Micro-g NExT FAQs

Micro-g Neutral Buoyancy Experiment Design Teams Frequently Asked Questions

Contents

Lessons Learned from former Micro-g NExT Participants

Want to know what advice past participants would give to students thinking about taking the Micro-g NExT journey? Click the links below to view video of past participants sharing their advice from a student's perspective. The topics include how to collaborate with teams, the importance of a timeline, how to build a successful team, and the impact Micro-g NExT can have on your future. These lessons learned from previous participants will help make your upcoming journey with Micro-g NExT more successful.

- How are teams structured? *(Video)*
- How do teams successfully manage deadlines? *(Video)*
- What is the makeup of a successful team? *(Video)*
- What can one expect to learn during Micro-g NExT? *(Video)*
- How can Micro-g NExT help in future career success? *(Video)*

FAQs: General

1. ***What is the Artemis program?***
   The Artemis program is NASA's lunar exploration program which will use innovative new technologies and systems to explore more of the Moon than ever before. To learn more, please visit https://www.nasa.gov/what-is-artemis.

2. ***What is Orion?***
   Orion will serve as the exploration vehicle for the Artemis program. It will carry the crew to space, provide emergency abort capability, sustain astronauts during their mission, and provide a safe re-entry from deep space return velocities. To learn more, please visit https://www.nasa.gov/exploration/systems/orion/index.html.

3. ***How does my team's design potentially benefit space exploration?***
   NASA is currently working on systems to take humans beyond Low Earth Orbit to explore the solar system. Some of the destinations of interest are the Moon and Mars. As part of NASA's exploration objectives, new tools and procedures are necessary to carry out the upcoming missions.

4. ***What expenses does NASA cover?***
   The selection of a team for this opportunity does not include a monetary award to your institution. NASA assumes responsibility for costs involved with prototype testing in the NBL. Each team is responsible for all other costs including travel to Houston and cost of building the prototype.

5. ***With whom will my team interface with at NASA?***
   Your team will have multiple interfaces at NASA, each of which serve a different function. Your primary interface will be the Micro-g NExT Coordinators.

6. ***How much time should I anticipate spending on this project?***
   Time requirements will vary from team to team. Expect to spend a large portion of your time on design, creation, and outreach. If your team is struggling with time management, please work with your faculty advisor to set a feasible timeline. The workload of this project is comparable to that of a 3-credit hour course.

7. ***How many teams will NASA select to test their prototypes in the NBL?***
   The number of teams is not predetermined but rather based on the quality of submitted proposals.

8. ***Can I submit a design for more than one tool?***
   Each team may submit a proposal for only **one** of the Micro-g NExT challenges.

9. ***Can more than one proposal be submitted from the same school?***
   Yes, more than one proposal can be submitted from the same school. However, students may only belong to a single team.

10. ***If a school submits multiple proposals, does each proposal need a different outreach section?***
Yes, each proposal will need its own outreach section.

11. ***Do we need a signature from the Department Head or any other management individual from our school before submitting the Letter of Intent and/or the Project Proposal?***
You do not need a letter of endorsement for the Letter of Intent, but it is a requirement for your team's proposal.

12. ***Does a prototype need to be submitted with the proposal?***
A prototype is not required to be submitted with the proposal. However, any prototyping you do will add to the quality of your proposal.

13. ***If selected, what is the first step?***
Your team will be invited to attend a 1-hour orientation session with the Micro-g NExT staff. Attendance of this session is required of the faculty advisor and student team. The session is conducted online.

14. ***Can teams be comprised of students from multiple schools?***
Absolutely! We encourage collaboration and interdisciplinary teams.

15. ***Can returning teams participate?***
Returning teams may participate; however, teams may only have 2 returning members.

16. ***Do members who have submitted a proposal, but have not been selected constitute a returning member?***
No, the requirement only refers to teams that have previously participated on a team that advanced to Phase II of Micro-g NExT.

17. ***Are BS/MS students who have yet to be immersed in graduate courses allowed to compete in this project?***
If your academic status is listed as an undergraduate student when we verify with your college/university, you are eligible to participate as a student.

18. ***Can I participate in Micro-g NExT if I have a green card/am a Legal Permanent Resident or DACA student?***
Micro-g NExT is currently available to U.S citizens enrolled in U.S institutions of higher learning.

19. ***My choice for faculty advisor is not a U.S. citizen. Is he still able to work with my team?***
Yes, he can still act as your advisor. However, he will be unable to travel to Houston for the test week. **Any person participating in the Test Week in Houston must be a US citizen.**

21. ***Where can I find information about the Neutral Buoyancy Laboratory (NBL)?***
Information about the NBL can be found at the following link: https://www.nasa.gov/centers/johnson/pdf/167748main_FS_NBL508c.pdf

22. ***Are there hardware requirements and/or standards my team should be aware of before testing in the NBL?***
Requirements for hardware that will be tested in the Neutral Buoyancy Laboratory (NBL) can be accessed in the NBL Engineering and Safety Requirements document.

23. ***Do I get to dive with my team's prototype during testing in the NBL?***
Professional NBL divers will test the tools and students will direct the divers from the Test Conductor Room of the NBL facility.

24. ***Who is responsible for writing the procedures that will be used to conduct test in the NBL?***
Your team is responsible for drafting the diver procedures and coordinating with the assigned Ops Lead to finalize the procedures.

25. ***What is considered STEM engagement?***
STEM engagement may consist of a presentation to a school group, a symposium, or other similar event. You may also incorporate a social media plan in your outreach.

26. ***When will we hold the STEM engagement component?***
Your STEM engagement component can occur prior to test week, but as some outreach components will include testing results, some outreach could occur after your team's test week.

27. ***The STEM engagement portion of my project involves development of K-12 curriculum for classroom use. Are there any suggested components I need to incorporate?***
The following websites might be useful when looking to incorporate NASA missions into the curriculum:

https://www.nasa.gov/stem/nextgenstem/index.html
https://www.nasa.gov/stem/nextgenstem/webb-toolkit.html

You may consult with a current K-12 educator on this topic. It is suggested that you consider the following:

- All curricula are aligned to national standards.
- Each curriculum piece provides the user with a connection between the curricula topic and microgravity, the NBL, or your prototype's potential use in space exploration via an introductory paragraph. This adds relevance to the material.
- A curriculum incorporates the 5E model to the extent possible.
- The curricula are written in grade level appropriate language.

28. ***How should STEM engagement be documented in the proposal?***
Include a description of activities you plan to carryout. The description should include the purpose of the activity, the intended audience, the expected number of participants, and the perceived impact of the activity. It helps to have a letter of support from organizations you plan to work with in your outreach efforts. It is advised that you begin making connections now.

29. ***Can we coordinate social media outputs about the project with Micro-g NExT?***
Absolutely. This can be coordinated with the Micro-g NExT coordinator.
We may retweet a team's posts. We encourage you to use our hashtag #MicrogNExT.

30. ***Would you prefer CAD files uploaded separately, or in a zip file?***
If it's an assembly with multiple files, it's easier on us if you Zip them but not required!

FAQs: Technical: General

Please visit the EVA Reference Website. It provides a reference you can use when considering your design. You will only be judged on your ability to meet the requirements outlined in the challenges. You are not required to meet the requirements outlined in the website.

1. ***Who would own the intellectual property rights?***
NASA hopes to potentially utilize some of the ideas that your team puts forward in a future space mission. Therefore, we ask that teams complete a "Statement of Rights" document. See the Proposal Guidelines for specifics regarding this topic.

2. ***Do I have to meet all the requirements?***
You will be scored based on how many requirements you meet.

3. ***Some requirements are vague. What should I do in this case?***
Some requirements are purposely vague. We want you to do the research and provide the rationale for why you designed your device the way you did.

4. ***Can you combine the functions of multiple tools together to save cargo space?***
That's a great thought and an important consideration for space tool development. For the purpose of this activity, we ask you select only one **(1)** challenge.

5. ***Can we have detachable parts on the prototypes?***
Yes. You can have multiple pieces of hardware to accomplish the challenge. All pieces together should fit within the given dimensions.

6. ***May we 3D print parts of the tool?***
Yes. Though you'll want to consider the loads that your tool will encounter and ensure that the plastics used in the 3D printer can handle those loads.

7. ***Will we have to make a waterproof version of our tool?***
You will have to make a version of your tool that operates in the NBL. We will work with you to ensure you are using approved materials.

8. ***Does the prototype have to be built on a 1:1 scale, or can it be smaller?***
The simulation in the NBL will be full-scale, 1:1. However, doing scale prototypes during the proposal phase is recommended to show the validity of your design.

9. ***Is there somewhere to get more in detailed specs regarding the NBL (such as density)?***
The NBL is filled with chlorinated water with a density of approximately 1 g/cm3.

10. ***What will be the depth of operation in the NBL?***
Assume a depth of 40ft. That is the maximum depth of the NBL.

11. ***Do the prototype materials need to be NBL and Space approved?***
For the purpose of the proposal, the minimum requirement is to describe the materials you would use in the NBL. Any additional information you want to provide about what you would do in a legitimate space application would be very valuable as well.

12. ***What are the temperatures our materials need to be able to withstand?***
The actual testing will occur in the NBL which is about 85°F. So, for this effort of developing a prototype, temperature will not be a major factor. For space application, there is information online that details different temperature ranges in space.

13. ***What is the size of an EVA glove?***
See the EVA Reference Website for glove dimensions. You can also use a ski glove as a reference. It is approximately the same thickness as an EVA glove. Remember that when a space suit glove is pressurized its nominal position will be "hand open" and the astronaut needs to expend energy to close their hand.

14. ***Will tools need to be able to be used with either hand?***
This is not a requirement, but NASA does like tools that can be used by both left and right-handed astronauts.

15. ***Are we able to use magnets for any part of the challenges, just as a small component, not as a whole?***
Yes, magnets are okay in that capacity.

16. ***How often can teams ask for technical clarifications? Will all technical clarifications be posted for all teams to see?***
All questions and their answers will be continuously posted in this FAQ document. Check this document regularly. Ask as many questions as you'd like, we'll get to them as soon as we can.

17. ***What kind of CAD program is best for all of these? SolidWorks or AutoCAD?***
You can use any CAD program you'd like, or none. A 3D model is not required, though it is recommended as it is easier to understand a design that way.

18. ***Can aerogel be used?***
As Aerogel can have different formulas, it will be up to the team to prove that it is safe to use in the water. You'll need to provide the Safety Data Sheet and do testing of your own to show it is safe.

19. ***Can we have more than two parts as detachments?***
Yes.

20. ***If we have something on our design that fits the requirements, but upon using it, that part may stretch outside of the dimensions given, is that allowed? Or does everything have to stick within the dimensions you gave us?***
The dimensional requirement is a stowage requirement. If your tool doesn't fit into that box when stowed, consider making your device in multiple pieces. Also, not meeting one of the requirements does not disqualify you. You just won't get full credit for meeting that requirement.

21. ***Can our design deviate slightly from proposal drawings to actual day of testing?***
Yes. As with all proposals, there may be slight modifications. However, all changes will need to be approved.

22. ***Can we adapt technology used in other industries for our design?***
Absolutely!

23. ***What types of rocks will be used during testing (flat surfaces, boulder-type surfaces, small rock outcropping surfaces)? How large of an object must the device interact with?***
The device will be attaching to rocks of various sizes and surfaces. Lunar rocks are typically basaltic Basalt, vesicular basalt, and anorthosite rocks are known to be on the lunar surface. Especially anorthosite at the south pole

24. ***What materials are to be used?***
Any material that is approved by the NBL can be used.

25. ***What are the maximum dimensions/weight of rocks that will be used?***
The rocks are a variety of sizes, some of which are as small as 12 inches in diameter, some much larger.

26. ***Are the divers able to kneel during testing?***
Kneeling is completely acceptable! The divers in the NBL likely won't be in a full suit, but they will have previous experience in the suit and can give feedback on the feasibility of kneeling while using your particular device. For the sample marker challenge, we don't want them to have to kneel each time they place a sample marker because there will be so many. For the anchoring it's completely fine (as long as they don't have to stand up and kneel multiple times). Our job is to complete science and engineering objectives by tiring out the crew a little as possible!

27. ***Does the build vs flight materials stipulation apply to all challenges?***
Flight ready materials should be used in your design, your final prototype does not need to be flight ready materials and can be made from pool friendly materials.

28. ***Can you use plastics in the design?***
Yes for the version that will be used in the NBL, plastics can be used in your prototype.

29. ***Since we do not need to have a flight like material design at the NBL showcase, does the testing prototype that we bring have to also be under one pound? Or only the flight like CAD design have to be under one pound?***
The weight requirement for both challenge 1-2 only applies to the flight-like design. Both the flight and NBL designs must meet all other requirements.

30. ***Is the weight requirement for each tool based on Earth or moon gravity?***
This limit is based on Earth gravity.

31. ***If these tools are being designed for space, why is the temperature only between 23 and 86 degrees Fahrenheit, shouldn't the temperature range be more extreme?***
That temperature range is the Earth based operating temperature for testing. It's ok if your device is not immediately ready for space.

FAQs: Technical: EVA Sample Size Location Calibration Marker

1. ***Are we being asked to manufacture 5 separate markers?***
Yes each team will need to manufacture a set of 5 markers but there will only be one design

2. ***Will there be any limit on the deployment time of the markers?***
No the deployment time is up to the team, but ideally the quicker the deployment time the better.

3. ***Do we need to include a reflectivity chart on the markers?***
You will not need to include a reflectivity chart in your design.

4. ***How much are the markers allowed to disturb the surface?***
The markers should make minimal disturbance to the surface. They are to be reusable so they should not permanently attach to the surface.

5. ***Are the color references, ruler, and other comparison tools going to be provided? Or are we expected to design that aspect of the tool too?***
Those are to be incorporated into your design. Be sure that your design meets all of the requirements of the challenge.

6. ***Does the sample marker need to record locations? Like latitude and longitude?***
No, the marker does not need to record latitude and longitude coordinates.

7. ***Is there a specified height of the marker when deployed?***
No, the marker should be able to deploy without the astronaut needing to kneel all the way down.

8. ***Does a method to contain the sample marker set need to be designed, such as a way to carry the sample marker set?***
No, you do not. You will be provided with a method to carry the 5 markers.

9. ***Visibility of the marker device- given the small size footprint of both the marker device and identification tag information areas, what sort of visibility is expected to be necessary for the sample markers? Will the crew member need to be able capture images of the device from a certain maximum distance or viewing angle?***

   The requirements for the size of the alphanumeric coding and color scale were determined by some testing we've done at various distances from the marker. Follow those requirements and it will be visible enough.

10. ***Will calibration markers need to be deployed in precise locations, or just general areas for sample collection? For example, could a marker device be dropped from waist height into an area of interest as a method of deployment?***

    Each marker is meant for one sample (not a general area), so it's not incredibly precise, but needs to be next to that sample in question. For example, if one rock has differ coloring or size than those around it, they would place the sample marker next to so that it's clear that's the sample in question. If they're scooping regolith or many rocks, it would be less precise but still nearby where they will be sampling. Dropping from waist height could be problematic in that the sample marker could flip over or the sample gets disrupted if it's too close. A method to deploy and retrieve the marker from waist height is great, but we don't want them to drop it from that high up.

11. ***Is NASA going to provide labels for the markers (like stickers or something), or are we supposed to make our own labeling system and labels?***
Labels are not going to be provided, that is for the team to design. It does not have to.

12. ***What are generally the size of the samples which need to be identified using the marker? Should marker be placed on top of sample or beside it? If on top, what is the clearance needed underneath the marker?***
The idea is that these are versatile and can be used with various rocks and various surfaces, so the marker will be placed next to samples and on top of others. If the marker is placed on top of a rock there needs to be enough clearance for the marker to be stable and sturdy on the surface.

13. ***At what distance from the sample will photos be taken?***
This will vary and is still being determined based on camera capabilities. Following the size requirements in the challenge document will ensure that a clear picture can still be taken from close range.

14. ***Are the markers going to be brought back from the lunar surface?***
The markers can be reused at different areas on the moon. The tentative plan is to leave EVA hardware on the moon in order to reduce the mass in the spacecraft returning to Earth.

15. ***Is the bag carrying the markers set up horizontally or vertically on the astronauts belt?***
The bag carrying the markers will be set up vertically on the tool belt.

16. ***Can we put the color indicators and marker labels on a curved surface?***
Yes these indicators can go on a curved surface.

17. ***Are the markers completely mechanical or can they have electronic components?***
The markers should be completely manually. The simpler and more lightweight the better.

18. ***Should there be a vertical orientation requirement like how the gnomon has a self leveling stadia rod?***
No, a vertical orientation requirement is not necessary.

19. ***Can we use the color indicator as the measurement indicator?***
A measurement indicator is not in the requirements. Those are potentially things that could be measured from other features, like the color scale or coating on the marker.

FAQs: Technical: Lunar Sample Bag and Dispensing Device

1. ***What are the standard dimensions for the sample bag in Challenge 2?***
9x9 inches for the actual bag. The overall size may be greater due to hooks or clasps that are used to seal the bag.

2. ***How much mobility should be retained by the astronaut while the bag is being dispensed? i.e. should the astronaut be able to get a bag while walking or performing other activities?***
   Assume they will be standing still and upright. Think about your standard work envelope in front of your chest. You don't want them to have to extend their arms all the way out or have it so close to their chest that they can't see in the suit.

3. ***In regards to the sample bag dispenser, are the users planning on filling the bags prior to dispensing, after, or a combination of the two? What action primarily would the astronauts be using?***
   That's actually something we want to leave up to crew preference, so we currently want both capabilities in the dispensing process. You could even have them do both during your test if that works for your design!

4. ***The dimensions specified in requirement 14 of the sample bag dispenser, are those correlating to a specific length width and height or can they be in any orientation?***
   Any orientation is fine! We just want to keep it within the crew's general work envelope in front of them (assume the dispenser is attached to a 3rd arm-type thing out in front or slightly to the side of the crew's waist while in use). We also want to make sure no one makes a design that's super long and skinny or something that couldn't be carried on the suit.

5. ***Are magnets acceptable for sealing the bags?***
   Lunar regolith can be magnetic and magnets could interfere with the sample in some way. Magnets could be acceptable but we don't understand the magnetic properties enough to convince the scientists to let us put magnets that close to the sample.

6. ***Do the bags have to be entirely plastic, or can non-magnetic metal be used near the open end?***
   Yes, non magnetic metal could be used, The bag is plastic, but the closure/opening method would include metal of some sort.

7. ***Do we have to store the bags after a sample has been collected?***
   You do NOT need to design anything to store the samples after they have been collected. NASA will provide this.

8. ***We were wondering about the type of seal for the bags. Is it acceptable for the bags to seal permanently, requiring partial destruction of the bag or seal to remove the contents, or should the bags necessarily be capable of being unsealed?***

   Yes the seal could be permanent or one-time use. They re-bag the samples back on the ground once they’re received. Make sure you think about sample integrity and that the seal won’t damage the contents in any way.

9. ***How well, specifically, should the bags seal? What percentage of mass loss is acceptable, or what size particle should be unable to leave the bag when sealed? Should the seal be airtight/watertight?***

   The best way to answer this is that any loss of mass is unacceptable. WE don't want to say airtight or watertight in case those are interpreted differently than intended. The sample needs to be fully contained and not be able to come out during transport (think multiple sealed bags in a larger bag together being transferred from the surface to the vehicle and home to Earth). Remember the sample could be one rock or a large scoop of very fine particle size regolith (like powdered sugar or sand).

10. ***Where are the bags being stored after a sample has been placed in them?***
    The bags are going to be stored in a larger bag in a cart near by, but that is beyond the scope of this challenge.

11. ***The interior dimensions of the bag are to be 9 x 9in. What does this mean specifically? Does this mean the maximum interior is a square or elliptical 9 x 9in.?***
    This requirement means the bag laying flat could hold a 9x9" piece of paper inside (the paper will obviously be crumpled smaller when the bag is opened). Basically, we have found that a 9" opening of a rectangular bag will accommodate the upper size limit of potential rock samples. The intention here is to accommodate the largest rock that the scientists are interested in, which is roughly bocce ball-size. So the opening size and bag size/shape are important to consider.

FAQs: Technical: Lunar Reusable Surface Anchoring Device

1. ***Is the device meant primarily to grapple onto a rock or to maintain something attached to the rock?***
   The device is designed to grapple onto a rock and be reusable. It should not permanently attach to the rock.

2. ***Is the device in this challenge meant for anchoring things that weigh less than 10 lbs?***
   For this particular challenge the device will only need to anchor something up to 10 lbs. But it would be beneficial if you could show that your device is scalable and could anchor larger objects without significantly increasing in mass and volume.

3. ***Is the 10 pounds of weight in normal gravity or 10 pounds of weight in micro gravity?***
   10 pounds of force in Earth's gravity.

4. ***Are we to build a device that can anchor to the rock so it can be picked up, and not anchoring a spaceship or rover to a planet?***
   The device will anchor to smaller rocks to pick them up but be large enough to anchor tools and other hardware to larger rocks.

5. ***Is the anchoring device supposed to autonomously perform the job or will it be control manually?***
The device will be a handheld device that is controlled manually.

6. ***Are we anchoring rocks down to the moon or are we anchoring tools to rocks?***
The device will anchor to smaller rocks to pick them up but be large enough to anchor tools and other hardware to larger rocks.

7. ***Will there be a layer of regolith that the anchor can embed itself in?***
The anchoring device will anchor to a solid rock, there will be no regolith / dust on top of it.

8. ***Did we have an upper bound or length for the lunar rocks in challenge 3?***
They will be of a variety of sizes, just like on the moon! You might describe what sizes or activities your device is optimized for within your proposal.

9. ***Are the astronauts allowed to touch the rocks that are utilized for anchoring? Does the tool need to be able to grab the rock without any help from the astronaut?***
The diver can touch the rocks for anchoring, but the best proposals will allow for these to be used as robotic end-effectors, that is, without an astronaut nearby.

10. ***When testing the anchor in the NBL, does there need to have a handle or loop as a way for the divers to apply the 10 Ibs of holding force?***
Yes, we anticipate a method will be present to test the pull strength in multiple directions.

11. ***It has been suggested that the anchor could be used to support antennae. Would a rope be used in that meaning should we have an interface on the anchor where we can connect a rope/wire/tarp?***
For future applications, we would anticipate multiple uses, such as supporting an antenna with a wire. For this challenge, we anticipate the diver should be able apply a force in some manner, though there is some flexibility on how you propose they do it.

12. ***Should the device be fully assembled inside the design constraints of the cylinder (6 in diameter, 18 in tall) ? If not, then should it be a collapsible design that is easily assembled?***
It should be collapsible to this size, it is not required to be fully assembled in the cylinder. However, you will have limited time with the diver so the design should be easily assembled.

13. ***Should teams stay away from design that damages the rock surface?***
For the purposes of the test environment we would suggest, that you not damage the rock surface.

14. ***Is it ok the scratch the surface of the rock?***
Yes scratching the surface of a rock with the anchor is acceptable.

15. ***Does the 10lb of force take into account the water absorption of rock?***
The force will be measured by a spring scale by the diver, not the weight of the rock.

16. ***Is it acceptable to have a design that can be left behind on the moon for use by future astronauts?***
Yes, it is acceptable however your anchor should not attach permanently to the rock, or be attached by chemical means.

17. ***Can there be movement within the device once it has anchored, similar to how a boat moves once it has been anchored?***
No, the device should be able to target a specific rock and attach while the diver actuates the device.

18. ***When you say non-penetrating are microspines allowed? Should we also be wary of them puncturing/penetrating a suit?***
Microspines are allowed as they non-penetrating. In regards to safety, all designs will need to go through a safety review prior to testing at the NBL (and prior to any future spaceflight). You might consider and mitigate likely safety objections in how you build and operate your device, such as using guards, retraction, etc.

19. ***What is the upper size limits of rocks that the anchor will interface with?***
There is no hard limit, the general idea is the grab onto a smaller rock or attach to a small section of a larger smooth rock.

20. ***Can we have detachable parts for the anchoring device?***
Yes you can have detachable parts that can be left behind.

21. ***When you say it must not be externally powered, can it still have built-in software or are you saying that it is completely mechanical and you're supposed to physically operate it?***
We would like the device to be operated only by mechanical means by the operator ("hand powered"). No electronics or software necessary. Future designs might need software/motors to use on a robot but we are most interested in the mechanical design for the scope of this challenge.

22. ***The anchor is supposed to not damage rocks. What are the rules regarding ice?***
We will not be able to test with ice at the NBL for this challenge so it would be rock only testing. But if we could, we would like a device that only minimally impacts ice. Scrapes are fine but significant damage (e.g. ice drill) is not.