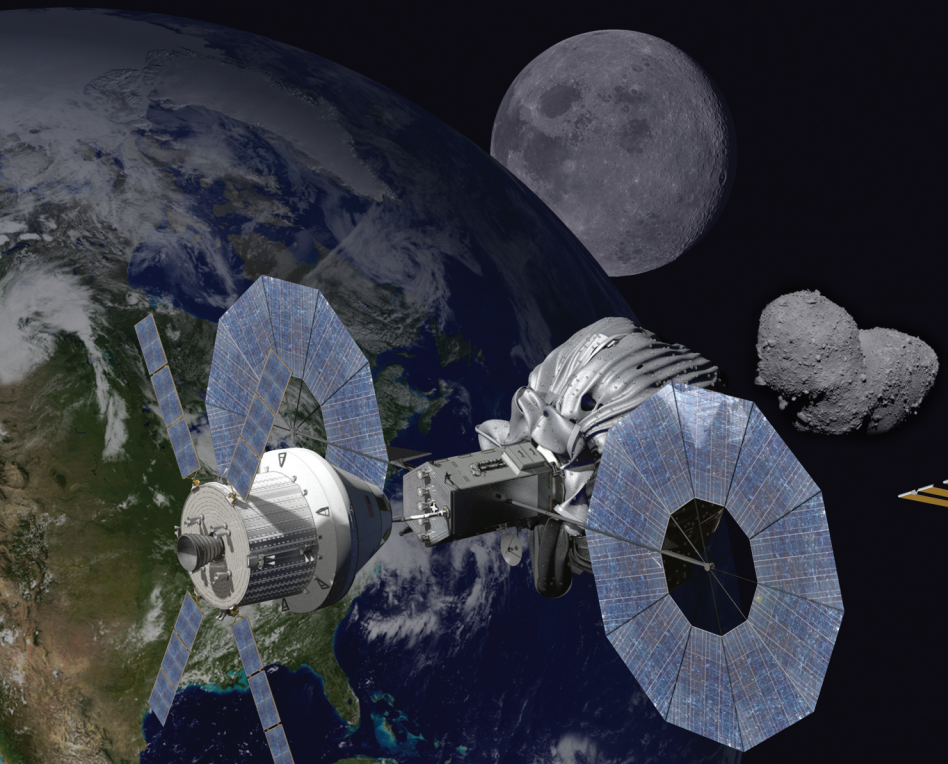
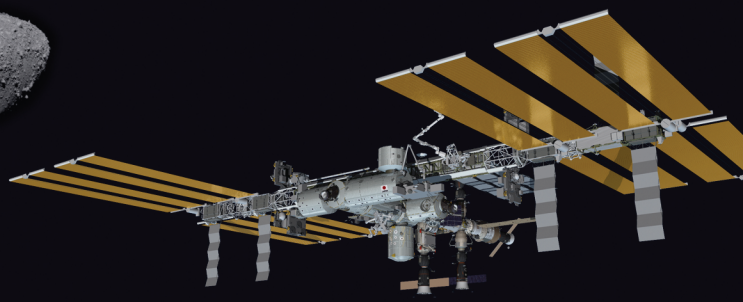
National Aeronautics and
Space Administration





Reduced Gravity Education Flight Program

Participant Handbook

Class of 2014

NASA'S REDUCED GRAVITY EDUCATION FLIGHT PROGRAM

Class of 2014
PARTICIPANT HANDBOOK
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Introduction

Welcome Statement

Congratulations on being selected to fly your experiment. We are excited that you are here and look forward to working with you. We've put together this handbook to give you our rules and expectations and also to give you some hints on places to go and things to see in and around Houston—the nation's fourth largest city!

So that operations can run smoothly during your time at Ellington Field, we ask you to adhere to the guidelines communicated in this handbook and in the group presentations. It is important to have your **full** cooperation. All of your activities are tightly scheduled and it is important that you stay informed about any changes. Remember that there are several other teams in your flight group and to make any changes to one schedule will produce additional changes to all group schedules.

NOTE: You MUST wear your visitor badge at all times when on site or at designated reduced gravity event.

With that in mind, please **HAVE FUN** and take home as many memories as you can!

NASA Aircraft Operations 990/993

Safe Workplace – *HAZARDOUS PLAYGROUND*
Normal Hours of Operation 0730-1600

This is an active flight operations facility. Be aware of maintenance personnel and related activities going on around you.

Watch out for ramp equipment (tractors, fork lifts, etc.) high noise environment may inhibit audible warnings.

Please **REMAIN WITHIN THE ROPED PERIMETER OF HANGAR 990** and areas designated on site map. You may enter/exit by the personnel gate.

Jet exhaust can be hazardous up to 200 feet behind aircraft.

Jet intake can be hazardous within 25 feet.

Secure all loose items, as even small articles can enter intakes and destroy jet engines.

Check any and all hazardous materials, liquids, gasses, and chemicals with Test Directors immediately. All liquids and materials must be clearly labeled (including water).

Do not use any brushed motor driven equipment in hangar 990, especially ***drill motors.***

Do not place any electrical connections, or operating equipment, lower than ***18" off the floor of hangar 990.***

You are responsible for *every* item you bring onto this facility (inside the gate).

To maintain proper tool (loose equipment) control you must have a written inventory and know the location of all items at all times.

Use **ONLY** RGO tools on board the aircraft at any time. No personal tools are allowed on the plane, even on the ground.

Do not enter or remain onboard the plane, without AOD/RGEFP personnel with you at any time.

Do not operate any Ground Support, Material Handling, or aircraft equipment or systems.

Do not operate **your** equipment, or perform hazardous ground support operations, without advising AOD personnel.

When in doubt Ask! Do not assume.
We are here to help.

HANGAR & FLIGHT LINE SAFETY

We want your visit with us to be pleasant, productive and most of all **SAFE**. A basic understanding of “things you should do” and “things you should not do” will help ensure a productive visit.

DO’S

- When you open an airfield gate, make sure it’s closed before you leave the gate.
- Keep your badge with you at all times while at NASA.
- Stay with your group and in your assigned area while in the hangar.
- In case of a hangar or building fire, evacuate the area, stay together.
- Look before crossing the flight line road.
- Wear hearing protection while on the flight line.
- Be careful while walking on the hangar floor. It is painted and can be slippery when wet.

DON’TS

- Go on a tour (explore the area) without permission, and an escort.
- Climb on any of the aircraft or support equipment.
- Touch any of the hangar controls (valves or switches).
- Try to fight any building or hangar fires.
- Take non-essential items on the flight line or in the aircraft (Tools and Spare parts), and NO items without a Tool Control list
- Wear open toed footwear (sandals or flip flops), or inappropriate footwear for an industrial facility.
- Get close to any aircraft being worked on by aircraft mechanics.

Emergency Number: ext. 3-3333

(On the **RED** hotline phone in the hangar.)

*** If dialing from your cell phone, call 281-483-3333***

Do not use 911 (except as last resort)

Safety Requirements – Ellington Field

Aircraft Operations Division

SAFETY is a number one concern at JSC's Ellington Field. To ensure the safety of all personnel and visitors, the JSC Aircraft Operations Division (AOD) posts the following Safety Requirements. All personnel and equipment visiting Ellington Field **MUST** adhere to the safety guidelines addressed herein – **persons found to be in violation of posted Safety Requirements will be escorted from the facility**.

A safety briefing will be delivered to all JSC participants during Program Orientation at Ellington Field. Although Safety Requirements will be included in Program materials, teams expecting late-arrival team members or faculty advisors are required to provide each visitor with an advance-copy of the Safety Requirements. Late arrivals will have to complete the safety briefing when they arrive.

In the event of an emergency at Ellington Field, dial x3-3333 from any NASA phone to immediately contact an Emergency Action Team. If using a cell phone, dial 281-483-3333.

1. Identification badges are issued for all pre-approved researchers to Ellington Field.
    a. ID badges must be worn at all times while on NASA property.

2. Microgravity aircraft researchers must stay within the immediate vicinity of Building 990/993 (Reduced Gravity Office/High Bay/Hangar).
    a. Areas outside RGO vicinity are restricted and researchers may not, under any circumstances, wander unescorted into these areas.
    b. Visiting adjacent Ellington Field facilities (U.S. Coast Guard, Air National Guard) is PROHIBITED.

3. Storage of equipment must be approved by the RGO prior to its arrival at Ellington Field.
    a. All equipment shipped/stored at Ellington Field must be properly labeled upon its arrival.

4. Smoking is discouraged, but allowed ONLY in designated areas.

5. Food and drink is allowed only in designated areas.

6. Loose items such as pencils, clothing, jewelry, badges, debris, etc. must be accounted for at all times in order to prevent Foreign Object Damage (FOD) to aircraft.

7. All equipment (tools, test hardware, fluids, etc.) brought to Ellington Field must be inventoried and accounted for at all times. Misplaced or lost equipment poses a FOD hazard to aircraft.

8. All trash must be carefully placed in trash receptacles provided throughout the area.

    a. Dispose of batteries, oil-rags, chemicals, etc. only in specially designated trash receptacles.

9. When in Hangar 990, stay on the marked walkway at all times.
    a. Stay 15 feet away from ALL aircraft in Hangar 990 unless escorted by a NASA AOD (AirOps) badged employee.
    b. Stay at least 200 feet away from all operating aircraft engines.

10. Hearing protection is required during all outdoor and flight operations.
    a. The Reduced Gravity Office (RGO) provides foam earplugs.

11. Researchers are allowed to walk on/across the “Flight Line” in order to get to/from the microgravity aircraft when it is on the ramp (parked outside Building 993.
    a. At all other times, “Flight Line” access is prohibited unless escorted by a NASA AOD (AirOps) badged employee.

Badging and Security Information

Ellington Field is a secured airfield and all research participants will be badged upon arrival. Each badge permits access to certain buildings only. An Official Temporary Visitor Badge is issued to flyers, alternate flyers, ground crew, journalists, and faculty upon arrival at Ellington. This badge is white plastic with black lettering. It permits access to the Reduced Gravity Office (Building 993), the Hangar (Building 990), the Clinic area (Building 8), and additional buildings as assigned for each specific flight week. You will also receive a gate access card that will permit you to enter the gate at the Hangar (Building 990).

Please make a special note of the access areas permitted by your badge. Remember that areas outside the Reduced Gravity Office vicinity are restricted and researchers may not, under any circumstances, wander unescorted into these areas. Visiting adjacent facilities (U.S. Coast Guard, and Air National Guard) is prohibited and can result in your removal from the program and/or incarceration.

The plastic portion of the badge (with your name on it) may be kept as a souvenir, but the gate access card MUST be returned to a RGEFP staff member at the end of your stay at Ellington Field.

If you have any questions about badge restrictions, please contact Kerry McManis, in the Reduced Gravity Office, at (281) 244-9874 or kerry.mcmanis-1@nasa.gov.

Hangar and Flight Line Manners

Ellington Field is a joint use civil and military airport. Acquired by the City of Houston in 1984, Ellington supports the operations of the United States military, NASA and general aviation. It is a secured airfield with a good deal of traffic. There are very strict rules and federal laws governing access to Ellington Field. **When you open a gate to enter or to leave the Field you are responsible for ensuring that the gate is closed before leaving the immediate area.** Please do your part to make sure unauthorized persons do not gain access to the Field.

Be especially careful as you enter Hangar 990. The floor is covered with a protective coating that may be slippery if it is damp. Hangar 990 is where the teams will set-up and work on their experiments. Each team has been assigned a table located in an area of the hangar reserved for the RGEF Program. Hangar 990 is an industrial work area and is not open for self-guided tours. It is a working facility to house and repair aircraft. Therefore, it is important that you stay with your group and within your assigned area. **Under no circumstances are you to climb on any of the aircraft.**

Do not be a button pusher, valve turner or switch flipper. Leave these tasks to the Test Directors. By pushing the wrong button or casually flipping a switch you could, for example, activate the fire suppression system and find yourself in 15 feet of water and high-expansion foam.

In the event of a fire or other such emergency, your sole responsibility will be to evacuate to a designated safe area. Your test directors, a facility manager or safety specialist will make sure you know where to assemble. Go to the assembly area quickly, orderly and remain there until the emergency is over and everyone has been accounted for.

The "**Flight Line**" is a "road" where aircraft and ground support equipment is operated outside the hangar. There is a flight line immediately in front of the Reduced Gravity Office in Building 993. A majority of the vehicular traffic in Ellington Field passes through this area. Always use caution and look for oncoming vehicular traffic when in the flight line. Do not loiter. You may not walk up and down the flight line. Do not set-up camera tripods or other stationary equipment on the flight line. This is a high noise level environment. **You should wear ear plugs whenever you are on the flight line**. When escorted, researchers are allowed to walk on or across the flight line in order to get to and from the microgravity aircraft when it is parked outside Building 993. At all other times, flight line access is prohibited unless escorted by a NASA AOD (AirOps) badged employee. Beware of jet engine intakes and exhaust blasts. Do not get closer than 25 feet to a jet engine intake and remain 200 feet away from the exhaust. There are documented instances when large jet engines at high power settings have sent small aircraft and automobiles tumbling. There are also documented instances where grown men have been ingested into intakes from 6 feet away.

Secure your stuff. Pens, pencils, combs, jewelry, etc. can be easily ingested into an aircraft engine intake causing serious damage. We call it Foreign Object Damage (FOD). Damage caused by these and other small items can be significant and cost $75,000 or more to repair. **Do not take unnecessary non-essential items on the flight or in the aircraft. If you lose an item anywhere, tell a test director and program staff.** We will make every effort to find it.

Finding What You Need

Restrooms:
Restrooms are found in the High Bay in Building 993 and the lower floor of Hangar 990.

Telephones, Faxes & Copy Machines:
Participants and journalists may use the telephones located in the briefing room and in the High Bay. Do not use the phones in Building 993 as it ties up the business lines. Houston requires dialing all ten digits of a phone number. Most telephone numbers in the Clear Lake area have the area code 281. The Houston area code is 713.

There is a fax and a copy machine in the Reduced Gravity Office in Building 993.

Telephone Numbers:

Main Number:	281-244-9874
Fax Number:	281-244-9500
High Bay:	281-244-9931 or 9932
Briefing Room:	281-244-9005 or 9811
Photo:	281-244-9701
Video:	281-244-9772

Building Hours:
Participants will be granted access from 7:30am to 4:00pm, Monday through Friday. If you need access outside of the times listed above, you will need to make arrangements in advance with the test directors and program staff.

Computer, Printer and Wireless Internet Access:
There are 3 team computers in Building 993 (one in the briefing room and two in the high bay). These computers are networked to the printer in the high bay.

Teams will receive login information for accessing the NASA Guest Wireless Network during orientation.

Snacks & Food:
There is a snack room in Hangar 990, which you have access to. However, please do not eat lunch or hang out in this room. You are welcome to bring lunch and eat at your team table or the grassy area by Building 993. Remember to keep all soda cans, paper, and plastic picked up at all times. These items can cause FOD (Foreign Object Damage) to the aircraft. We have provided a listing of eateries in the area at the back of this handbook. Check it out. If you leave Ellington Field for lunch, please return promptly for any scheduled afternoon briefings or to load or unload your equipment.

Shipping:
You should set-up the return shipping arrangements for your equipment **BEFORE** you arrive in Houston. The Reduced Gravity Office does not take responsibility for shipping your equipment home. Please notify the shipper that shipping hours are from 7:30am to 3:00pm Monday through Friday. Make sure to leave a copy of shipping information with Kerry McManis, in the Reduced Gravity Office.

Flight Day Tips

We ask that you show up to Ellington Field on your flight day at 7:30am; however, if your experiment needs further attention before your flight you may want to arrive even earlier (with prior approval.) We will not hold a flight for you unless there is an extreme emergency.

The following is a tentative flight day schedule applies to all flyers:

0745	Mandatory Flight Day Meeting 993 Conference Room (2 representatives from each team must be present- flyer or ground crew)
0800	Report to Building 993 Conference Room for Education briefing
0815	Medical Briefing
0845	Pre-Flight Briefing
0900	Board Plane
0930	Take Off
1115	Return to Ellington and group photo

Please be aware that all posted schedules are **TENTATIVE** and subject to change! In case of a **delay** of flight, do not leave the premises. In the case of a **canceled** flight, do not leave the premises until the make-up flight time has been determined and you are positive you can return on time. **It is your responsibility to keep yourself and your team informed of schedule and procedure changes.** All schedule changes will be posted on the information boards in Hangar 990 and Building 993.

Flight Suits:
Flight suits are issued in men's coat sizes. Please sign your issued equipment in and out. Remember to empty **and** double check your pockets of your used flight suit before dropping it in the washing machine in the High Bay. You would not appreciate finding someone else's bags in the pocket of the flight suit issued to you--please pass on the courtesy.

On the Flight:
Remember anything that is not tied down floats in reduced gravity; therefore it is recommended that you leave unnecessary personal items at the hotel or in the briefing room while on flight. **Please silence all personal mobile devices while you are away.**

After Flight:
There will be a group photo of the flyers immediately after the flight. Then the aircraft will usually be refueled. No one is allowed on the aircraft or flight line during refueling (usually about 45 minutes), or while engines are running for an engine check. After the plane is refueled and the experiments have been flown twice, teams will off-load their experiments and the next teams will on-load their experiments. Team members must be present to on/off load their experiments.

It is advisable to drink plenty of water after your flight to prevent dehydration. In the event you are nauseous after the flight, lie down and take it easy for a short while and perhaps eat a few crackers.

WHO TO KNOW

Reduced Gravity Office Staff

Dominic Del Rosso

Lead Reduced Gravity Flight Test Director
WB-57F SEO (Systems Equipment Operator)

Work:
Mr. Del Rosso is formerly an Engineering Project Manager with NASA Crew and Thermal Systems Division. Prior to his employment by NASA, he was employed by Ocean Systems Engineering in the capacity of project engineer; where he specialized in robotic systems and bringing the sub-sea experience base, of using divers in robot systems, to NASA. During his NASA service, Dom's responsibilities have included all human demonstration testing for space suited crew members and management of the external maintenance for the Space Station, where he has acquired more than 400 pressurized hours in the U.S. (and other nations') space suits as a NASA Class I Test Subject. Mr. Del Rosso has also served as the Subsystem Manager for the U.S. space suit, managed the effort to design and build the tooling and support equipment for the International Space Station, served as the lead for completing the work on a bioreactor flight experiment and served as the Space Station Oxygen Recharge Compressor Assembly Project Manager. Currently he is also working to transfer NASA technology to the fire fighting industry and US Navy in the area of personal protective equipment and life support.

Education:
B.S., Aerospace Engineering, University at Buffalo

Terry Lee

Lead Reduced Gravity Flight Test Director
Flight Management Office and Flight Engineer/Mechanic

Work:

Terry has been with NASA more than 23 years and the U.S. Government 26 years. Her government career began with a tour in the United States Navy where she worked in the aviation maintenance arena as a Plane Captain and Aviation Electrician. Prior to joining the RGO, she held the position of the Program Manager for NASA's T-38 depot maintenance facility in El Paso, TX and served as the Project Quality Assurance (QA) for the same operation. Prior to the T-38 depot duties, Terry served as project QA for the Shuttle Training Aircraft Simulation Program (ASP), QA on the mission management aircraft, and QA on the T-38 jet aircraft. Additionally, she flew as a Shuttle Training Aircraft Flight Simulation Engineer (FSE) which essentially prepared the shuttle pilot for landing. While in simulation, Terry provided the necessary shuttle calls for the shuttle commander during the landing approach; these calls are similar the calls the shuttle pilot makes to the shuttle commander during the shuttle landing phase. Her other duties include Flight Management Scheduling, Flight Engineer/Mechanic on the NASA Mission Management Aircraft which support the crew return events for the Space Station astronauts, air born science missions, and support of additional NASA missions.

Education:
B. S., Professional Aeronautics, Embry-Riddle Aeronautical University

Reduced Gravity Office Staff

Kerry McManis

NASA's Reduced Gravity Office, Administrative Support

Work:
Ms. McManis has been employed with REDE/Critique Inc. since March 2004. She began working with NASA's Engineering Department at Ellington Field. During her tenure with the Engineering Department, Ms. McManis has supported the RGO during flight week activities over the past three years. Full time support in the Reduced Gravity Flight Program began in October 2012. Her duties and responsibilities for the RGO are countless and her dedication to the air crew and maintenance crew is beyond exceptional. Her additional duties are throughout the Aircraft Operations Division Office and the Flight Crew Directorate Office.

Education Office/Reduced Gravity Flight Staff

Frank Prochaska

Program Manager

Work:
Frank E. Prochaska began his career with NASA in 2000 at the Johnson Space Center in Houston as a human resources specialist. His responsibilities included advising management on a variety of human resource management issues, such as staffing, classification, employee relations and development. In 2004, Prochaska relocated to Kennedy Space Center (KSC) in Florida where, as a human resources specialist, he led the implementation and roll out at KSC of the Agency's new performance rating system. Prochaska joined the newly forming NSSC in 2005 as Lead, Human Resource Specialist where he lead a team of six human resource specialists with the goal of supporting the NASA Shared Services Center (NSSC) human resource activities at 10 NASA centers. In July 2007 Frank was named as the Director of the Customer Satisfaction and Communication Office at the NSSC, responsible for ensuring the NSSC developed, maintained and monitored high customer satisfaction levels and communication between itself and its customers. In this role, he was also the Public Affairs Officer and Communications Officer for the NSSC.

In 2009 Frank joined the JSC Education Office as the University Affairs Officer, managing the Steckler Space Grant Program, the Graduate Student Researchers Program, and all JSC Student Employment Programs. A University of Houston graduate with a master's degree in human resources management, Prochaska holds a bachelors degree in business administration from Texas A&M University.

Education:
B.B.A., Texas A&M University
M.A., University of Houston

Education Office/Reduced Gravity Flight Staff

Veronica Seyl

Program Manager

Work:
Veronica Seyl is a NASA Program Manager with the Reduced Gravity Education Flight Program (specifically Educator Flight weeks). She graduated from Texas A & M University earning a Bachelor of Science Degree in Curriculum and Instruction with a mathematics specialization. After graduation she worked part time at NASA until she was a classroom teacher for 8 years collectively in Pasadena, Clear Creek and Friendswood ISDs. After working summer at Florida Space Camp, she joined the Space Center Houston crew in 1992 and initiated the day camp and scout camp-in programs along with the Space Exploration Educator Conference (SEEC) among other educator programs. After forming her own company, she consulted for Pearland ISD to write and implement professional development as well as write and publish classroom curriculum for Challenger Center in Alexandria, VA and Space Center Houston. Joining Space Center Houston for a second round as an Education Specialist, Veronica managed the school visit and school overnight programs before coming to NASA as a Reduced Gravity and Undergraduate Student Research Program (internship) coordinator. After serving 3 years as the Career Exploration Program Manager, she currently works as the NASA Aerospace Scholars Program Manager in addition to Reduced Gravity and is excited that you are here to fly, share your experience and help us inspire all generations!

Education:
B. S., Texas A&M University

Jamie Semple

NASA Education Specialist - Program Coordinator

Work:

Jamie Semple is a NASA Education Specialist and Program Coordinator with the Reduced Gravity Education Flight Program. He graduated from Samford University in Birmingham, AL earning a Bachelor of Science Degree while studying both Biology and Chemistry. After graduation Jamie worked for the University of Alabama at Birmingham conducting nutrition research studies on vitamin deficiencies. He went on to work as an Education Instructor at the McWane Science Center in Birmingham, AL eventually managing educational operations of the center's program exhibits. He subsequently taught high school biology and marine biology at Clay-Chalkville High School and integrated science at Hewitt-Trussville Middle School. Jamie's experience teaching in schools also includes coaching where he has served as both an assistant and head coach for football, basketball, and track and field. Jamie arrived to Houston in 2006 to serve as an Education Specialist at Space Center Houston. While at Space Center Houston Jamie successfully managed the day camp, scout camp-in and space school programs. He joined the Reduced Gravity Education Program as a Program Coordinator in May, 2011. Jamie has also served as a Program Coordinator for Fellowship programs at JSC.

Education:
B.S., Samford University
M.A.Ed., University of Alabama at Birmingham

Education Office/Reduced Gravity Flight Staff

Sarah Gonzales

NASA Education Specialist - Program Coordinator

Work:

Sarah Gonzales is a NASA Education Specialist and Program Coordinator with the Reduced Gravity Education Flight Program. She graduated from Cornell University in Ithaca, NY earning a Bachelor of Science Degree in Communications. For the first ten years of her career, Sarah led public relations programs for high technology companies where she launched major software products for Microsoft and several start-ups. She then spent four years teaching math and science at Travis Elementary in Houston, Texas. She served as the science lead teacher on her campus and developed and led several seminars in math and science for teachers. Sarah also coached the robotics and number sense teams. Sarah joined the Reduced Gravity Education Program at Johnson Space Center as a Program Coordinator in June 2013.

Education:
B.S., Cornell University

Selected Abstracts

High School United with NASA to Create Hardware (HUNCH) Participants

The High Schools United with NASA to Create Hardware, or HUNCH, project is an instructional partnership between NASA and high schools and intermediate/middle schools throughout the nation. This partnership benefits both NASA and students. NASA receives cost-effective hardware, soft goods and educational videos that are produced by the students. The students receive hands-on experiences and in some cases, NASA certification in the development of training hardware for the International Space Station Astronaut crew members or ground support personnel. A spin-off of this teaming is the inspiration of the next generation.

Clear Creek High School: League City, Texas
Microgravity Crystallization

The intended purpose of this experiment is to test various chemical reactions, mainly crystallization, in microgravity. Our expectation for the experiment is that significantly different results than those done on Earth will occur. With the absence of gravity, crystals, during chemical formation, have the ability to grow uniformly with a much more organized structure throughout. This has been mainly tested with protein crystals in the past, but may apply with others as well. Additionally, chemical reactions also act differently in microgravity. Testing some basic chemical reactions in such an environment may yield completely different products as would a normal earth-bound environment. In the microgravity environment we'll be observing the reaction as it takes place, and we will be recording temperature and pressure from the chemical reactions. The experiment ultimately will answer whether this is true to different crystallizations and chemical reactions. The experiment will show if some chemical reactions will be more useful in space. Some crystalline structures could be stronger with microgravity and some could be weaker. Also, certain chemicals we are using are in medication, so some applications could yield a future study of medication in microgravity.

Clear Springs High School: League City, Texas
Trouble with Bubbles and Rocket Control System Design Study

Trouble with Bubbles
The experiment is being flown as part of the High School Students United with NASA to Create Hardware (HUNCH) program from a Project Lead the Way School. A modern challenge that engineers are facing is the hindrance of air bubbles in liquids in microgravity.
Unlike on Earth, air bubbles do not separate themselves from liquids due to the lack of gravity in space. This creates a problem with storing and transferring vital liquids such as fuel and hydraulic fluid. It is essential for all gases to be removed from fluid lines for systems to operate efficiently. In order to assist aerospace engineers in solving this problem, we focused on designing a contraption that can separate gas bubbles from liquids in microgravity. Our apparatus consists of two different separating systems (centrifugal and thermal design) stored in a master box. Each system has its own

mixture bag and extraction method after the separation. In order to measure the effectiveness of the separating apparatus, we will measure the initial volume of the mixture and then measure the volume of liquid and gas separated. We will observe the fluid and gas flow inside the separator by using a micro-camera. We will also measure the temperature of our thermal design.

Rocket Control System Design Study
The experiment is being flown as part of the High School Students United with NASA to Create Hardware (HUNCH) program from a Project Lead the Way school. It was designed by the students of the engineering design and development class at Clear Springs High School in League City, Texas. Reaction Control System (RCS) engines are used for propulsion in microgravity environments. The Engine works by combining two hypergolic fluids which combust and provide propulsion. Due to a lack of public information on design and development, our experiment will be to design various injectors and find a more efficient method to gain a greater liquid contact surface that will make RCS engines more efficient and effective. We will do this by taking two different colored liquids (water colored with two different food colors) will be stored in two separate syringes. The syringes connect to three different sets of needles that will be mounted on a plate at 30 degrees, 45 degrees, and 60 degrees. Motors will apply a constant force in increments to these syringes, and the liquids will be sprayed at a sheet of paper inside of the collection chamber to collect the water and imprint the spray pattern. The colors showing on the paper will show how well the liquids mixed and cameras positioned to view the spray from both the side and top will be used to observe the spray pattern as it happens. After each parabola, the paper to collect the water will shift to a dry portion for the next test. Each angle of the syringes will be used for ten parabolas; the angles will be selected by opening and closing valves which change the openings directing the fluid to the different needle sets. The syringe angles will vary to test different methods of gaining contact surface, and hopefully give us a better understanding of injector fluid physics in a low gravity environment. The experiment will be held down with Velcro.

Council Rock High School South: Holland, Pennsylvania
Gravitational Effects on Capillary Action

As the National Aeronautics and Space Administration (NASA) explores beyond Low Earth Orbit (LEO), sustaining life for a six month voyage has become increasingly important. In order to decrease risks associated with a six month voyage to another planet, it is likely that NASA will need alternative ways to purify air, circulate liquids, and produce foods. This will include the investigation of ways to control the movements of liquids in Zero Gravity and its effect on space travel.

In order to assess potential applications for controlling liquids in Zero Gravity that may aid astronaut life, the students at Council Rock High School South collaborated with staff members during many after school planning sessions. The group meetings involving students and teachers lead to extensive research of liquids in Zero Gravity. The awareness that plants have grown on the ISS (International Space Station) and its benefits have been discussed. Like NASA, the ESA, and Lakewood High School, we want to go to the “root” of capillary action and try and determine whether it actually happens in Zero Gravity, or if liquid movement is simply just upward momentum. Such discussions lead to answering the question “How is capillary action affected in Zero Gravity and what would its applications be?” The students eventually came up with a

controlled experiment that tested the capillary action of three different liquids: mineral oil, water, and a plant nutrient solution. Thus, we can gather enough experiment data in order to determine the most efficient way to do things such as transporting liquids, nourishing plants, and lubricating motors. The experiment will help us further our experiments regarding capillary action in the future.

Cristo Rey Jesuit College Preparatory: Houston, Texas
Self-Assembly of Mesoscopic Lipid Mimics

The Junior Team of the Experimental Design class at Cristo Rey Jesuit College Preparatory have designed an experiment that will test our ability to create mesoscopic (between microscopic and macroscopic) lipid mimics that will self-assemble in a reduced gravity environment. We believe that this project will yield novel data about self-assembling structures. This experiment will be conducted on the ISS, through the CASIS NDC program, during the month of May 2014. However, the experiment does not allow for significant ground based preliminary data. In the presence of standard terrestrial surface gravity the structures are not able to form. The lipid mimics are only able to aggregate in small groups. The parabolic reduced gravity flight will allow us to test an array of lipid mimics and it will provide the data necessary for us to make adjustments to the selection of 3D printed lipid mimics that we send to the ISS in May.

We have printed small (millimeter range) “lipid” structures that have a magnetic “head” and an electrostatic “tail.” We will then allow the “lipids” to self-assemble into stable macrostructures with the reaction chambers of our Ardulab (powered by an Arduino Mega 2560). We will manipulate the “lipids” by collecting them with an electromagnet into a side chamber. We will vary the effective concentration of lipids by adjusting the size of the container. We will free the “lipids” from direct interactions with the container using an eccentric motor vibration device. This device will also provide some energy to allow the structures to move about the chamber and encounter each other. The vibration motor will be tuned to the average natural resonance of the lipid mimics, and one harmonic. The variables we will change will be: the number or effective concentration of “lipids” in the interaction chamber; the field strength of the electromagnet; the vibration frequency of the eccentric motor. The data will be collected via video and analyzed according to the relative symmetries and structures of self-assembly as a function of vibration frequency and electromagnetic field. We hope to gather data not only concerning the ability of the structures to self-assemble, but also our ability to direct and coax this self-assembly through acoustic manipulation.

Eaglecrest High School: Centennial, Colorado
Lubrication of Mechanical Systems in Microgravity

Lubrication is a necessity for mechanical systems to run efficiently and with minimal wear. We designed a system to test the efficacy of lubricants in microgravity by having two meshing gears accelerate for a period of five seconds, and then spin freely. The difference in coast times between lubricated sets, using a non-lubricated set as control, will determine the effectiveness of each material. Our system is contained entirely in Lexan boxes to prevent loose material from entering either the surrounding experiments or the aircraft. Our experiment will quantify which lubricants are most efficient in microgravity, so that future mechanical systems work at their peak capabilities.

East Troy High School: East Troy, Wisconsin

Spatial Identification Environmental Reader (SPIDER)

This experiment is designed by High school students United with NASA to Create Hardware (HUNCH) Team at East Troy High School in East Troy, Wisconsin. The experiment is being flown for the purpose and benefit of the astronauts on the ISS. It is based off of the issue to have a way to locate items that float away while astronauts are working with them. The experiment uses Radio Frequency Identification (RFID) tags attached to items that the astronauts are working with, which communicates with a microcontroller that alerts the astronaut of its location. Tags located in the flyers' pockets will send signals to a receiver, which is inside the glove box in a NanoLab.

Fairport High School: Fairport, New York
Effect of UV Radiation on Bioluminescent Bacteria

Recently, the ISS has encountered metal-eating bacteria which are causing the hull of the station to decay. Astronauts are using UV radiation to remove this harmful bacteria; however, few studies on the efficacy of this method have been conducted. We will study the effects of change in gravity on the effectiveness of using UV radiation to eliminate bacteria colonies, using less harmful bioluminescent bacteria. Using a spectrometer, we will measure the change in the luminosity of the bacteria colony after it has been exposed to UV radiation in 0G. The procedure will be repeated on another colony of the same bacteria during 2G. The luminescence of the bacteria we are using is linked to the production of ATP; therefore, by considering bacteria no longer producing ATP to be dead, measuring the luminescence of the bacteria will show the survival rate of the bacteria when exposed to UV radiation. An outside agent may be necessary to trigger the luminescence initially.

We are studying this because UV radiation is how the ISS is currently destroying the bacteria eating away at the hull. We can use this information to find the most effective application, and to more effectively destroy the bacteria. We're trying to see if gravity influences the effect of UV radiation on bacteria. Luminescence can be measured with a light sensor and visually. If the rate at which light intensity decreases changes we can see that rate of decay of the bacteria is affected by gravity.

Governor's School for Science and Technology: Hampton, Virginia
Electrolysis for Local Artificial Photosynthesis Aboard ISS

The International Space Station (ISS) and future space exploration needs a way to efficiently supply oxygen. Currently, the space station relies heavily on shipments of oxygen from Earth. However, this system has many flaws as it requires the astronauts to essentially ration their air. For many labor intensive tasks, such as repairing equipment or exercising, rationing adds complexity and constraints. The astronauts also complain about times in which they are all together for an interview and began to produce too much carbon dioxide from all the talking.

The need for a system to produce breathable air is important also for future long-term life in space. One solution to this problem employs plants for a natural process; however, this approach entails the astronauts to tend to the plants and risks introducing additional microbes to the ISS or other planets.

A better solution would be the use of artificial photosynthesis, a solar-powered electrolysis system. This oxygen-producing electrochemical process has been demonstrated in laboratory settings using a variety of designs and several different catalysts. The challenge will be to select an appropriate system, design and build a container to house the system, and monitor the system's performance in microgravity. The first phase in development will be testing an electrolysis system in microgravity; because this will have a hydrogen output, a fuel cell will be implemented to use up the hydrogen.

This experiment is attempting to determine if through electrolysis, energy can be produced through a fuel cell in zero gravity. The efficiency of a system on earth will be compared to that of a system run in microgravity. After filling a plastic container created by a 3D printer with water, an electrical current will be turned on, splitting the water into oxygen and hydrogen. The oxygen will be allowed to escape, acting like a local oxygen source, and the hydrogen will pass through the PEM membrane into another plastic container. In order to ensure that no pressure builds up from storing the hydrogen in a closed container, it will be immediately used by the fuel cell. That fuel cell should produce enough energy to power a light bulb. A watt meter will be used to measure the cumulative power provided by the fuel cell. To ensure that data is recorded exclusively in microgravity a switch will be used to disconnect the battery and end electrolysis before hyper gravity. Data from the watt meter will be recorded at the end of the flight. An identical experiment will take place on the ground for comparison. It is expected that the system in microgravity will produce oxygen with one third efficiency of the system on the ground.

Jackson Hole High School: Jackson, Wyoming
Advanced Three Dimensional Magnetic Modeling with Ferrowax

On the International Space Station, or command modules, if a crucial part were to break it would be very difficult to repair. A 3D printer would require too much time (anywhere from 15 minutes to a few days), it would require too much space to keep replacement parts aboard, and delivery from Earth to the ISS could take too much time and be costly. Currently, there is no process to safely manufacture new parts onboard quickly. Our team is looking at a possible solution to this by creating a new way to make parts by furthering the research acquired during "Three Dimensional Magnetic Modeling with Ferrofluid" (Jackson Hole High School HUNCH 2012-2013). They successfully manufactured a washer in a zero gravity environment using ferrowax and a washer shaped magnet. We plan to expand on their experiment by implementing a magnetic array to create different, more complex shapes in under a minute. We will use the same material that our team used last year, ferrowax. Our project would also be small enough to put on other space stations and vehicles other than just the ISS to be used for many different purposes. Our magnetically modeled part would be a quick solution, even if it's just temporary, to help solve problems faced by astronauts onboard the ISS and other, more compact, space vehicles.

Lakewood High School: Lakewood, Colorado
Omega Hydrofuge Plant Growth Chamber

The experiment is being flown as part of the High School Students United with NASA to Create Hardware (HUNCH) program. It was designed by the students from the Sustainable Energy/Living class at Lakewood High School in Lakewood, Colorado. The

Hydrofuge Omega will grow plants and could, in the future, provide the astronauts aboard the ISS access to fresh food. Considering the effect of low gravity on water, the plants will be watered through a teardrop shaped hydrofuge system, with centrifugal concepts. In the Omega system, the plant chamber will be flooded with water by a pump. Then, after the roots have had adequate access to the water, the excess water will be removed via the pump. This excess water will then gravitate towards the smallest angle, in the bottom of the tear drop, due to surface tension and polarity. As the pump is draining the chamber, the plant will be spun to shake off water that remained on the roots. The students will observe watering systems, water removal, spinning of the centrifuge design, and efficiency of the tear drop shape.

North Carolina School of Science and Mathematics: Durham, North Carolina
Memory Alloy Actuated Peristaltic Pump (MAAPP)

In any spacecraft, the plumbing system is vitally important. Pump mechanisms used today in spacecraft such as the International Space Station are prone to frequent malfunction due to a large number of moving parts. We propose a new pump mechanism for use in microgravity containing no moving parts. We seek to do this by employing peristalsis, a biomimetic type of movement imitating that of the human digestive tract, which functions by sequential contraction. This peristaltic pump is actuated using Nitinol, a shape memory alloy that can be activated by applying electrical current. This mechanism could entirely eliminate the need for moving parts and therefore increase the reliability of the system. This experiment was flown last year; this year will focus on quantifying data collection and miniaturizing design for potential flight on the International Space Station in a NanoLab. This experiment is being flown as a part of the High School Students United with NASA to Create Hardware (HUNCH) program.

Overland High School: Aurora, Colorado
Channel Surface Tension Effecting Crystallization in MicroG

Understanding crystal growth is important because the microgravity environment is known to affect both the size and quality of the crystal formed. Better crystals mean a more precise structure of the molecule can be determined. This is critical to understanding the biological binding sites of drug targets and the development of new pharmaceutical products. As a result, the ISS has been used extensively to grow some of the best bio-molecular crystals ever. Using solid works software and a 3-D printer we will design and create a number of slides containing a series of channels. Each slide will be filled with an identical volume of a saturated sodium acetate solution which will be nucleated and allowed to crystalize during the microgravity portion of the flight. The crystals will then be preserved and their average size and purity will be compared to the control group grown in a 1-G environment.

Tri-County Regional Vocational Technical High School: Franklin, Massachusetts
Zero Gravity Scale

Without gravity, calculating mass in space can be quite a challenge. Our purpose as part of HUNCH is to devise a way to measure mass without the force of gravity required. Our scale will consist of two force sensors mounted perpendicular to a motor driven axle. An object of known mass will be attached to one force sensor and an object of unknown mass will be attached to the other. When the motor spins the axle, it will essentially create an artificial gravitational field which will allow the force gauges to function in zero

gravity. As the objects spin, we will take readings from the force gauges and use the formula, F=ma, to find the unknown mass by assuming the acceleration of both objects is the same. Our mission this year is to adapt the scale that flew on the Zero-G plane last year to meet the constraints of the ISS.

Warren TECH: Lakewood, Colorado
Eggs in Space

The experiment is being flown as part of the High School Students United with NASA to Create Hardware (HUNCH) program. It was designed by the students of the S2TEM Program, Warren Tech High School. The reason for doing the project is for fresh food and home style culinary feeling, on the ISS. Our group is investigating, shipping, cracking, and cooking eggs on the International Space Station (ISS) so that astronauts can fry their very own eggs in space. Astronauts' ability to "Cook Their Own Meal" on the ISS would boost their nutritional and psychological well-being, especially as astronauts spend longer times in space. The first step is to successfully cook eggs in space. We are developing an egg cooker that uses Peltier Thermoelectric plates. With thermoelectric plates we can cook the egg in less than 20 minutes. In the end, we hope to provide astronauts with home cooking on the ISS.

Undergraduate Participants

The Reduced Gravity Student Flight Opportunities Program, also known as Microgravity University, provides a unique academic experience for undergraduate students to successfully propose, design, fabricate, fly and evaluate a reduced gravity experiment of their choice. This year's participants were asked to submit proposals based on skill knowledge gaps (SKG's) and critical technology developments (CTD's) that the agency has identified as important for future research.

Arizona State University: Tempe, Arizona
Proposal ID: 2014-25567
Dust Coagulation in Microgravity 2

The Dust Devils Microgravity Team from Arizona State University, comprised of all new students, proposes to utilize the Reduced Gravity Education Flight Program to refine previous observations of dust coagulation in a microgravity environment. During the Dust Devils flight in 2012, essential instrumentation specifications and some preliminary results were obtained. Due to successful upgrades of the dust coagulation scientific process, the re-flight experiment will completely focus on investigating the underlying mechanisms responsible for triboelectric charging of particles in microgravity by varying composition of the dust particles studied. This test is performed to constrain existing theories on electrostatic properties of dust coagulation, specifically comparing the research models of Desch & Cuzzi (2000) and Kok & Renno (2008). The microgravity environment will enable the observation of these weaker electrical interactions relative to conditions present in each of the 10 case studies. In addition, this experiment will include two planetary surface environment simulations by testing coagulation of Mars simulant and lunar regolith. Results from the experiment will hopefully improve the understanding of coagulation mechanisms, in turn providing insight into the formation of planets from proto-planetary disks as well as the charging effects of particles within storms and other systems on planetary surfaces.

Boise State University: Boise, Idaho
Proposal ID: 2014-25558
Monitoring Cerebrospinal Fluid During Parabolic Flight

The proposed experiment, "Gravitational Effects on Cerebrospinal Fluid Pressure and Flow in an Anatomical Model," seeks to address Section C.6.7 "Microgravity Biomedical Counter-Measures for Long Duration Spaceflight" in NASA's Critical Technology Determination (CTD) for Future Human Space Flight document. This section states that intracranial hypertension has the potential to have temporary and permanent health risks (p. 24). This experiment will provide a foundation of information on the CSF fluid movement inside the cranium. Using an anatomically representative model, the Boise State Microgravity Team seeks to better understand cerebrospinal fluid (CSF) movement and changes in intracranial pressure (ICP) in response to hyper- and microgravity in real time during parabolic flight. We propose to monitor these changes using pressure and flow sensors positioned throughout our "CSF flow apparatus," allowing us to collect data at multiple locations. Results of our study could provide a preliminary explanation for some of the symptoms seen in extended spaceflight, as well as providing a foundation for future research in monitoring and treatment of increased ICP (Alexander, Gibson, and Hamilton). Upon completion of this experiment, the Boise State Microgravity Research Team plans to reapply in the 2014-2015 academic year to the NASA Reduced

Gravity Student Flight Opportunities Program for a follow-on research opportunity. The anticipated year two experiment aims to address the Human Health/Mission Cost/Feasibility knowledge gap of the Near Earth Objects section in the Strategic Knowledge Gap (SKG) document related to space radiation health risks (International Space Exploration Coordination Group p. 13). This follow up experiment will use the methods created in year one to monitor pressure and fluid flow in response to hyper- and microgravity on both radiated and non-radiated choroid plexus epithelial cells by monitoring intercellular signaling.

Duke University and Embry-Riddle Aeronautical University: Durham, North Carolina and Daytona Beach, Florida.
Proposal ID: 2014-25578
Investigation of Corneal Biomechanics in Microgravity

This project consists of two explorations of the eye: the group will (1) model the computational fluid dynamics of the aqueous humor and (2) use applanation techniques to induce corneal deformations to determine corneal biomechanical properties in microgravity. After generating a computer-aided design (CAD) of a simplified eye in ANSYS Fluent, the group will use computational fluid dynamics (CFD) and fluid-structure interaction (FSI) analyses to determine key points of interest where fluid dynamics induced abnormal forces on the cornea. Observed sites of abnormal forces will guide the experimental focus during applanation-based biomechanical testing of the cornea in microgravity. Corneal applanation will be induced by a puff of air emitted from a Corvis ST tonometer, and the intraocular pressure (IOP) will be set to mimic the five mmHg IOP increase observed in space. The cornea responds to such applanation by flattening, and the velocity and deformation magnitude of this flattening can be used to characterize corneal stiffness. The corneal response to applanation will be measured by taking 140 images of the cornea over a 30 ms period with the Corvis ST tonometer's ultra-high-speed scheimpflug camera. Subsequent image analysis will be used to derive corneal response properties such as deformation velocity and corneal thickness. Using this data, the group will characterize the behavior of the cornea in microgravity. Computational fluid dynamics will help the scientific community better understand aqueous humor behavior, and the analysis of corneal response to applanation will provide insight into the role of corneal biomechanics in vision loss in space. Results from this investigation will contribute to the development of future diagnostic and preventative measures concerning blurred vision in long-term space travel.

Missouri University of Science and Technology: Rolla, Missouri
Proposal ID: 2014-25576
ACD-CPR in a Microgravity Environment

Testing of new methods of cardiopulmonary resuscitation (CPR) will be conducted in a microgravity environment to evaluate potential improvements in current microgravity CPR protocols. Active compression decompression cardiopulmonary resuscitation (ACD-CPR) will be utilized through a "behind-the-back" method to improve time of onset of CPR and improve cardiac output during CPR. Two tests will be conducted to demonstrate the feasibility of performing CPR through this method. The first test will monitor the time of onset from an individual entering cardiac arrest to receiving the first compression. The second test will model a human's circulatory system and monitor fluid flow during CPR. Varied compression depth cycles will be tested along with ACD cycles. Results will be compared to quantify how fluid flow rate changes as depth of

compression decreases due to fatigue and at what point ACD-CPR will become no longer effective. This experiment will attempt to show a significant improvement in onset of CPR compared to current NASA protocols as well as showing that ACD-CPR has an improved cardiac output as compared to traditional CPR.

Northwestern University: Evanston, Illinois
Proposal ID: 2014-25569
Alteration of Actin's Critical Concentration in Microgravity

Functional mechanoreceptor signal transduction is critical for the development and homeostasis of every cell in the human body (Thompson et al.) - especially for the maintenance of healthy bone tissue (Kular et al.). Signal transduction can be inhibited with a break in the mechanical pathway, and can cause cells to present with altered gene expression (J. Rubin et al.; Kim et al.). Breaks in the pathway have been shown to occur in the actin cytoskeleton after experiencing a mere 20 seconds in microgravity (Ulbrich et al.), which demonstrates a major health issue for astronauts on the ISS and in long-duration missions. Building a complete understanding of the actin cytoskeleton and its dynamic assembly is, therefore, of utmost importance to the space community. Previous studies of the actin cytoskeleton have consisted of macroscopic analysis and the deciphering of protein-protein interactions within different types of cells (Ingber,"Cellular"; Hall; Hughes-Fulford; Falzone et al.). However, there are very few, if any, studies that have specifically examined the dynamics and parameters of actin's critical concentration and filament assembly in a microgravity environment.

A study of microtubule cytoskeleton in microgravity suggests irregular diffusion for tubulin monomers in vivo (Vassy et al.) - a possible cause for actin cytoskeleton disruption as well. In fact, when the pH of actin cytoskeleton environment changes to create stronger electrostatic repulsion between G-actin monomers on Earth, microfilament assembly is inhibited (Crevenna etal.). This simulates one possible scenario of how actin assembly is affected by electrostatic forces in the absence of gravity. Thus, it is quite possible that microgravity-altered reaction-diffusion is hindering actin's self-assembly (Hughes-Fulford). The goal of this experiment is to determine if the non-physiological environment of microgravity alters actin's critical concentration through the analysis of filament elongation rates.

Oklahoma State University: Stillwater, Oklahoma
Proposal ID: 2014-25562
Electrodynamic Dust Mitigation for NEO Missions

Next generation manned space exploration missions face numerous challenges including designing advanced spacecraft systems that provide astronauts safe, functional habitation. Environmental Control and Life Support Systems (ECLSS) are one of the top development priorities as they are directly responsible for maintaining livable, sustainable environments for the entire duration of the mission. Human Exploration Destination Systems—TA 07, as outlined by NASA technical memorandum 2012-217670 (Mercer, et. al.), calls for technologies to address adverse regolith and dust effects. Based on experiences during Apollo surface operations, the possibility for dust or regolith induced system degradation is high. EVA suits faced the greatest degradation during lunar operations, with Harrison Schmitt reporting that at the end of the mission, dust had worn through three layers of Kevlar on his boot. Apollo systems were designed

to last for only one mission cycle and therefore dust mitigation technologies were not prevalent on the EVA suits, lunar module, or command module aside from basic air filtration (during Apollo 16, the basic filtration systems failed resulting in severe command module regolith contamination). Dust contamination was considered an acceptable risk because of the short mission duration. However, because future human exploration missions are planned to be much longer in duration, dust mitigation technology is required to increase the life cycle of systems, ensure crew health, and overall probability of mission success.

NASA's current proposed human exploration mission is to rendezvous with a near Earth object (NEO) like an asteroid, orbiting around the moon. These asteroids are thought to have a high probability of exhibiting suspended particulate clouds, similar to lunar regolith. Past Apollo missions were conducted on the lunar surface, where a gravity force exists, allowing dust to become easily identifiable when settled on surfaces. However, the NEO mission will be the first time terrestrial surface operations are performed in reduced gravity. This presents a problem to system designers who may have to deal with large quantities of suspended particulates. The Space Cowboys propose an electrodynamic dust shield for use on EVA suits during asteroid surface operations. A proof of concept experiment is designed to quantify the electric field potentials, particle velocities, and trajectories in a reduced gravity environment for active dust mitigation and control. A pentachart that summarizes the demonstrable technology and its future can be found on the following page in Figure 1.

Purdue University: West Lafayette, Indiana
Proposal ID: 2014-25538
Flow Boiling Bubble Detachment in Microgravity

Flow boiling provides high rates of heat transfer such that the mass and volume of the heat transfer system can be minimized. The investigation of flow boiling systems in microgravity is relevant to the design of space-flight heat transfer systems in addition to several applications on earth. A significant benefit for space-flight applications is achieved by any reduction in the mass and volume of a heat transfer system as it becomes more practical to launch. Boiling heat transfer in microgravity lacks buoyancy forces, and thus, the capillary forces dominate. Similar system behavior is observed on earth in applications of micro-scale flow loops such as those used to cool high-power electronics. In addition to being useful for space-flight applications, the investigation of flow boiling behavior in microgravity can be applied as a model for any system on earth where the capillary forces are dominant over buoyancy.

Heat transfer surface development researchers primarily use two methods to enhance the heat transfer through a surface. The first method is to increase the liquid replenishment along the boiling surface by encouraging the bubbles to detach quickly. Additional boiling research has shown that the heat flux is maximized through the contact line between the vapor bubble and the boiling surface. Accordingly, the second method is to develop surface geometries that extend this bubble contact line to increase the region of enhanced heat transfer. The introduction of these enhanced heat transfer surface geometries to boiling systems in microgravity will improve heat transfer systems both on earth and for space-flight applications.

The proposed experiment will examine the vapor bubble formation, growth, and detachment behavior of several of these enhanced heat transfer surfaces in microgravity. The time from initial bubble detection to detachment will be recorded to describe the liquid replenishment performance of each surface relative to a smooth flat plate. Additionally, the bubble contact line will be measured at detachment to

characterize the extension of the bubble contact line for each surface geometry. Although an investigation has been made of air bubble detachment from these surfaces in microgravity by a previous Purdue student experiment flown in 2009-2010 with the RGEFP, the previous experiment did not boil the liquid with heat from the surface but simply injected air through the surfaces [Sumcad, 2009]. The proposed experiment would be the first to examine the boiling behavior of these enhanced heat transfer surfaces in microgravity.

Stanford University and the California Institute of Technology: Stanford, California and Pasadena, California
Proposal ID: 2014-25560
hTEE Evaluation and Analysis Research Team (HEART)

The risk of significant in-flight cardiac emergencies that require advanced medical monitoring and treatment increases as humans spend longer periods in space. This is especially relevant for future human missions that go beyond Earth orbit. However, the ability to monitor cardiac function in space is currently limited. Recent advancements in miniaturized cardiac monitoring technology has led to the development of the hemodynamic transesophageal echocardiogram (hTEE) made by ImaCor, inc. The hTEE has been increasingly utilized in Intensive Care Units for real-time cardiac monitoring with the advantage of being small, easy to use with minimal experience, and capable of being used for up to 72 hours straight. This study aims to explore the effect of a microgravity environment on the functionality and usability of the hTEE system. It will open the door for future studies about hemodynamic monitoring hardware in space, possibly leading to the use of the hTEE in future spaceflight missions.

State University of New York at Buffalo: Buffalo, New York
Proposal ID: 2014-25535
Canfield Joint Attitude Control

Man-made satellites assist in a wide variety of modern applications. For many such spacecraft, the ability to control the orientation of the spacecraft body relative to some external reference is essential for completing their mission. However, attitude control in space is no trivial matter, as momentum is conserved, and there is often no external solid mass or atmosphere within reach with which momentum can be transferred. Typically, satellites achieve control over the orientation of the main satellite body by manipulating the angular momentum of internal components. This experiment seeks to provide an improved alternative to traditional methods of satellite attitude control, particularly for small satellite applications.
A Canfield joint is an omnidirectional joint consisting of two end plates, joined by three hinged arms. By controlling the angles between the three arms and one of the end plates, the orientation of one plate relative to the other can be fully controlled. More specifically, if one end plate is assumed to be stationary, the other end plate can be reoriented in such a way that a vector normal to its plane can be made to point in any direction outward from a hemispherical surface
In this experiment, a momentum wheel and motor will be mounted to the end plate of a Canfield joint so that the spin axis of the wheel is normal to the surface of that plate. The other end plate will be mounted to the inside of a cube, meant to represent the body of a small satellite. By using the Canfield joint to change the direction of the momentum wheel's spin, angular momentum can be transferred between the wheel and the satellite body. The satellite mock-up will be attached to the end of a pendulum with two degrees

of rotational freedom. A single Canfield joint, with control over two rotational axes, is sufficient to provide control of the orientation of a system that is constrained in this way. The system will be tested to see how well it can achieve commanded orientations and angular velocities in the presence of external perturbations. If control is successfully demonstrated, this experiment will provide proof of concept for an attitude control system based on the Canfield joint. This will open the way for further research into the possibility of using two momentum wheels mounted on two Canfield joints, working in tandem to provide full attitude control for an unrestrained satellite body.

Texas A&M University: College Station, Texas
Proposal ID: 2014-25563
Zero Gravity Mass Inventory Gauge System

Determining the location and mass of liquids in a terrestrial environment is straightforward. Earth's gravitational pull ensures that different density fluids stratify with the denser fluid occupying the lower portion of the tank. In a microgravity environment however, buoyancy is lost and liquids are no longer forced to fill the bottom of a storage container. In fact, capillary and other forces that negligible in a terrestrial environment can become significant under zero gravity. As a result, locating the location of liquid as well as gauging the mass of a liquid accurately is a challenge. Liquid location and mass gauging is of high interest to NASA and the commercial space community due to its need in power, propulsion, and other spacecraft systems.
The Agstronauts, a multidisciplinary team of undergraduate students from Texas A&M University, is proposing a novel approach to meeting this gauging challenge. The team plans to collect data from a LED light source and photo-sensor array to be used in the determination of the location and volume of a liquid floating freely in an enclosure under the effects of microgravity. This non-intrusive system has been simulated using radiation transport codes but actual test data does not exist for a carried gravity environment. Reduced gravity flight is required to produce the liquid-gas configurations that cannot be simulated on Earth. Successful demonstration of this technology has broad potential for utilization in supply gauging in fuel and life support systems, assisting with the efficient use of vital resources in space.

University of Arizona: Tucson, Arizona
Proposal ID: 2014-25551
Frontal Polymerization in Microgravity

Materials processing is a limiting factor for many technologies; without appropriate materials, many innovative technologies would be impossible. Progress in science is dependent on improvements in materials processing, which has led to the creation to this proposal. Despite being a relatively new science, polymer chemistry has emerged to the forefront of materials processing due to its versatility and cost-effectiveness. Because many polymerizations (processes where a single monomer is converted into a large chain of repeating monomers) are well understood, organic polymer synthesis is a natural avenue when considering the development of novel materials for emerging technologies. Although the versatility of this material class allows for certain polymers to be tailored directly for their intended use, little research has been conducted on the effect of gravity on quantifiable properties of a polymerization process (i.e. tensile strength, thermal resistance etc.). After preliminary laboratory testing, a free-radical polymerization of 1,6-hexanediol diacrylate (HDDA) was chosen due to reproducibility and potential for real-world applications. Differences in chemical, mechanical, thermal,

and electrical (CMTE) properties are anticipated when the polymerization is conducted in a microgravity environment as compared to samples produced in an identical manner in unit gravity. A higher polymer molecular weight and lower density are expected, which could manifest in an increased tensile strength and lower thermal transmittance. Because of the vast applicability of a polymer, is it not difficult to envision what improvements could be made from successful execution of this technique. *In-situ* production of polymers can be employed to make cost-effective and durable repairs, fabricate insulation for Extravehicular Activity (EVA) suits, and introduce the concept of orbital-based material production for extended missions.

University of California San Diego: La Jolla, California
Proposal ID: 2014-25579
Fiber Supported Droplet Combustion of Biofuels

Fuel droplet combustion provides researchers with a valid method for determining and analyzing the combustion processes of a given fuel. However, droplet combustion performed under standard gravity conditions is hindered by buoyancy and deformation, which produce convective flows around the droplet and cause the burning rate to increase. These negative effects can be virtually eliminated through the use of a microgravity environment. To date, the only biofuel constituents which have been tested in microgravity are butanol and ethanol, while there are many more plant-based fuels without accurate burning rate and droplet extinction diameter data. This research focuses on studying the burning rates and extinction diameters for four individual biofuel constituents. Ethanol and butanol droplets will be tested to compare against the results of past experiments, while two new biofuels will be selected to provide burning rates for untested fuels. The experimental apparatus consists of two separate syringe ejection systems, which are each capable of holding a unique biofuel in a given microgravity flight. These ejection systems deploy a single droplet of a given fuel onto a taut cross-fiber to maintain droplet position while in microgravity. Once each droplet is successfully deployed on the cross-fiber, a spark igniter is brought toward the droplet to ignite it. During the combustion process, one camera records video of the flame diameter while another camera records the silhouette of the droplet diameter. This visual data is then observed with Matlab's pixel distance image processing to determine how the droplet and flame diameters vary with time. The droplet diameter may then be modeled against the "d-square" law, which states that there is a linear decrease in the square of the droplet diameter with time. Further, the extinction diameter, or the droplet diameter at which the flame extinguishes, will be determined for each biofuel. Engineers may then use the burning rate data and extinction diameters gathered through this experiment to improve terrestrial engine efficiencies and the effectiveness of fire extinguishers for given biofuels.

University of Florida: Gainesville, Florida
Proposal ID: 2014-25556
Still Deployment Mechanism for Small Satellite Platforms

Small satellites offer a faster and cheaper way of supporting payloads in space compared to traditional larger satellites. The form factor of a 1U CubeSat is a 10x10x10 cm structure with a mass under 1.3 kg, which can be stacked to realize larger structures (e.g., 2U, 3U, 6U). Its standardized form factor coupled with the reduced size supports a market of commercial off the shelf parts and general reduced costs. Additionally, the

standard form factor facilitates containerized launches which reduce integration complexity, resulting in lower launch costs. The evolving utility of small satellites requires power budgets that, coupled with the current photovoltaic technology (~28% efficiencies), necessitates the use deployable solar panels. These deployable panels, however, introduce disturbances during initial deployment and more critically their flexibility can limit the maneuverability of the satellites during mission operations. In addition, future CubeSat applications may include multi-stage deployable booms and antennae, which would require very stiff deployment mechanisms. The University of Florida's Small Satellite Design Club (SSDC) Microgravity Team proposes the implementation of a prototype latch mechanism that can ensure rapid deployment while exhibiting sufficient stiffness in the final deployed state, which is necessary for rapid retargeting slew maneuvers. A 1U cube-sat analog equipped with the suggested latch, on a gimbal-like test-bed capable of rotating in two dimensions to simulate slewing, is used to test the mechanism's stiffness and resistance to induced vibrations.

University of Minnesota: Minneapolis, Minnesota
Proposal ID: 2014-25570
Moisture Transport Systems for Wearable Applications

Currently, the astronaut's thermal and moisture balance inside the Extravehicular Mobility Unit (EMU) suit is maintained through a ventilation and a liquid-cooling garment (LCG) that circulates cool liquid around the body from neck to wrists and ankles. However, due to the mobility needs of the fingers and the limited space within the glove, the LCG does not extend over the hands. Therefore, when the hands get warm and sweat, astronauts suffer from moisture management issues. These issues include fingernail delamination due to excess sweat buildup in the glove. The limited supply of power, as well as the risks of electrical signals in an oxygen-rich environment, mean that no-power moisture management solutions are needed. Such a solution could greatly improve the astronaut's health in the EMU suit. Drawing on our team's background in textiles and apparel, we plan to explore solutions based on materials like wicking textiles, superabsorbent materials, and manual pump and valve systems. Though many of these moisture management textiles and mechanisms have been well studied in earth gravity, little is known about their performance in microgravity, where liquids behave differently than they do in earth gravity. We propose to measure the speed, direction, and quantity of moisture transported by these alternative systems in a sweating hand simulation. Tests will be performed in a laboratory setting and then repeated in microgravity conditions to ultimately compare functionality of alternative systems in earth gravity to performance in microgravity. Our team is made up entirely of women studying functional apparel design. We believe our approach to applying science and engineering to apparel design can be particularly effective in attracting younger girls to STEM disciplines. Our outreach plan partners with an ongoing program that several team members have been extensively involved in to introduce middle school girls to STEM careers through clothing design.

University of Nebraska-Lincoln: Lincoln, Nebraska
Proposal ID: 2014-25531
Noninvasive Biosensing for Long Distance Space Flights

The purpose of the proposed experiment is to study the effect of microgravity on robotic capsule endoscope (RCE) propulsion and tissue adhesion techniques in the small intestine. RCEs are pill shaped devices used for non-invasive imaging, performing

simple surgical procedures, and actively locomoting through the bowel lumen. With an advent of long-distance space flights approaching and implausibility of taking a surgeon on missions, the United States must improve RCE and miniature surgical robotic technology to make emergency on-board procedures feasible for astronauts. The proposed capsule technology features a tissue attachment technique for adhesion of a biosensor to intestinal tissue for long periods of time. The capsule delivery and tissue attachment procedures will be tested *in vitro* using an already developed intestinal biomechanics simulator. The simulator is an RCE testing device which accurately simulates the biomechanical conditions of the human small intestine. The device actuates two separately controlled peristaltic waves which are calibrated to human physiological values in traction force, radial contact force, and wave propagation speed. This experiment will enlighten the country's researchers on feasibility of RCE application on space flights. The intuitive biosensing system 4 delivered by such RCEs will enable noninvasive diagnostic readings to be taken without astronaut interaction and enable detection of conditions such as obscure bleeding (OGIB), inflammatory bowel disease (IBD), irritable bowel syndrome or Crohns disease. RCEs will also enable study of the effect of microgravity on GI mobility. Without a study in microgravity, the proposed design cannot be further developed to coincide with astronaut needs. During this experiment, we will observe capsule propulsion, test a biosensor-tissue attachment technique, and study the effect of free floating chyme on this tissue attachment technique.

University of North Florida: Jacksonville, Florida
Proposal ID: 2014-25539
Peristaltic Flow in Zero Gravity

An experiment prototype is being developed to observe controlled conditions for fluid flow in a microgravity environment. The effect of prolonged space missions on the human body's bone tissue via radiation and zero gravity raises the need for biological research applications such as bone cell research to be implemented in microgravity conditions. The proposed system provides the motivation to develop such a bioreactor for this as well as other applications for biomedical and pharmaceutical purposes. Peristaltic flow is to be tested for regulating media flow in microgravity experiments. A prototype has been iterated by previous student researchers at UNF, and is going through a second design iteration. After verification on a parabolic flight, the prototype will subsequently be miniaturized and used to design a CubeSAT to analyze the effects of radiation and zero gravity on bone cells as well as to run experiments to negate these effects.

University of Texas at Austin: Austin, Texas
Proposal ID: 2014-25530
Vectran Combustion in Microgravity

Women in Aerospace and Leadership Development (WIALD) proposes to test the thermal properties of Vectran in microgravity environments. This experiment will fulfill the National Aeronautics and Space Administration (NASA) Critical Technology Development (CTD) objective C.6.11, "Fire Prevention, Detection and Suppression (Reduced Pressure)." The behavior of flames in microgravity is less predictable than on Earth, due to the absence of buoyancy forces. This causes a difference in shape of the flame that correlates to a difference in smoldering combustion, which is also unpredictable in microgravity. This unpredictability raises many concerns about

astronauts' safety during future deep space missions to Mars. Since smoldering is currently undetectable, a great deal of damage can be done to a spacecraft before the combustion is found and extinguished. This could lead to the destruction of expensive research tools and critical life-support systems. Since resupplying destroyed resources is not a viable option for deep space missions, sustainability is the central objective. Because of this, advanced detection methods need to be created, and systems need to be designed to mitigate possible fire risks. Researchers currently favor Vectran as the most viable structural material for future manned missions to Mars, due to its strength and protection from radiation. Bigelow Aerospace is collaborating with NASA to build an inflatable module using Vectran as one of the primary materials, in order to research the behavior of this module in microgravity. This module could be the basis for future manned Mars transport ships. Although Vectran's thermal properties have been tested on Earth, they have not been tested in microgravity. Thus there is a gap in critical knowledge that affects the safety and feasibility of future manned Mars missions.
Our hypothesis underscores that smoldering combustion in microgravity must be further understood. This understanding directly impacts the development of advanced detection systems and the risk reduction of fire in microgravity.

University of Washington: Seattle, Washington
Proposal ID: 2014-25534
Low-Velocity Regolith Ejecta

Lunar regolith has proved a problem for past lunar missions, notably the Apollo missions, and will continue to be a concern in the future. The characteristics of regolith, including its extreme abrasiveness and electrostatic properties make lunar operations a challenge. Because of the scarcity of collected lunar regolith and the unique environment that must be created to represent lunar conditions, lunar dust behavior and characteristics are not yet fully understood. By better understanding lunar regolith characteristics, dust mitigation strategies and techniques can be focused to address the true obstacles. Our experiment aims to qualitatively and quantitatively explore the impact reaction of regolith in response to varying impact geometries. A pneumatic cylinder (with attached impact geometries) will provide an impact force to a bed of lunar regolith simulant, with the resulting ejecta characteristics including size, density, direction, and velocity being recorded. If the resulting relationship between ejecta and impact geometry can be successfully characterized, potentially expensive dust mitigation techniques can be tailored to areas that are expected to encounter more detrimental dust ejecta, e.g., high velocity or denser particulate. The result would be a decrease in cost and weight of future lunar activities.

Minority University Research and Education Program (MUREP) Participants

NASA's Minority University Research and Education Program, in partnership with the Reduced Gravity Education Flight Program, provides the opportunity for undergraduates from Minority Serving Institutions across the country to conduct research in a unique reduced gravity environment. The fourteen teams selected in 2014 mark the third year of the program.

Austin Community College: Austin, Texas
Proposal ID: 2014-25580
SWAG- SWing-induced Artificial Gravity

During the extended periods of microgravity encountered on missions such as those aboard the ISS, astronauts experience deterioration to the body due to the lack of normal 1G forces acting on their circulatory system. After substantial amounts of time, this deterioration creates major health problems from common colds to loss of muscle mass or poor cardiac performance. Our team is proposing an experiment that will help generate a force that would simulate a normal 1G force as experienced on earth. It is known that if an object or a person is spun in a centrifuge, they can experience gravitational forces equal to or greater than the normal 1G forces experienced on Earth. The experiment our team is proposing shall test to see that if the centripetal force generated in a simple rocking motion is sufficient enough to replicate the gravitational forces experienced on Earth. In this experiment we shall specifically test the effects the previously mentioned rocking motion has on body fluids that include water, blood, and plasma. While our team will not be using any actual biological fluids, we plan on achieving the same results with fluids that shall mimic blood and plasma. What our experiment shall consist of shall be an apparatus that will create a rocking motion. Fixed to this apparatus shall be several arms, each of them containing one of the previously mentioned fluids. These swinging arms shall have pressure sensors that shall be connected to Logger Pro. With this arrangement our team shall be able to obtain instant results and shall be able to easily monitor the experiment.

California State Polytechnic University: Pomona, California
Proposal ID: 2014-25586
CubeSAT in Microgravity: Three-Axis Attitude Control

CubeSATs allow space missions and the gathering of data from space much easier and more inexpensive compared to large satellites. The appeal of CubeSATs is that they are smaller and cheaper than the spacecraft that have been used in the past. The average cost of a CubeSAT is usually less than $100K, while large satellites cost $10-100M to build. As the technology for CubeSATs advances and they become cheaper to build, the demand for large satellites will continue, but space will become more accessible as a medium for research.

In order to further advance the technology of a CubeSAT and make them cheaper to build, different methods must be considered. The method that will be explored is using commercially available off-the-shelf parts that will control and operate the CubeSAT. The proposed CubeSAT will be in the 1U configuration, measuring 10 cm × 10 cm × 10 cm. It will be powered by three brushless DC motors whose attached flywheels will allow the CubeSAT to achieve a three axis control system. The motors will be powered by three

11.1 V Lithium-Ion batteries, and the six external faces of the CubeSAT will be covered by Plexiglas panels. In order to achieve three-axis control, one microcontroller will be programmed to command the motors to react to disturbances and correct the CubeSAT's attitude as measured by an on-board inertial platform. An Xbee mounted inside the CubeSAT will provide wireless data transmission to a computer that will record the data.

Dallas County Community College District: Dallas, Texas
Proposal ID: 2014-25586
Crystallization in Microgravity

Crystallization of sodium acetate super saturated solution has never performed in microgravity. The effects of microgravity on crystallization have not been fully experimented. Our experiment will take a new look into scientific experiment. We will take a super-saturated solution of Sodium acetate for the first trial, and for the second one we will use sodium chloride. We will insert a seed crystal into the solution during the microgravity phase. Then, we will study the structure, quality, and rate of crystallization. After the microgravity experiment, we will compare the results with the ones taken on earth in the laboratory. We expect a higher quality of crystallization. The experiment will pave the way for further research into crystallization of salts under a microgravity environment.

Gadsden State Community College: Gadsden, Alabama
Proposal ID: 2014-25582
Automated Microgravity Fluids Testing for Advanced Plant Habitat

The Advanced Plant Habitat (APH) is a quad deck locker payload that will become a permanent facility aboard the International Space Station in the US Laboratory. APH is scheduled to launch in 2017 with the purpose of housing very high fidelity experiments that will examine the fundamental principles of plant growth in a microgravity environment. For these experiments to be high fidelity, every aspect of the science will be monitored and controlled. The environmental growth chamber within APH will house two critical subsystems for controlling the plant's environment. These two subsystems, the science carrier and humidity control unit (HCU) were designated as high risk by the ISS program office due to the difficulty for maintaining a proper fluid control system at microgravity conditions. In the previous MUREP experiment flown in November 2013, we flew these two subsystems to develop a basic understanding of the operations and capability of the new designs. The data obtained from our successful flight was presented to NASA Headquarters and the ISS program office, and both offices have agreed to fund the development of a second round of testing. In this round, we propose to test the two subsystems again with an automated approach. In the previous testing, students manually operated the test equipment switching the test on and off at their discretion. This procedure led to operational inconsistencies; therefore, this project will automate the water delivery system to actively deliver water through the subsystems as they would operate aboard ISS.

San Jose State University: San Jose, California
Proposal ID: 2014-25559
Debris Mitigation for Carbon Fiber Boom Removal Applicable for Satellite Servicing (DeMASS)

To date there are no reports on the internet or other citation sources that have reported any technology that describes a solution to cutting or capturing, “debris removal, or spacecraft servicing operational capability for space environment preservation.” In the future of satellite servicing we expect we will run into issues during operations that involve cutting or severing booms. Since cutting will generate debris we are interested in examining cutting methods that will not generate debris, analyzing the characteristics of the debris generated from cutting booms, and techniques on how to capture the debris generated. This purpose of this project is to find the most effective debris capture system for a satellite servicing mission in a micro-gravity environment. More specifically there will be three experimental setups that will include a.) examining the effects of cutting a boom using a shear and rotary blade in zero gravity environments, b.) examining and characterizing the static and dynamic debris trajectories from a rotary saw and a shear cutting device in zero and one gravity environments, c.) and lastly examining and validating various debris capture methods after a cutting technique has been performed. A plausible application of the system developed can be for a satellite servicing mission where in order to reuse a deployable mesh antenna from a retired communication satellite in geosynchronous orbit (GEO), the carbon fiber boom will need to be severed.

Texas Southern University: Houston, Texas
Proposal ID: 2014-25581
A reporter system to assess the effects of microgravity on UV-induced DNA damage

Space environment consists of cosmic rays and other environmental toxins, which induce damage in the DNA of living organisms. Whether living cells respond to DNA damages in the microgravity differently from the response in 1g will impact the accuracy in the assessment of the astronauts’ radiation risks after spaceflight, and impact the mutation rate in microorganisms from exposures to the DNA damaging agents. Last year we flew human fibroblast cells in the reduced gravity airplane and exposed the cells to UV radiation during flight. The cells were then processed for DNA damages on the ground as measured by the formation of micronuclei (MN). The yield of MN between the flight and 1g conditions were compared. This experiment involves cell culture and analysis of MN with a microscope, which can be performed by undergraduate students. The second part of this experiment will be to fly cells with a specific gene response reporter system (0-12 second exposures to UV during ‘0’ g parabolas) which will help provide a specific read out to pin point the mechanism of UV based DNA damage in microgravity.

Tuskegee University: Tuskegee, Alabama
Proposal ID: 2014-25574
Particle Transport Across a Fluid Using Sound Waves in a Microgravity Environment

Acoustic sound waves are capable of controlling particles in a fluid such as water or air. The sound waves create a medium to transport particles to different locations in which unwanted trace elements and/or bacterial infestations could be filtered out of the system. By producing and manipulating sound waves, the unwanted particles can become isolated, effectively separating them from the fluid. To demonstrate a proof of concept using acoustic manipulation, we plan on using a medium of air rather than water and Styrofoam balls to imitate the unwanted particles. The phenomenon of acoustic levitation involves particles balanced by changes in pressure and gravity; an interest arises when the surrounding gravitational force is altered while particles are manipulated in a 2-dimensional manner.

University of North Carolina at Pembroke & Robeson Community College: Pembroke and Robeson, North Carolina
Proposal ID: 2014-25550
Measuring and Interpreting the Effects of Gravity on Human Biochemical Processes

Since the beginning of manned space flight NASA has extensively studied the effects of microgravity on humans. One such physiological process is the Cori Cycle, which occurs as pyruvate is converted to lactate. This process produces Adenosine triphosphate (ATP), which is used by muscle cells as an energy source for muscular contraction. During muscular activity, glycolysis must occur constantly in order for ATP to be constantly replenished (Elmhurst, 2003). When oxygen is not present, such as during intense muscular activity, ATP is formed through the conversion of pyruvate to lactate. Another physiological process affected by microgravity is the human specific defense immune response, which occurs when an antibody binds to an antigen (bacteria, virus or toxin). During previous fights, we found that microgravity gravity had an effect on both biological processes. Our results for both the Cori Cycle experiment and Immune Response experiments show there is a change in the reaction rate during microgravity when compared to 1-g (ground truth) data. While our results show the biomechanisms are altered in microgravity, we believe that part of the process leading to these differences is related to convection currents, not the gravitational effects on the actual biochemical process. We believe that the dominant gravitational effect on the processes observed in previous results is a result of reduced convective flow within the fluid samples while in 0-g. Convection is a gravitationally driven phenomenon which affects the rate of mixing. In the presence of reduced convection, a reaction may be dependent on passive diffusion.

In order to correctly interpret our Cori cycle and immune response experimental results, it is critical that we fully understand the convective effects on the mixing process that occurs during the reactions. More information on the convective effects on the mixing process will allow us to better understand, and thus remove, the effects of convection from our data. The main focus of our research is to further understand the 0-g convective effects on our two specific biochemical processes by comparing convection-aided-diffusion to non-convection-aided-diffusion. This will allow us to accurately assess our previous results and conclude if microgravity affects the actual biochemical processes during the Cori cycle and immune response.

University of Houston: Houston, Texas
Proposal ID: 2014-25572
Characterization of Forces and Mechanisms Required to Separate Material Particle Sizes In Situ at Near Earth Objects (NEO)

The processing of materials in situ on the Moon and Mars, referred to as “In Situ Resource Utilization”, ISRU, has been the subject of numerous technical studies and design reference missions. More recently, commercial companies, such as Planetary Resources1 and Deep Space Industries2, have targeted the extraction of Platinum and other rare earth elements from Near Earth Objects (NEOs). NASA has also recently included NEOs in its design reference missions, for example, extracting water from NEOs for use in fuel synthesis and life support systems. The processes of extracting Platinum and water are relatively well-defined in the “1 g” environment on Earth, with most of the process steps taking advantage of the forces imparted by gravity on the materials. While not yet verified, it is assumed that the gravitational forces on Mars (3/8 g) and the Moon (1/6g) would probably alter chemical process times (heat and mass transport) but that the lower “g” levels would still allow most mining processes to be implemented as they are on Earth. Processing, however, is problematic for the microgravity environment typical of a NEO (10-6 g). Nearly every step involved in mineral or water extraction on the surface of the Earth from materials handling to chemical processing requires a force imparted by gravity not present at a NEO. New “mining” methods must be developed for this microgravity environment. We have decided to focus on one step common to all Earth based mining or extraction processes: the separation of pulverized or crushed materials into uniform particle sizes for further chemical or physical processing. We propose to substitute the force of gravity with a centrifugal force, in combination with air flow, and to use mixtures of different “known material” spherical particle sizes, to develop models of particle transport and separation in microgravity.

University of Miami: Coral Gables, Florida
Proposal ID: 2014-25528
The Effect of Reduced Gravity on Ultrasonic Nanoparticle Dispersion

Nanoparticle dispersion is an increasingly critical field, as composite materials become a more viable option for improved performance. While the properties of a single material can be well suited for the objective, combining several materials that possess advantageous properties can drastically improve the performance of a component. Composite materials can fulfill this need, but overall properties depend on the quality of its constituents. In our experiment, we are aiming to improve the quality of nanoclay exfoliation and dispersion in a polymer matrix by acoustic cavitation. This will be attempted using a sonicator in a reduced-gravity environment to eliminate the buoyancy force. Buoyancy is a driving factor when cavitation occurs and eliminating it will result in higher energy cavitation. This higher energy cavitation will result in smaller sized nanoparticles that are better dispersed throughout the liquid. An even dispersion will cause the material to have better mechanical properties and a lower nanoclay signature on X-ray diffraction than samples created in a 1G environment.

University of Puerto Rico at Rio Piedras: San Juan, Puerto Rico
Proposal ID: 2014-25592
Mitigation of Buoyancy Effects by Employing Pt Micropillared Array Electrodes

The diffusion of molecular species in microgravity conditions is of interest due to its implications in space technologies. It has been shown that the microgravity environment has an adverse impact on the oxidation process of species resulting in a significant current decrease. The herein proposed study will provide insights on the diffusion processes in enabling technologies such as Fuel Cells, and wastewater purification systems. In general, the fundamental experiment to be studied is the ammonia oxidation at a platinum structured micropillar array. The micropillar array is expected to compensate for the lack of buoyancy via capillary action which will improve the diffusional mass transfer process of gaseous molecules moving away from the electroactive sites and enabling fresh ammonia moving in to be oxidized from the bulk solution which will in turn increase the oxidation rate. This system is currently being studied by the NASA-URC Center for Advanced Nanoscale Materials interdisciplinary research group in conjunction with NASA Ames Research Center Life Support Systems. The microgravity experiment will involve the measurement of current as a function of time at an applied potential needed for the oxidation of ammonia. Due to the truly diffusional environment under micro-g conditions the diffusion of species through the micropillar array is expected to change and it will be quantified. The electrochemical cell to be employed consists of a working electrode made of an array of platinum micropillars on its surface, an Ag quasi-reference electrode, and a Pt mesh as counter electrode.

University of Southern California: Los Angeles, California
Proposal ID: 2014-25573
Validation of an Adaptive Control System for a Platform in Reduced Gravity Under Degrading Actuation

This project is a proof of concept of an adaptive control algorithm for space-based applications. The proposed platform will be a free-floating cube, with three internal reaction wheels, each spinning about a different axis. The cube will be free floating and will only attempt to correct its orientation using the three reaction wheels, one for each degree of freedom controlled. During the first flight, the platform will attempt to “learn” its own dynamics, estimating its ability to rotate in any of its known degrees of freedom and establishing a baseline. Once this is completed, one of the reaction wheels will be partially “degraded” for the second flight, such that it can only spin at a fixed speed, and then entirely shut off. This will change the overall kinematics of the system, forcing the adaptive control algorithm to learn new modes of motion. On the second set of runs, the algorithm will automatically adapt to these new sets of conditions, and then find a best possible trajectory under degraded conditions to orient itself correctly. This will be achieved using underatcuated control concepts, using dynamics phenomena such as the cross coupling of angular momentum between sets of reactions wheels to attempt to create a torque on the platform in direction that cannot be directly controlled by a reaction wheel due to degradation, or by rotating the platform such that the working reaction wheels are in a different plane.

University of Texas at El Paso: El Paso, Texas
Proposal ID: 2014-25564
Magnetic Cleaning Device for Lunar Regolith

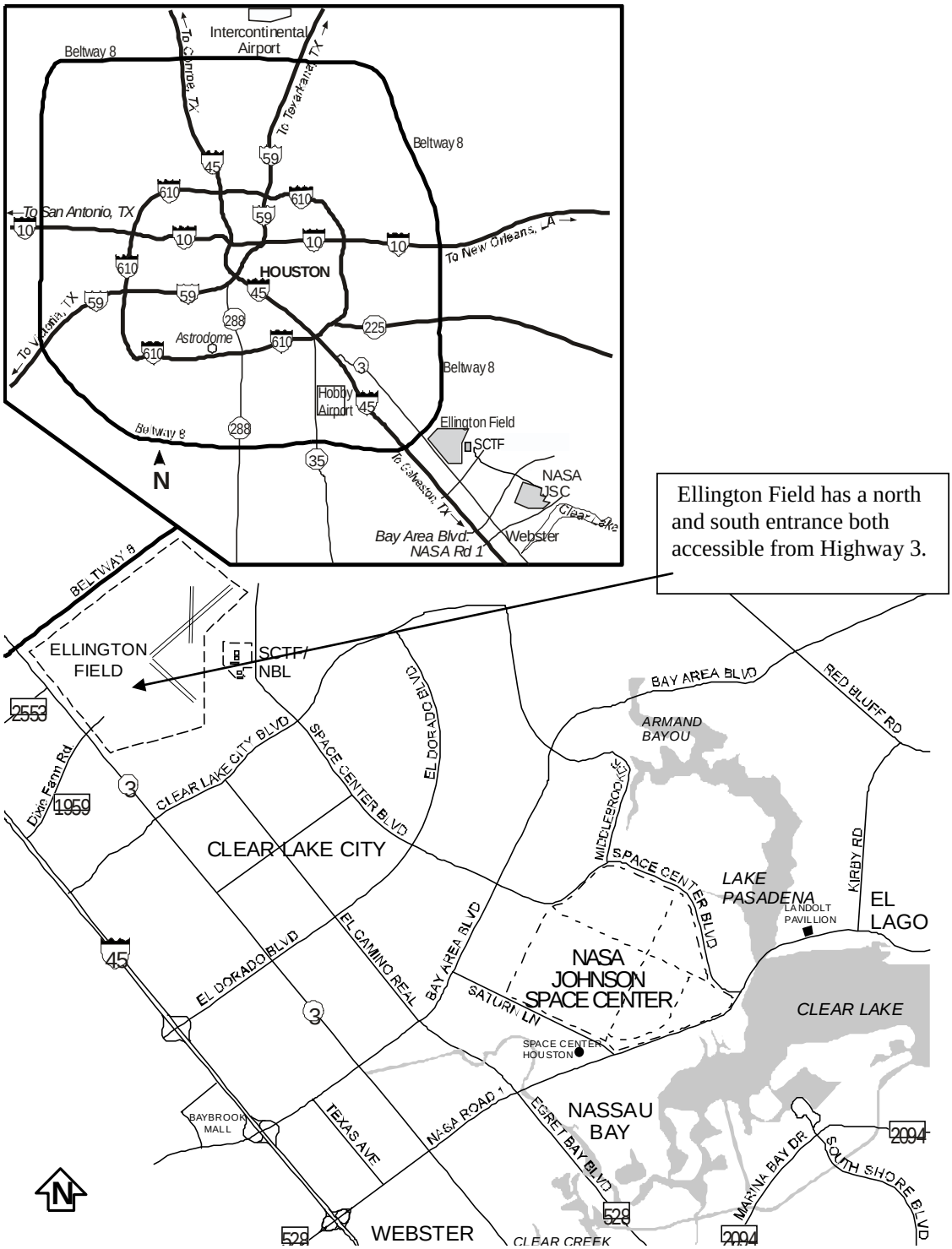
The removal of lunar dust from the spacesuits of astronauts is essential for the long-term exploration of the Moon. Because of the regolith's small particle size and the Moon's low gravity, lunar dust easily adheres to the spacesuits of these space explorers. The dust may cause respiratory problems as well as problems for the equipment onboard the spacecraft. Large particles can be removed from spacesuits by conventional mechanical means, but when a significant amount of fine particles adheres to the fabric of the suit it is a more difficult task to remove the regolith. Therefore, directly addressing NASA Strategic Knowledge Gaps (SKGs) our team will develop a handheld type-cleaning device for removing lunar dust utilizing magnetic force based on the fact that some fraction of lunar dust is magnetic. The device consists of a shaft, a magnetic roller to which the particles will attach, a rotating sleeve on top of the magnetic roller, a container at the end and a backup magnet to keep dust in the bag. The device will be suitable for space applications, because it is simple to use as a lint roller, it is lightweight, easily operated, and produces no waste. This appliance will be powered by a single DC electric motor. The device will enable removal of lunar dust from spacesuits and other equipment. This device is intended to be as versatile and as user friendly as possible, allowing the astronauts to effortlessly use the device to their convenience. The objective of the present research is to test the proposed design under reduced-gravity conditions.

University of Texas Pan American: Edinburg, Texas
Proposal ID: 2014-25591
Autonomously Deployable Solar Arrays

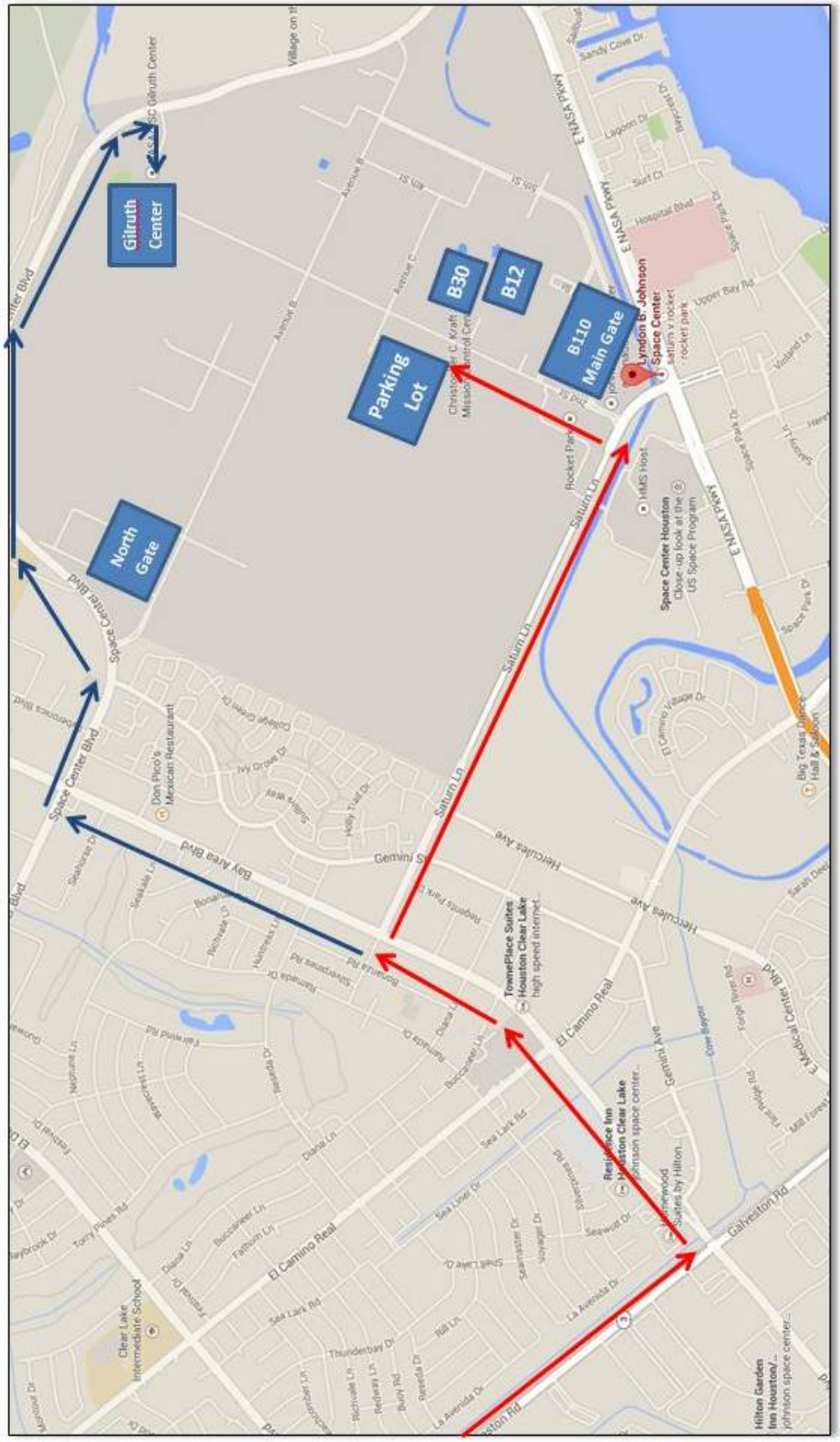
We propose to analyze the deployment of flexible nanofiber based solar panels. On our last flight we investigated a deployment system designed to roll out a flexible polymer nonwoven nanofiber membrane through the use of compressed air. The second phase to this project is to create a fully functional organic solar cell using polymer nanofiber nonwoven composite mats, while also investigating the possibility of deploying the system through an intrinsic chemical reaction to avoid the need of carrying compressed gas systems.

Getting Around

Map of the Clear Lake Area



Map of Johnson Space Center



B110 & Main Gate – The main entrance to JSC. You must show your visitor badge and picture ID.

B12 – For sessions in B12, after going through the main gate, proceed along 2nd street. B12 is a newly renovated building on the right. It is next to Mission Control. There is ample parking on the left of 2nd street. Park there, cross 2nd street and walk to B12.

B30 – For sessions in B30, after going through the main gate, proceed along 2nd Street. B30 is the Mission Control Center on the right.

Gilruth Center – For sessions in the Gilruth Center, enter via the direct gate off of Space Center Blvd. There is a parking lot next to the center.

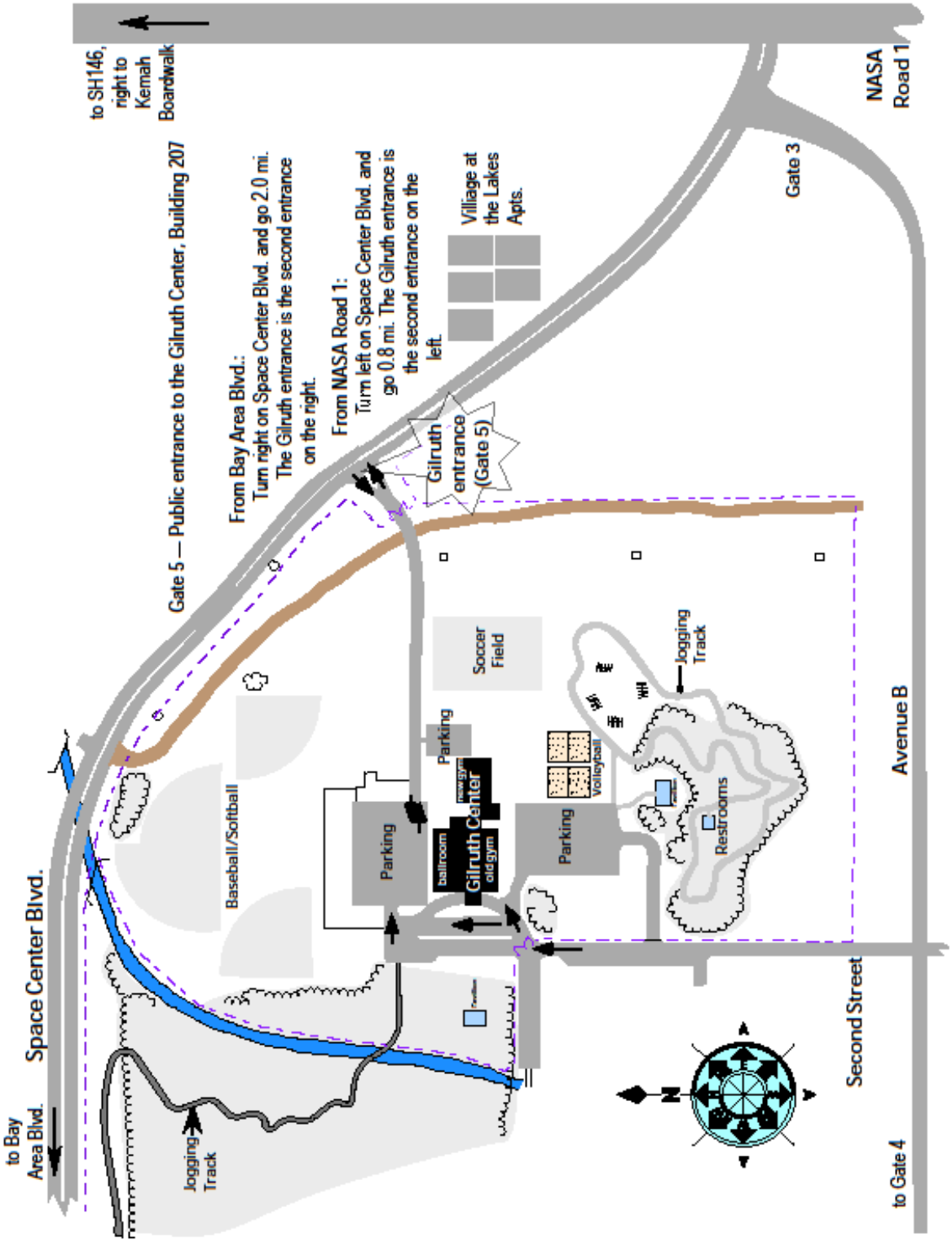
Map of Ellington Field

B267 – The badging office for Ellington Field.
Hangar 990 – Where you will be setting up your experiments.
B993 – Behind Hangar 990, this is where the RG office is, as well as the High Bay and The Mission Briefing Room.
Hangar 276 – The T-38 hangar.

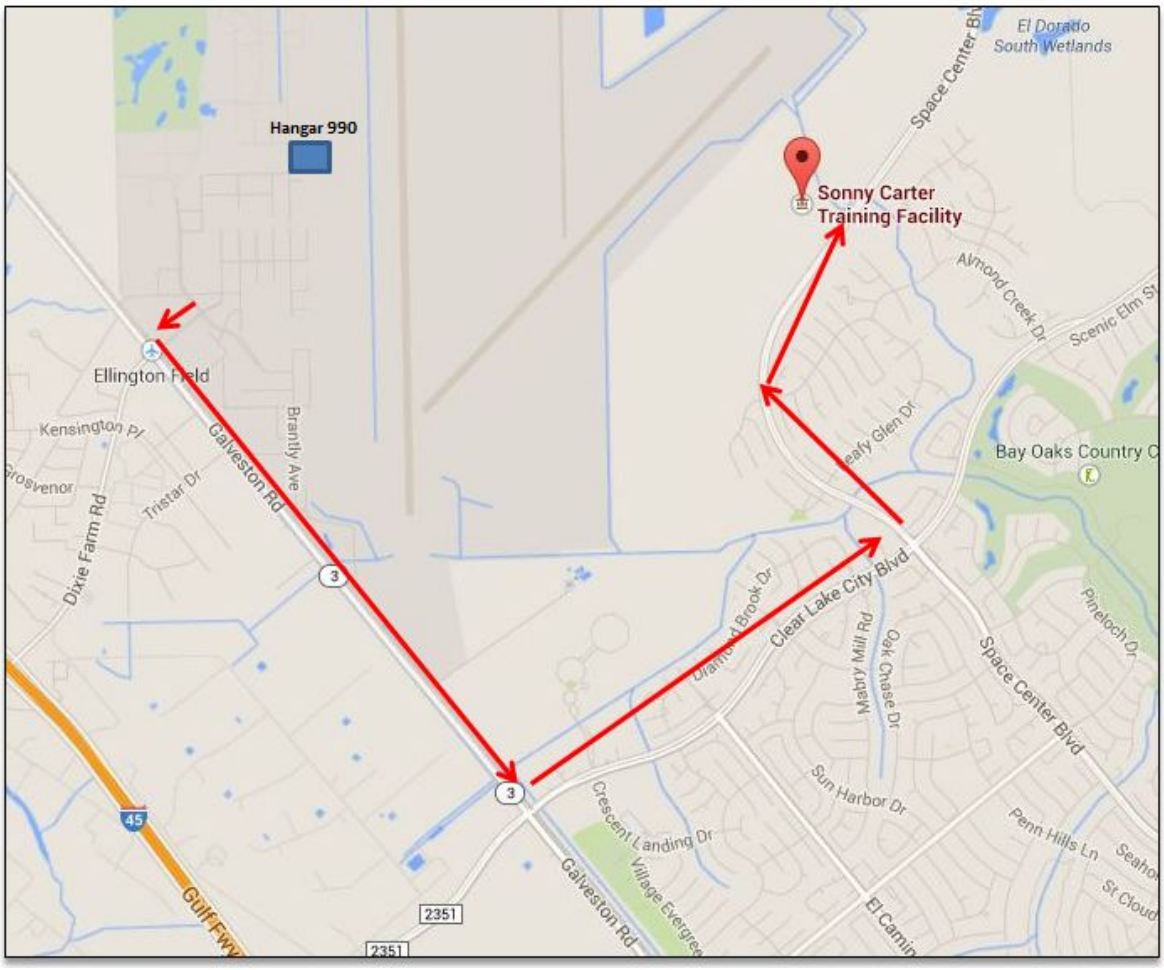
Directions to Hangar 990 from Galveston Rd: (THERE ARE BLUE & WHITE SIGNS DIRECTING YOU TO EFD 990)

- Turn on to **Challenger Rd**; you'll see a large blue sign for Ellington Field and a large airplane (the KC-135) ahead of you. Proceed towards the KC-135 to a stop sign. This is **Aerospace Drive**. Take a **Left**.
- Follow Aerospace to **Popa**, this is the road just before the National Guard gate. Take a **Right**.
- Take Popa to **Nelson**, take a **Left** on Nelson, and follow it until you have to turn **Left** on **Scholl**.
- Take Scholl until you reach the end of the road. There will be a gate and **Hangar 990** will be in front of you. Take a **Left** onto **Brantley**. Then take the first **Left** into the gated parking lot. Do not go to the guard gate.
- The entrance to Ellington Field is a metal turnabout gate. You will need to pass your Ellington Field Badge over the keypad and listen for the gate to unlock. Then **one** person can go through.

Map to Gilruth Center



Map to Sonny Carter Training Facility/Neutral Buoyancy Lab



Directions to Neutral Buoyancy Lab from Ellington Field:

- From **Challenger Rd**, turn **Left** onto **Galveston Road/Highway 3.**
- Turn **Left** onto **Clear Lake City Boulevard.**
- Turn **Left** onto **Space Center Boulevard.**
- The Sonny Carter Training Facility/Neutral Buoyancy Lab will be on your Left, next to a Boeing office building.
- Show your badge at the guard gate and park on the far Left side of the parking lot near the Visitors' Gallery. Proceed into the Visitors' Gallery.

Important Information Regarding Reduced Gravity Tours

- You MUST wear your badge at all times and have a valid ID!

- Your visit to the Johnson Space Center is not a typical tourist event. You will be entering working facilities subject to strict safety and security policies. Please follow the direction of your escort(s) at all times.

- It is essential that all members of the group stay together and not venture from their JSC escort. Wandering into restricted areas constitutes a security violation and could result in the termination of the tour.

- Safety is a priority for everyone at the Johnson Space Center. Since JSC is a working facility, it is required that guests wear flat or low-heeled, fully-enclosed shoes (no sandals, flip-flops, slides, mules, etc.) during their visit. We also recommend that guests wear slacks (instead of shorts or skirts) as an additional safety precaution.

- Attire should be business casual.

- Visit may require walking and standing for extended periods and may require climbing several flights of stairs.

- Cameras are welcome in all facilities unless instructed otherwise. However, photography of individuals outside your program is discouraged without permission.

Activities in Houston

Events and Entertainment

Kemah Boardwalk: Lots of great restaurants (see below), games, rides (The Boardwalk Bullet - Houston's only Roller Coaster) and a carnival-like atmosphere. Go East on NASA Parkway (away from I-45), take a right at Hwy 146. It will be on your left after crossing the big bridge. Look for the Roller Coaster. About 7 miles from NASA. (281)334-9880/www.kemahboardwalk.com

Galveston Beach and The Strand: The Strand downtown area offers an intriguing selection of shops, restaurants, galleries, and museums. Beaches run along the south and east sides of the island. Take I-45 South about 15-20 minutes, go over the bridge. I-45 becomes Broadway. Make a left on 23rd Street/The Strand. About 33 miles from NASA. (888)425-4753/www.galveston.com/whattodo/

Moody Gardens: Offers three themed pyramids: Aquarium, Rainforest and Discovery. Take I-45 South toward Galveston, exit 1A onto Avenue J/ 61st Street, Turn Right on 61st, Right on Stewart Rd. onto Jones Dr, Turn on Hope Blvd. About 32 miles from NASA. (800)582-4673/www.moodygardens.com

Baybrook Mall: It's right down the street and has some great shops. On Bay Area Blvd., on the other side of I-45. (281)488-4627

Rice Village: Outside shopping center with boutiques and awesome restaurants; big college hangout (near Rice University). Take I-45 N to 59 South. Exit Kirby, make a left on Kirby. Go straight. It will be on your left hand side between University and Rice. It's several blocks long and wide. Near the museum district. About 27 miles from NASA.

Galleria and Water Wall: One of the largest shopping centers in the country. Go if you want to brave the traffic, but it's a nice area. Take I-45 North to 59 South. Exit and make a Left on Westheimer. Stay in your left lane; make a left on Post Oak (first light). The Water Wall will be about three blocks down at the Williams Tower. Great for pictures. Make a right at Hidalgo (the next light) to enter the Galleria Parking lot if you want to shop. About 31 miles from NASA. (713)622-0663

Parks: **Eleanor Tinsley Park, off Memorial. Great for runners. Take I-45 North past 59 South. Stay in left lane and take the left Allen Parkway Exit onto Allen Parkway/Memorial. Look for parking on your right – there will be a ball shaped fountain. About 27 miles from NASA.
**Tranquility Park, at 400 Rusk (Take I-45 North, Exit Houston Ave. Curve left on to Houston, stay right on Houston after the fork-in-the-road. Turn Right onto W Capitol, which becomes Rusk. About 26 miles from NASA.
**Clear Lake Park: just past NASA, on NASA Parkway, on your right. On the lake.

Museum District: Located outside of downtown Houston, this area features 16 museums, including the Houston Museum of Natural Science and the Museum of Fine Arts. Explore their Web site for current exhibits: http://www.houstonmuseumdistrict.org About 22 miles from NASA.

Restaurants

Asian

Pho 21 or Pho Hoang: Opposite each other at Bay Area and Space Center Blvd
East Star Chinese Buffet and Sushi Bar: 1025 Nasa Pkwy @ El Camino Real, 281-280-8822
Masa Sushi: 977 Nasa Pkwy @ El Camino Real, 281-486-9888
Tokyo Bowl: 2402 Bay Area Blvd @ Space Center Blvd, 281-480-5311

BBQ

Brown Sugar's Bar-B-Q: 11030 Kingspoint, 713-944-6544
Dickey's: 1109 Bay Area Blvd @ Diana Lane, 281-286-7427
Randy's Smokehouse & BBQ: 15104 Galveston Rd @ Pineloch, 281-486-8727
Tony's BBQ and Steakhouse: 17052 Saturn Lane @ Gemini Ave, 281-286-8669

Cajun

Abe's Cajun Café: 1080 Clear Lake City Blvd @ Galveston, 281-480-2237

Italian

Frenchie's: 1041 Nasa Rd 1, 281-486-7144
Olive Garden: 1310 W Bay area Blvd near Baybrook Mall, 281-488-1022
Perry's: 1001 Pineloch Dr @ El Camino Real, 281-488-2626 (great pork chop lunch special)
Pomodoro's: 1303 Nasa Pkwy, 281-480-0700

Mediterranean

Wael's Mediterranean Cuisine: 2449 Bay Area Blvd near Space Center Blvd, 281-286-1110

Mexican

Berryhill Baja Grill: 2660 Marina Bay Dr in Kemah, 281-535-1000
Bullritos: 1820 Nasa Pkwy @ Saturn Lane, 281-333-0300
Chuy's: 20975 Gulf Fwy @ Nasa Pkwy, 281-554-2489
Don Pico's: 2110 Bay Area Blvd between Space Center Blvd and Saturn Ln, 281-280-8081
La Hacienda Mexican Bar & Grill: 12933 Gulf Freeway Frontage Rd, 281-484-6888
Mamacita's: 515 E Nasa Rd 1, 281-332-5362

Burgers/Kolaches/Sandwiches

Dixie's Deli: 364A FM 1959 Rd about two blocks outside Ellington Field, 281-484-3083
Freebirds World Burritos: 528 Bay Area Blvd, 281-557-2300 (next to Buffalo WW)
Fuddrucker's: 2040 Nasa Pkwy across from JSC, 281-333-1598
Kolache Factory: 528 Bay Area Blvd between Bay Area and Galveston, 281-557-2253
Miller's Café: 2403 Bay Area Blvd @ Space Center Blvd, 281-461-8998
Morning Kolaches: 2402 Bay Area Blvd @ Space Center Blvd, 281-280-8432
Subway: 1190 Clear Lake City Blvd. @ Galveston, 281-461-6162

Seafood, Steaks, and Stuff

Lots of seafood restaurants on the Kemah Boardwalk

Texas Roadhouse: 18194 Gulf Fwy near Wal-Mart, 281-461-3800

Saltgrass Steakhouse: Kemah Boardwalk, 281-538-5441

Buffalo Wild Wings: 528 W. Bay Area Blvd, 281-338-9464 (next to Freebirds)

Shopping and Movies

Retail/Souvenirs

Baybrook Mall	Bay Area Blvd. & I-45	281-488-4627
Space Center Houston	1601 NASA Road	281-244-2100
Space Center Souvenirs	710 West NASA Road 1	281-332-5051
Galleria Shopping Center	5015 Westheimer (in Houston)	713-622-0663
Kemah Boadwalk	215 Kipp Ave	877-AT-KEMAH

Hardware/Supplies

Best Buy	19425 Gulf Freeway (I-45 & Bay Area Blvd)	281-554-3004
Central Ace Hardware	2422 Bay Area Blvd. (East of Space Center Blvd)	281-286-2400
Friendswood Hardware	203 W. Edgebrook Dr. (Friendswood FM 518)	281-482-3487
HEB Grocery	6210 Fairmont Pkwy (Pasadena)	281-487-1946
Home Depot	18251 Gulf Freeway (I-45 & El Dorado Blvd)	281-488-2274
Lowe's Home Improve	19225 Gulf Freeway (I-45 & Bay Area Blvd)	281-332-3006
Radio Shack	1801 Bay Area Blvd. (I-45 & El Dorado Blvd)	281-819-4116
Space City Ace Hardw	3902 NASA Pkwy	281-326-3300
Super Target	255 Marina Bay Dr, Kemah (over the big bridge, on the right)	281-538-7957
Super Target	1801 W Bay Area Blvd (By Baybrook Mall)	281-819-4116
Wal-Mart Super Center	150 El Dorado Blvd (El Dorado & I-45 S)	281-480-6146

Movies

Dollar Cinema	NASA Road 1 & I-45 N. - $1.50 tickets	281-332-4403
Cinemark 18	1820915 Gulf Freeway (I-45)	281-557-4141
Star Cinema Grill	NASA Rd. and I-45 N. (restaurant & movies)	281-557-9300

Parks/Museums

Armand Bayou Park & Nature Center 4300 Bay Area Blvd

- Wed-Sat 9-5, Sun noon-5, $4 admission for Center. Featuring wetlands prairie, forest and marsh habitats, bird-watching, hiking trails, pontoon boat adventures.

Clear Lake Park 5002 E NASA Pkwy

- Right on the water with tennis courts, lake, picnic/BBQ area. Good place to run.

Galveston Beach and The Strand I-45 S about 33 miles

- Beaches, shops, restaurants, galleries, and museums on the Gulf Coast.

Museum District Near downtown

- 16 museums including Museum of Natural Science and the Museum of Fine Arts. www.houstonmuseumdistrict.org

Rocket Park 1698 Nasa Rd 1

- At the main gate of JSC. An historic Saturn V rocket is housed here along with interesting history of the Apollo program.

Sylvan Rodriguez Park and Solstice Circle 1201 Clear Lake City

- Very close to Ellington Field. Small covered picnic area, small jogging/walking trail, and a turtle-filled pond.

Tranquility Park 400 Rusk St

- About 26 miles from JSC, in downtown Houston, this park commemorates the moon landings.

Notes

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Notes

Hall of Fame

John Yaniec

C-9 Test Director,
JSC Aircraft Operations
Parabola Count: 37,942
1998-2008

Donn Sickorez

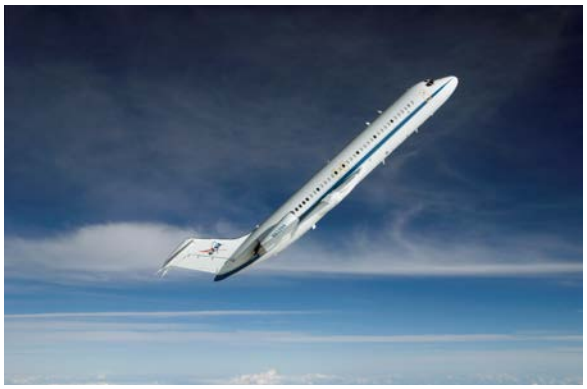
University Affairs Officer,
Office of Education
1997-2007

Douglas Goforth

Program Manager,
Office of Education
2007-2012

KC-135 Weightless Wonder

Parabola Count: 34,757
JSC Aircraft Operations
1995-2004

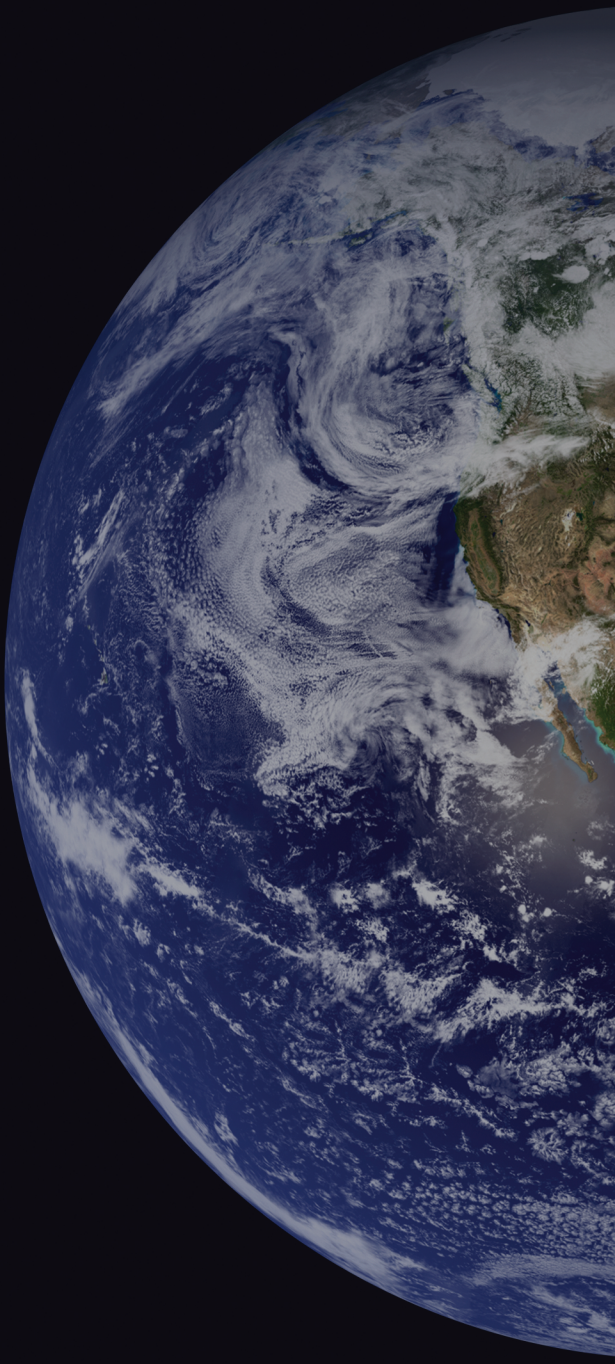


C-9 Weightless Wonder

JSC Aircraft Operations
2005-2008

IMPORTANT PHONE NUMBERS

LOCATION/PERSON	FROM ELLINGTON OR JSC	FROM CELL PHONE/ OFF-SITE
EMERGENCY NUMBER Ellington Field and JSC	**33333**	**281-483-3333 (Dial 911 if off site)**
Del Rosso, Dominic (RGO, Lead Test Director)	49113	281-244-9113
Lee, Terry (RGO test director)	49211	281-244-9211
McManis, Kerry (RGO, Administration)	49874	281-244-9874
Prochaska, Frank (Education, Program Manager)	31999	281-483-1999
Seyl, Veronica (Education, Program Manager)	35110	281-483-5110
Semple, Jamie (Education, Program Coordinator)	27872	281-792-7872
Gonzales, Sarah (Education, Program Coordinator)	38623	281-483-8623
Ashle Harris Megan Sumner (Public Affairs Office)	27457 27520	281-792-7457 281-792-7520
JSC General Information	38600	281-483-8600
JSC Newsroom	35111	281-483-5111



www.nasa.gov