was probably as close as I'll get," he said, "but this was enough, it was worth it."

As Smith put it last week, "if there's a better way to motivate students to work in the aerospace field, I haven't seen it.

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FREE AT LAST IN NASA'S HIGH-FLYING ``VOMIT COMET,'' STUDENTS CAN ESCAPE THE GRIP OF GRAVITY AND LEARN A FEW THINGS IN THE PROCESS.

Author(s): David L. Chandler, Globe Staff **Date:** May 31, 1998
Page: 20 **Section:** Sunday Magazine

It's not the kind of thing you usually have to worry about. But there's no mistaking the urgency in the voice of zero-gravity test director Judy Rickard: Several of us are floating upside down in the airplane cabin -- not that it's easy to tell upside from down, with gravity temporarily suspended -- and the half-minute of weightlessness is about to end.

Landing headfirst can be a real hazard on **zero-G** flights, even though the floor, like the rest of our aircraft's interior, is well padded, so Rickard and the other instructors are keeping a vigilant eye on the suspended novices. With a quick kick to the ceiling, I propel my legs back down below head level -- just in the nick of time. As "down" abruptly reasserts its existence, I crumple to the floor, more or less feet first, and settle in for a couple of minutes of double-strength gravity. Keeping track of which way the floor lies is just one of the bewildering tasks that confront the passengers on NASA's reduced-gravity test aircraft, otherwise known as the "vomit comet." There's nothing stomach-churning about the plane itself -- it's essentially like a commercial Boeing 707 with interior padding instead of windows -- but its two-hour flight can produce nausea in even a seasoned sailor. The aircraft follows a roller-coaster flight path consisting of 40 parabolic arcs, and at the

On this flight, the 21 passengers -- 19 students and two journalists -- are getting their first and maybe their last taste of zero gravity. Even

for the unlucky ones who are sidelined by motion sickness, it's the ride of a lifetime. But the students all have experiments to conduct, so after the first thrill of floating up off the floor, most of them are knuckling down to work. Two members of the Massachusetts Institute of Technology team -- Mandy Chambers, an aspiring astronaut, and Onier Villarreal, a premed student -- float over to their equipment and pull themselves into position to start their test of weightless welding.

About three dozen parabolas later, though, the students realize it's their last chance to have some gravity-free fun. One by one they abandon their experiments and begin -- gingerly at first, then with increasing gusto -- to attempt things they can do only in these weightless moments, like spinning upside down or doing midair quadruple somersaults. Chambers tries slithering "up" one wall, across the top, and headfirst "down" the other side, and finds herself convinced that the floor is the ceiling.

All too soon, the plane is rolling back into Ellington Field, north of the Johnson Space Center, in Houston, and the sense of letdown has begun. We stumble down the stairs into the blazing Texas sun and line up by the plane for the obligatory group photo, once more firmly in the grip of gravity.

Gravity has had us in its thrall since the first life forms emerged from the primeval ooze. Its absence -- weightlessness, or zero gravity -- is a sensation unknown before the space age, except to those who experienced it for a few brief seconds in falls from very high places.

Science fiction writers filled the information void with imaginative scenarios of human behavior in an unearthly weightless environment. They differed on how zero gravity would affect humans -- would it extend lives or drive people batty? -- and nobody guessed how much astronauts would enjoy playing with their food. But there was no knowing exactly what it would feel like, because the force of gravity cannot be canceled out on the surface of any planet. Absent a gravity shield, which most physicists agree is impossible, the only way to be weightless is to be in free fall -- for example, in an elevator plunging toward doom or in a spacecraft in orbit, which is perpetually "falling" along a curved and bottomless path.

Or in a plane flying the course our aircraft took, a series of steep parabolic arcs. Much as people in a roller coaster feel themselves rising out of their seats at each crest, parabolic flight can provide a few seconds of true weightlessness at the top of each arc.

The NASA craft went into service in 1959 to train the Mercury Seven astronauts, and it and a successor have been used by every US astronaut since for initial training. The converted KC-135 military plane was also the stage for space scenes in Apollo 13, the first movie

ever to include authentic **zero-G** footage rather than simulations. But this is only the second year that a shot at the unique ride has been offered to college students across the nation, who compete for a spot by planning zero-Gresearch projects to be conducted on board.

The program is the brainchild of NASA **zero-G** test director Bob Williams, a veteran of 71,000 weightless parabolas, and University of Texas space researcher Burke Fort. They started the program three years ago with just a few teams from local Texas colleges, then expanded nationwide in 1997. This year, the program flew almost 200 students from 47 colleges and universities, and it expects to double the number of students next year. The program costs NASA about $170,000, which its managers consider a small price for the educational benefits -- not to mention the public relations value of sending the students back to their campuses full of enthusiasm and armed with required "outreach" plans for sharing the experience. Fort beams as he describes the cards and letters he received from grateful veterans of last year's flights. "I wasn't sure what I wanted to do, but now I know," said one. "You've changed my life!" said another.

For the MIT team, and most of the others, the trip to Houston began last summer on the Internet. Some received e-mail messages from friends or professors, others stumbled onto the NASA zero-gravity site on their own. The terms of the offer were simple: Come up with an experiment to be carried out in weightlessness, submit a proposal to the National Aeronautics and Space Administration, and teams of up to four students could test their experiments -- and their stomachs -- aboard the vomit comet.skydives, and spent three summers at Space Camp, a privately run facility in Huntsville, Alabama. She chose her college and her major, mechanical engineering, with an eye to NASA's future needs, and joined the Air Force ROTC in hopes of becoming a test-flight engineer.

A successful bid for the vomit comet would get her in the door of the Johnson Space Center, and she might even meet members of the astronaut selection committee. Best of all, she would get a taste of what it feels like to be in space -- a few minutes of real weightlessness.

In September, Chambers and three fellow students, one of whom later dropped out, set to work planning their proposal. They started with tedious searches of Internet and library sources, checking what kinds of experiments others had done in **zero-G** and what might be possible. In the end, their inspiration came from team member Hernan Mercado's summer job. Working in a machine shop, Mercado, a 20-year-old junior from Puerto Rico, had learned a bit about arc welding; a search of the literatureshowed that it was an area ripe for exploration.

"There were only two other experiments on welding, but gazillions on soldering," says Chambers. Soldering, a low-heat process used to join pipes or wires, is much simpler than welding. But to join large sections of metal -- for example, to repair a leaking seam between panels of a space station's hull -- you need high-temperature welding, which melts the metal edges so they fuse together. Clearly, this is not just abstract research; astronauts may have to make such repairs in space, possibly in an emergency situation like last year's air leak on Mir, the aging Russian space station. "I can think of a couple of Russians last year who wouldn't have minded having a welding torch," says Chambers.

Their experiment, Mercado explains, would examine "the quality of the weld -- can we weld at all? -- and the way zero-gravity affects the melt density and surface tension." The MIT team put together a formal proposal and e-mailed it to NASA. Early in December, just before first-semester exams and winter vacation, they got word that their project had been approved.

That was the easy part, compared with the task they faced after vacation. With a March deadline looming, the team got to work on constructing the equipment they needed.

But first, they had to scrounge up some money. NASA would cover the costs of the flight, but all equipment and travel expenses were up to the students -- and figuring out how to pay for it turned out to be a big part of the learning experience. As in many a real-world research enterprise, "Money was the hardest part of the whole project, by far," Mercado says. After weeks of begging and bargaining, the roughly $7,000 they needed to pay for welding equipment and two weeks in Houston was eventually collected from various MIT offices and departments; in return, the equipment will end up in an MIT machine shop.

There were logistical problems as well. None of the team members was old enough to rent a car -- almost a requirement for getting around Houston. They decided they'd have to make do with cabs. Then a freight company refused to ship their tank of argon gas, a crucial part of the welding equipment. They would have to find another argon tank in Houston. But those problems were behind them, and soon forgotten, when they pulled into Ellington Field on March 16 and joined the other teams in the NASA hangar, where students were setting up equipment on a series of long tables flanked by an exotic assortment of NASA test and training aircraft.

Forty-eight teams had been accepted from this year's 98 applications, and some were taking the concept of team spirit to picturesque lengths. Several teams were decked out in matching T-shirts, including the pessimistically named "Team Hurl" from George

Washington University. The Pomona College team, two men and two women, had all dyed their hair deep blue.

The teams' projects were almost as various: One group was studying the use of power tools in weightlessness -- something that astronauts assembling the International Space Station later this year will have to deal with. For instance, what's the best way to anchor a power drill so that it's the bit that turns, rather than the person holding the drill? Another group was looking at ways of putting out a fire in space, something that's trickier than you might think. In zero gravity, water from a sprinkler system, for example, wouldn't fall "down" but would have to be directed at the flames under pressure. Another team would observe how goldfish in a sealed tank reacted to the absence of gravity: Would they swim cheerfully and omnidirectionally or fishily freak out as they lost their moorings?

Like commercial airline passengers, the students can't fly till they've had their safety instructions. NASA's version, though, is a bit more complicated than the flight attendant's memorized spiel: It starts with a full day of lectures, attendance required, on dealing with sudden decompression and moves on to the high-altitude chamber for a sample of actual oxygen deprivation.

Decompression -- a loss of the cabin air pressure that makes high-altitude flight survivable -- can happen in any airplane, as passengers are reminded before every flight. But on a commercial flight, you're strapped in inches from the oxygen mask; on the KC-135, passengers could be anywhere in the 61-foot-long empty cabin, far from the seats in the rear, where the oxygen masks are stowed, if a decompression occurs. They need to know how to recognize the confusion that signals oxygen deprivation, or hypoxia, before it's too late to respond. There are other uncomfortable effects of decompression, too, the lecturers explain: Gas will expand to several times its original volume, so it's important to avoid gas-producing foods before the

Burke Fort, the lanky and genial director of the program, explains that the altitude chamber would simulate suddenly being transported to a 24,000-foot mountaintop. Even experienced mountaineers require weeks of acclimatization to function at that altitude, so being "transported" rapidly to such heights is guaranteed to make anyone black out within minutes; the brain simply can't get enough oxygen to keep functioning. The trick -- and the purpose of the training -- is to recognize the symptoms of impending hypoxic unconsciousness in time to get one's oxygen mask on.

The chamber itself -- World War II vintage, and "older than most of your parents," as one instructor points out to the students -- is a big steel cylinder that looks a bit like a used fuel tank. Originally used to train pilots, since the 1950s it has been a testing ground for every US

astronaut from the Mercury and Apollo pioneers through today's space shuttlers, as well as anyone (including Tom Hanks and the rest of the Apollo 13 cast and crew) planning to fly on the vomit comet.

Inside, 14 students sit on the benches that line the chamber, with consoles by each seat for oxygen supply regulators, dials, and indicators. For 15 minutes, they all breathe pure oxygen through masks, to rid their bodies of nitrogen and prevent the bends during decompression. Then the hatch is sealed and the "climb" begins.

At 25,000 feet, everyone takes off the masks. The initial impression is surprising: Breathing feels perfectly normal, with no gasping or shortness of breath. That's what makes hypoxia so dangerous: It sneaks up on you. Long before you notice anything unusual, brain cells are hurting -- and even dying -- from the deprivation. The students are handed clipboards with simple questions and exercises; the task seems easy, but looking back at their sheets later, the college whiz kids are startled to see that they have messed up simple sums and connect-the-dots puzzles that most grade-schoolers would have aced. One, asked to list the last three presidents, wrote "Clinton, Clinton, Clinton." Chambers found that she had written "Bush, Reagan, Nixon."

Though it's very rare, even hours later serious effects of decompression -- including some neurological symptoms, joint pains, or choking -- can appear, so everyone is sent off with a "Hazardous Duty" card containing emergency instructions for medical personnel. It's a sobering reminder that this zero-gravity project is a serious, even risky, business, and not just the world's fanciest amusement-park ride.

On the morning of the flight, everyone assembles early at the Ellington hangar, nervous, excited, and just a little scared. First, there's a round of preflight briefings, and everyone is issued a Scop-Dex capsule -- standard issue for astronauts before a flight. It's a combination of scopolamine, to combat nausea, and dexedrine, to counteract the drowsiness scopolamine causes. It's optional, but everyone agrees that it drastically improves the odds of keeping down your breakfast.

Just what those odds are seems to depend on who's estimating. In one of the first-week briefings, an instructor confidently stated that about 20 percent of people who fly on the vomit comet throw up at least once. But now that the moment is at hand, some instructors are saying it's more like 80 percent.

On a flight the day before, one student didn't manage to get his barf bag out in time. That can be a real problem in **zero-G** -- something test directors Williams and Rickard have clearly seen more often than they like to remember. In this case, they tell the group, the plane had

to suspend its parabolic maneuvers and maintain level flight for about 10 minutes while the mess was cleaned up. On really hot days, they say, the interior of the plane reeks of lunches lost in years past, a sickening trigger for the stomach of anyone teetering on the verge of nausea.

The students get one last stern warning about keeping track of their feet as they move around in zero gravity. "If you kick me, I will kick you back," Williams says gruffly, "and it will hurt." Then, finally, it's time to strap into the seats in the plane's rear and prepare for the unknown.

The takeoff, though smooth and uneventful, already has an eerie feel; with no windows nearby, you can't quite tell when you've left the ground. Once in the air, the student teams scramble into position next to their experimental apparatus, all well padded and reinforced to protect both people and equipment against unforeseen collisions when the gravity changes.

There's plenty of warning before the first bout of weightlessness, because each parabola begins with a couple of minutes of increased gravity, about 1.8 Gs. That didn't sound like much during the briefings; people can experience more than that on some roller coasters, though not for nearly as long. But when it hits, it's surprising just how intense all that extra pressure feels. Most people, it turns out, get sick during the increased gravity segments, not while floating weightless. "I'm really not feeling well, really not," says one student -- and the **zero**-G hasn't even started yet.

Then, abruptly, the heavy weight lifts, and the students begin to drift slowly up from their places on the floor. Yelps, whoops, and laughter fill the cabin. "This is by far the coolest thing I've ever done," says one grinning George Washington student. Some students begin right away to experiment with the new sensation, trying aerial somersaults and spins. Others are more cautious, just letting themselves drift a little or grabbing straps to hold themselves down.

It doesn't feel like anything you've experienced before. The closest thing is probably scuba diving, with its sense of weightlessness and the freedom to move in any direction through three-dimensional space, instead of moving along horizontal surfaces, as we've been conditioned to do by millions of years of evolution. But it's also very different, because water has resistance: You can push against it to get yourself moving, and you drift to a stop quickly because of its friction. In weightlessness, you can get yourself moving only by pushing against a wall, and then nothing's going to stop you or slow you down until another wall (or floor or ceiling) comes along.

After a few parabolas of getting used to the new freedom, and trying

to get stomachs back down out of throats, the students settle in to do what they came here for. Most of the experiments deal with basic engineering, chemical reactions, or fluid dynamics, but a few are more offbeat. One team, from the San Francisco Art Institute, is experimenting with painting and dancing in weightlessness. As Fort explains, such creative endeavors might be important for maintaining psychological balance during

The painting looks like a lot of fun: The artist, encased in a large cube of clear plastic to prevent the paint from permanently decorating the entire cabin, squeezes acrylic paint in the general direction of a canvas that surrounds him on three sides. Like a weightless Jackson Pollock, he launches arcs of color that eventually splatter onto some convenient surface -- most of it on the plastic rather than the canvas, it seems. But there's all that pesky extra-strength gravity in between the periods of weightlessness, so by the end of the flight, the plastic cube appears ankle-deep in muddy mixed colors that have pooled at the bottom, and the canvases look like something from the fingerpainting table at a day-care center.

More aesthetically pleasing, it turns out, is a fluid dynamics experiment from the University of Alabama. Inside a large vertical tank, blue and green fluids curve gracefully upward, looking like a cross between the Museum of Science's wave tank and a '60s-era lava lamp. The variations in these wavelike flows are fascinating to watch, and nothing dramatizes the shift from weightlessness to double gravity as starkly as the blue swirls suddenly sinking to the bottom of the tank in one big schlooomp!

MIT's welding is less glamorous, though perhaps of more practical value. The students find it's harder than they expected to hold themselves in position while welding, but the steel welds they complete appear smooth and strong -- potentially good news for some future astronaut in a leaky craft. Later, when the students are back in the lab, a microscope reveals surprising differences in the orientation of stress lines in the welds, which may require followup study by some future team.

And then, suddenly, it's all over; our feet are planted on the floor again, the plane heads home, and **zero-G** is just a memory. Our 40 parabolas have added up to less than 20 minutes of weightless time, but it's 20 minutes of rare adventure, and it has left a lasting impression.

Chambers, exhilarated by the flight and proud that she never had to reach for a barf bag, is more eager than ever to make it into the astronaut corps. Later, describing the experience to fellow students back at MIT, she recommends that future teams automate their experiments as much as possible: "You don't want to have to work --

it's so much fun!" Even her MIT teammates, who felt quite sick in flight, are saying by the end of the day that they might give it another try. "Not many people getto do this," Mercado says. "It was great."

A few veterans of the vomit comet, inspired by the experience, may reappear at the Johnson Space Center in years to come, perhaps to train for missions on the shuttle, the space station, or even the first human flight to Mars. But even those who will never return are taking home, along with their used equipment and hard-won research data, memories and photos of a truly exotic trip.

And stories they'll be telling for the rest of their lives.

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Their experiment, Mercado explains, would examine "the quality of the weld -- can we weld at all? -- and the way zero-gravity affects the melt density and surface tension." The MIT team put together a formal proposal and e-mailed it to NASA. Early in December, just before first-semester exams and winter vacation, they got word that their project had been approved.

That was the easy part, compared with the task they faced after vacation. With a March deadline looming, the team got to work on constructing the equipment they needed.

But first, they had to scrounge up some money. NASA would cover the costs of the flight, but all equipment and travel expenses were up to the students -- and figuring out how to pay for it turned out to be a big part of the learning experience. As in many a real-world research enterprise, "Money was the hardest part of the whole project, by far," Mercado says. After weeks of begging and bargaining, the roughly $7,000 they needed to pay for welding equipment and two weeks in Houston was eventually collected from various MIT offices and departments; in return, the equipment will end up in an MIT machine shop.

There were logistical problems as well. None of the team members was old enough to rent a car -- almost a requirement for getting around Houston. They decided they'd have to make do with cabs. Then a freight company refused to ship their tank of argon gas, a crucial part of the welding equipment. They would have to find another argon tank in Houston. But those problems were behind them, and soon forgotten, when they pulled into Ellington Field on March 16 and joined the other teams in the NASA hangar, where students were setting up equipment on a series of long tables flanked by an exotic assortment of NASA test and training aircraft.

Forty-eight teams had been accepted from this year's 98 applications, and some were taking the concept of team spirit to picturesque lengths. Several teams were decked out in matching T-shirts, including the pessimistically named "Team Hurl" from George

Washington University. The Pomona College team, two men and two women, had all dyed their hair deep blue.

The teams' projects were almost as various: One group was studying the use of power tools in weightlessness -- something that astronauts assembling the International Space Station later this year will have to deal with. For instance, what's the best way to anchor a power drill so that it's the bit that turns, rather than the person holding the drill? Another group was looking at ways of putting out a fire in space, something that's trickier than you might think. In zero gravity, water from a sprinkler system, for example, wouldn't fall "down" but would have to be directed at the flames under pressure. Another team would observe how goldfish in a sealed tank reacted to the absence of gravity: Would they swim cheerfully and omnidirectionally or fishily freak out as they lost their moorings?

Like commercial airline passengers, the students can't fly till they've had their safety instructions. NASA's version, though, is a bit more complicated than the flight attendant's memorized spiel: It starts with a full day of lectures, attendance required, on dealing with sudden decompression and moves on to the high-altitude chamber for a sample of actual oxygen deprivation.

Decompression -- a loss of the cabin air pressure that makes high-altitude flight survivable -- can happen in any airplane, as passengers are reminded before every flight. But on a commercial flight, you're strapped in inches from the oxygen mask; on the KC-135, passengers could be anywhere in the 61-foot-long empty cabin, far from the seats in the rear, where the oxygen masks are stowed, if a decompression occurs. They need to know how to recognize the confusion that signals oxygen deprivation, or hypoxia, before it's too late to respond. There are other uncomfortable effects of decompression, too, the lecturers explain: Gas will expand to several times its original volume, so it's important to avoid gas-producing foods before the

Burke Fort, the lanky and genial director of the program, explains that the altitude chamber would simulate suddenly being transported to a 24,000-foot mountaintop. Even experienced mountaineers require weeks of acclimatization to function at that altitude, so being "transported" rapidly to such heights is guaranteed to make anyone black out within minutes; the brain simply can't get enough oxygen to keep functioning. The trick -- and the purpose of the training -- is to recognize the symptoms of impending hypoxic unconsciousness in time to get one's oxygen mask on.

The chamber itself -- World War II vintage, and "older than most of your parents," as one instructor points out to the students -- is a big steel cylinder that looks a bit like a used fuel tank. Originally used to train pilots, since the 1950s it has been a testing ground for every US

astronaut from the Mercury and Apollo pioneers through today's space shuttlers, as well as anyone (including Tom Hanks and the rest of the Apollo 13 cast and crew) planning to fly on the vomit comet.

Inside, 14 students sit on the benches that line the chamber, with consoles by each seat for oxygen supply regulators, dials, and indicators. For 15 minutes, they all breathe pure oxygen through masks, to rid their bodies of nitrogen and prevent the bends during decompression. Then the hatch is sealed and the "climb" begins.

At 25,000 feet, everyone takes off the masks. The initial impression is surprising: Breathing feels perfectly normal, with no gasping or shortness of breath. That's what makes hypoxia so dangerous: It sneaks up on you. Long before you notice anything unusual, brain cells are hurting -- and even dying -- from the deprivation. The students are handed clipboards with simple questions and exercises; the task seems easy, but looking back at their sheets later, the college whiz kids are startled to see that they have messed up simple sums and connect-the-dots puzzles that most grade-schoolers would have aced. One, asked to list the last three presidents, wrote "Clinton, Clinton, Clinton." Chambers found that she had written "Bush, Reagan, Nixon."

Though it's very rare, even hours later serious effects of decompression -- including some neurological symptoms, joint pains, or choking -- can appear, so everyone is sent off with a "Hazardous Duty" card containing emergency instructions for medical personnel. It's a sobering reminder that this zero-gravity project is a serious, even risky, business, and not just the world's fanciest amusement-park ride.

On the morning of the flight, everyone assembles early at the Ellington hangar, nervous, excited, and just a little scared. First, there's a round of preflight briefings, and everyone is issued a Scop-Dex capsule -- standard issue for astronauts before a flight. It's a combination of scopolamine, to combat nausea, and dexedrine, to counteract the drowsiness scopolamine causes. It's optional, but everyone agrees that it drastically improves the odds of keeping down your breakfast.

Just what those odds are seems to depend on who's estimating. In one of the first-week briefings, an instructor confidently stated that about 20 percent of people who fly on the vomit comet throw up at least once. But now that the moment is at hand, some instructors are saying it's more like 80 percent.

On a flight the day before, one student didn't manage to get his barf bag out in time. That can be a real problem in **zero-G** -- something test directors Williams and Rickard have clearly seen more often than they like to remember. In this case, they tell the group, the plane had

to suspend its parabolic maneuvers and maintain level flight for about 10 minutes while the mess was cleaned up. On really hot days, they say, the interior of the plane reeks of lunches lost in years past, a sickening trigger for the stomach of anyone teetering on the verge of nausea.

The students get one last stern warning about keeping track of their feet as they move around in zero gravity. "If you kick me, I will kick you back," Williams says gruffly, "and it will hurt." Then, finally, it's time to strap into the seats in the plane's rear and prepare for the unknown.

The takeoff, though smooth and uneventful, already has an eerie feel; with no windows nearby, you can't quite tell when you've left the ground. Once in the air, the student teams scramble into position next to their experimental apparatus, all well padded and reinforced to protect both people and equipment against unforeseen collisions when the gravity changes.

There's plenty of warning before the first bout of weightlessness, because each parabola begins with a couple of minutes of increased gravity, about 1.8 Gs. That didn't sound like much during the briefings; people can experience more than that on some roller coasters, though not for nearly as long. But when it hits, it's surprising just how intense all that extra pressure feels. Most people, it turns out, get sick during the increased gravity segments, not while floating weightless. "I'm really not feeling well, really not," says one student -- and the **zero**-G hasn't even started yet.

Then, abruptly, the heavy weight lifts, and the students begin to drift slowly up from their places on the floor. Yelps, whoops, and laughter fill the cabin. "This is by far the coolest thing I've ever done," says one grinning George Washington student. Some students begin right away to experiment with the new sensation, trying aerial somersaults and spins. Others are more cautious, just letting themselves drift a little or grabbing straps to hold themselves down.

It doesn't feel like anything you've experienced before. The closest thing is probably scuba diving, with its sense of weightlessness and the freedom to move in any direction through three-dimensional space, instead of moving along horizontal surfaces, as we've been conditioned to do by millions of years of evolution. But it's also very different, because water has resistance: You can push against it to get yourself moving, and you drift to a stop quickly because of its friction. In weightlessness, you can get yourself moving only by pushing against a wall, and then nothing's going to stop you or slow you down until another wall (or floor or ceiling) comes along.

After a few parabolas of getting used to the new freedom, and trying

to get stomachs back down out of throats, the students settle in to do what they came here for. Most of the experiments deal with basic engineering, chemical reactions, or fluid dynamics, but a few are more offbeat. One team, from the San Francisco Art Institute, is experimenting with painting and dancing in weightlessness. As Fort explains, such creative endeavors might be important for maintaining psychological balance during

The painting looks like a lot of fun: The artist, encased in a large cube of clear plastic to prevent the paint from permanently decorating the entire cabin, squeezes acrylic paint in the general direction of a canvas that surrounds him on three sides. Like a weightless Jackson Pollock, he launches arcs of color that eventually splatter onto some convenient surface -- most of it on the plastic rather than the canvas, it seems. But there's all that pesky extra-strength gravity in between the periods of weightlessness, so by the end of the flight, the plastic cube appears ankle-deep in muddy mixed colors that have pooled at the bottom, and the canvases look like something from the fingerpainting table at a day-care center.

More aesthetically pleasing, it turns out, is a fluid dynamics experiment from the University of Alabama. Inside a large vertical tank, blue and green fluids curve gracefully upward, looking like a cross between the Museum of Science's wave tank and a '60s-era lava lamp. The variations in these wavelike flows are fascinating to watch, and nothing dramatizes the shift from weightlessness to double gravity as starkly as the blue swirls suddenly sinking to the bottom of the tank in one big schlooomp!

MIT's welding is less glamorous, though perhaps of more practical value. The students find it's harder than they expected to hold themselves in position while welding, but the steel welds they complete appear smooth and strong -- potentially good news for some future astronaut in a leaky craft. Later, when the students are back in the lab, a microscope reveals surprising differences in the orientation of stress lines in the welds, which may require followup study by some future team.

And then, suddenly, it's all over; our feet are planted on the floor again, the plane heads home, and **zero-G** is just a memory. Our 40 parabolas have added up to less than 20 minutes of weightless time, but it's 20 minutes of rare adventure, and it has left a lasting impression.

Chambers, exhilarated by the flight and proud that she never had to reach for a barf bag, is more eager than ever to make it into the astronaut corps. Later, describing the experience to fellow students back at MIT, she recommends that future teams automate their experiments as much as possible: "You don't want to have to work --

it's so much fun!" Even her MIT teammates, who felt quite sick in flight, are saying by the end of the day that they might give it another try. "Not many people getto do this," Mercado says. "It was great."

A few veterans of the vomit comet, inspired by the experience, may reappear at the Johnson Space Center in years to come, perhaps to train for missions on the shuttle, the space station, or even the first human flight to Mars. But even those who will never return are taking home, along with their used equipment and hard-won research data, memories and photos of a truly exotic trip.

And stories they'll be telling for the rest of their lives.

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