National Aeronautics and Space Administration

PROPOSAL AND VIDEO GUIDELINES

Microgravity Neutral Buoyancy Experiment Design Teams (Micro-g NExT) Challenge

2024-2025

NASA STEM INSPIRE · ENGAGE · EDUCATE · EMPLOY
The Next Generation of Explorers

Title of Design
Design Challenge Addressed

Team Name
Optional Team Logo

Academic Institution Name
Address

Team Contact
Student Name
Email Address

Concept Video Pitch
Unlisted YouTube Video Link

Team Members
(Please list ALL team members. No more than two former Micro-g NExT team members per team. Identify former Micro-g NExT team members with an asterisk.)*

Team Member Name — Role
Email address — Academic year/Academic major

Team Member Name — Role
Email address — Academic year/Academic major

Team Member Name — Role
Email address — Academic year/Academic major

Team Member Name — Role
Email address — Academic year/Academic major

Faculty Advisor
Faculty Name
Email Address

_____
Faculty Advisor Signature

Contents

1. Introduction

Microgravity Neutral Buoyancy Experiment Design Teams (Micro-g NExT) challenges undergraduate students to design, build, and test a tool or device that addresses an authentic, current space exploration challenge. The overall experience includes hands-on engineering design, test operations, and public outreach. Teams will conduct test operations in the simulated microgravity environment of the NASA Johnson Space Center Neutral Buoyancy Laboratory (NBL). Teams will propose the design and prototyping of a tool or simulant identified by NASA engineers as necessary for space exploration missions. Professional NBL divers will test the tools, and students will direct the divers from the Test Conductor Room of the NBL facility. Micro-g NExT provides a unique opportunity for students to contribute to NASA's missions.

This document serves as a reference to assist potential Micro-g NExT participants with the requirements to submit a proposal. Included in this document are all required components of an official proposal. Please also review the eligibility requirements for Micro-g NExT at our website, https://go.nasa.gov/micrognext.

2. Eligibility

Each prospective Micro-g Neutral Buoyancy Experiment Design Teams (Micro-g NExT) team member must meet all the following requirements:

- Enrolled as an undergraduate student at an accredited U.S. institution of higher learning (junior college, community college, college, university) at the time you submit the proposal.
- 16 or older before arrival in Houston.
- U.S. citizen or legal permanent resident.

Additionally, each team must meet all the following requirements:

- Supervising faculty member from an accredited U.S. institution of higher learning.
- All primary team members must attend the orientation, preliminary design review, and test readiness review events.
- Primary team members may only participate with one team in the same challenge.
- Teams may not have more than two former Micro-g NExT team members per team.

Other Considerations:

- Teams can consist of multiple institutions collaborating on the same challenge.
- Team make-up should include an interdisciplinary aspect of any academic study area.
- Teams may receive support from university students of any level, faculty members, professional consultants, etc. However, only primary team members may participate in test week activities at NASA’s Johnson Space Center in Houston, Texas.
- During prototype test week, we will allow up to six primary team members and one faculty advisor to travel to JSC.
- One proposal per team.

3. Letter of Intent

Submit a letter of intent by Tuesday, October 8, 2024, indicating a team's intention to submit a written proposal. The **optional** letter of intent should follow the format below, and you should submit it as an email. Send the email directly to jsc-reducedgravity@nasa.gov. ***Teams may still submit a proposal even if they do not submit a letter of intent.***

The letter of intent should provide:

- Team Lead contact information — this should be a **student** team member.
    - Include: name, email, academic year, academic major
    - Sample: John Doe, JDoe123@instituiton.edi, Sophomore, Mechanical Engineering
- Academic institution your team represents. If your team is a multi-institutional team, list all participating institutions and designate a lead institution.
- 2025 Micro-g NExT challenge chosen.
- State: "Micro-g NExT Challenge Letter of Intent" in the subject line.

4. Concept Video Pitch

The following guidelines outline the type of content your concept video pitch should include. You must submit the video and link it on the cover page of the proposal for full selection consideration.

- Note: a working prototype **is not** required for this video.

a. Concept Requirements

The video can be as simple as an explanation on a dry erase board or the demonstration of a mock-up. Every video, however, must include/explain the following:

- Institution Name
- Team Name
- What is your idea/concept?
- How does it meet the requirements? (Please answer this with a brief sentence that is an overall summary.)
- How does your idea advance space exploration?

b. Format Requirements

- Needs to be 1 minute or less in duration.
- Must upload to YouTube as an **unlisted** setting so that only those with the specific URL may view the video.
    - Video title format: School Name_Team Name_2025 Micro-g NExT Concept Video
- Do not include any music, images, or videos that are copyrighted.

5. Written Proposal Tips

The following tips are from technical reviewers and will aid you in writing your proposal.

- Start your design description with an overview of your design and a visual of the entire assembly. Then, break it down into components and functionality. Explain all pertinent details to help reviewers better understand the design.
- Include technical drawings in an appendix and not in the main body of the proposal.
- Verify the CAD files you submit are the right file types. Send your CAD files in IGES or STP form.

- Use third person throughout the document. This is a best practice for all technical documents.
- An abstract is a summary of the entire document, not a summary of the challenge background or individual device components. Explain why this challenge exists and how your device is meeting that purpose and helping further spaceflight.

6. Proposal Requirements

- Each team must submit one electronic copy of an original proposal on the appropriate Micro-g NExT Challenge opening on the NASA STEM Gateway by **Tuesday, October 29, 2024**.
- You must submit each proposal in a three-section format containing the required sections in the following order: Technical, STEM Engagement, and Administrative.
- The Technical section shall not exceed 12 pages.
- All information on the title page must be complete.
- Figures and tables must be labeled and referenced within the text.

7. Technical Section

The technical section should include information on the design the team is proposing. Review points awarded to this section are worth 75% of the overall total score. Therefore, this section should include any information that a technical reviewer might find informative or instructive in understanding the aims and goals of the design. Evaluators ranking the proposal for its scientific merit will read only this section, so teams should be sure to address all relevant factors as listed below.

a. Abstract

The abstract should be a brief (up to 300 words) summary that touches upon the purpose of the challenge, the benefit to NASA and spaceflight, and a description of the prototype design you are proposing.

b. Design Description

This section should include a description of the design you are proposing, including the design and function of any mechanisms. Describe how the proposed design meets each of the challenge requirements by including a requirements compliance table explaining how you will meet each requirement. Be sure to include at least one of the following for your design: a sketch, drawing, model, or photo. All images/figures in the proposal should be numbered and include labels for the components in view. We prefer detailed images over long text descriptions. You should also submit a CAD file(s) in .stp or .iges format.

b.1 Manufacturing Plan

Describe the manufacturing plan to create the proposed design. The manufacturing plan should include a Bill of Materials with details about material selections and quantities, a manufacturing timeline, and a location where you will manufacture and assemble the parts.

c. Operations Plan

This section should include a detailed description of the test plan for the device in the NBL and any other testing facilities at NASA that are applicable to your challenge. Refer to the challenge description document for relevant facilities. List the steps of the test plan to highlight how you use the device and

how you will conduct the operation to show that your device meets challenge requirements. Include how the device should be configured before, during, and after testing.

d. Safety

This section should describe any safety features and considerations. Include any unique hazards your device creates. Explain how you will mitigate those hazards, including testing and analysis that you would perform to prove it is safe to use in the NBL.

The NBL will be responsible for facility-related hazards (e.g., drowning, barotrauma), so you do not need to address these in your proposal.

Focus on hazards that your device creates. You may include hazards from manufacturing/fabrication of the device if desired, but you must address hazards associated with operating the device once it is built. Some common hazards to consider are: pinch points, finger entrapment, sharp edges, structural/mechanical failure (consider what secondary hazards a mechanism/component failure could cause), stored energy, corrosion, and electrical issues.

d.1 Hazard Analysis Table

Include a Hazard Analysis (HA) table which outlines all identified hazards and their controls. Several approaches exist for creating HA tables. Any approach is acceptable as long as it is thorough and organized. We've provided an example below. Using a Risk Assessment Code matrix and identifying values for consequence and likelihood is optional.

Item Number	Hazard	Cause	Effect	Controls	Verification
1	Pinch Points	Improper design Improper user training Lack of hazard labels	Personnel injury Equipment damage	Hardware designed to minimize pinch points. Any pinch points that cannot be eliminated will be identified, addressed, labeled, and/or information relayed to the user.	QSAR (Quality/Safety Acceptance Review, to be done at the NBL by NASA personnel) document and documented in team TEDP and TRR. User training briefing will be completed prior to Micro-g NExT testing.
2, etc.					

e. Testing and Analysis

e.1 Functional Testing and Analysis

This section should describe testing and analysis that characterize the performance of the device. Describe any testing and analysis you have already done, including a brief procedure overview, results, and an interpretation of the results. Describe testing and analysis you plan to do in later stages of hardware development and how you will use these tests to verify that the device meets the challenge performance requirements.

e.2 Safety Testing and Analysis

This section should describe testing and analysis that proves the device meets the challenge safety requirements and is safe to use in the NBL. Describe testing and analysis you have already done, as well as testing and analysis you plan to do in later stages of hardware development. Examples of testing and analysis that you can use to prove your device is safe for the NBL include finite element analysis (with appropriate loading and load directions), physical load testing on components, tests of specific safety features to show effectiveness, etc.

e. Technical References

You should cite referenced works in the text and in the References section. You should use standard APA format or a similar format. Make sure that references are relevant, and at least half of the references should come from research journals or other academic sources (textbooks, etc.).

8. STEM Engagement Section

The STEM engagement section of the proposal will include the team's plan for disseminating the results of its experiment/experience to the general public. Review points awarded to this section are worth 25% of the overall score total. Information contained in this section should focus on what outreach activities the team intends to do and what audience you will address. The STEM engagement plans must be original to the team, and you should not post the proposal on any social media.

A plan is an organized way to achieve a specific objective. Random activities, even good random activities, do not constitute a plan. An outreach plan should have two major components:

- The plan — for example:
    - Description of the team's objectives and goals.
    - What activities are planned for the upcoming year?
    - Where and when will the activities take place?
    - What audience will be targeted?
- The activities — for example:
    - What will the team do when they get there?
    - What materials will they refer to?
    - What are the main points that they will make?

For maximum point value, the plan should include the following:

- The team's objectives in each outreach activity.
- A description of the outreach audience (K-12 class or school groups, undergraduate research symposiums, university outreach to local schools, informal groups such as Boy/Girl Scouts, after-school clubs, church groups, etc.).
- Specific plans for activities, strengthened by incorporating alignment of an activity to state or national standards that will help a K-12 teacher, or use of age/grade-appropriate language during the activity.

- Letters or agreements from institutions that have accepted your invitation to address their group.
- A press and/or social media plan.
- A connection between curriculum/activity and Micro-g NExT, the NBL, or the team's tool.

9. Administrative Section

The administrative section of the proposal contains a letter of support from the team's institution, a statement of involvement from a faculty advisor, evidence of a plan to acquire funding, etc. Although this section is not awarded a point value, exclusion of these materials will affect the team's overall ranking when compared to more complete submissions. Additional information will be required if selected.

a. Mentor Request

The Micro-g NExT staff pairs teams with a NASA engineer or scientist. Mentors augment the guidance provided by faculty members and the Micro-g NExT staff. If your team is currently collaborating on your project with a technical point of contact at NASA, please list the name in this section. However, this does not guarantee this individual will be offered an official role in the program.

b. Institutional Letter of Endorsement

This letter must be on the endorsing institution's letterhead and must come from the institution's president, dean of college, or department chair. It indicates that the team's institution has knowledge of the team's interest in participating in this activity and endorses the team's involvement. We will not consider teams if their institution does not approve of their involvement.

c. Statement of Supervising Faculty

A statement of support from a supervising faculty member indicates a willingness to supervise and work with the team during all stages of the activity. We will not consider teams working without a faculty advisor. The faculty advisor must also sign off on the cover of the proposal as evidence that he/she has seen the proposal and approves of the submission. The following statement should appear on institution letterhead and include the signature of the faculty advisor:

> As the faculty advisor for an experiment entitled "_____" proposed by a team of undergraduate students from_____ institution, I concur with the concepts and methods by which this project will be conducted. I will ensure that all reports and deadlines are completed by the student team members in a timely manner. I understand that any default by this team concerning any program requirements (including submission of final report materials) could adversely affect selection opportunities of future teams from their institution.

If your team is composed of students from more than one institution, submit the above from the lead institution. Additionally, supply a letter of support from a faculty member of each participating institution acknowledging they are aware of the participation of their student(s).

d. Statement of Rights of Use

These statements grant NASA, acting on behalf of the U.S. Government, rights to use the team's technical data and design concept, in part or in entirety, for government purposes. This statement is not required. However, teams with a Statement of Rights of Use will receive greater consideration in the proposal selection. If choosing to include these statements, **all team members and faculty advisors must sign**.

The statements read as follows:

> As a team member for a proposal entitled "_____" proposed by a team of undergraduate students from _____ institution, I will and hereby do grant the U.S. Government a royalty-free, nonexclusive, and irrevocable license to use, reproduce, distribute (including distribution by transmission) to the public, perform publicly, prepare derivative works, and display publicly, any data contained in this proposal in whole or in part and in any manner for Federal purposes, and to have or permit others to do so for Federal purposes only.
>
> As a team member for a proposal entitled "_____" proposed by a team of undergraduate students from_____ institution, I will and hereby do grant the U.S. Government a nonexclusive, nontransferable, irrevocable, paid-up license to practice or have practiced for or on behalf of the United States an invention described or made part of this proposal throughout the world.

e. Funding and Budget Statement

This section should include a simple columnar layout showing expected expenditures associated with the proposed design, such as materials, machining, operating, testing, shipping, etc. See Table 1 for an example. It is imperative that teams anticipate all costs involved and actively work to seek funding. List potential sources for funding, which can include institutional grants, state Space Grant funds, corporate sponsors, etc. Participants are responsible for **all costs** associated with their participation in the Micro-g NExT challenge, including but not limited to development, travel, lodging, and food. Micro-g NExT will notify participants if any funding or student allowances become available.

Table 1 Micro-g NExT Cost Example

Items	**Cost**
Materials and Supplies	
3D Filament	$85.00
Aluminum	$75.00
Pelican Case (29 x 18 x 11")	$422.00
Manufacturing Costs	
Machine Shop	$250.00
Travel	
Flights	$4,500.00
Hotel	$3,300.00
Ground Transportation	$500.00
Food	$800.00
Total	**$10,312.00**

f. Parental Consent Forms

The parental consent forms provide consent for general participation and you must submit them for any team member under the age of 18 that will be accompanying the team to Houston. Please email the Micro-g NExT Coordinators at jsc-reducedgravity@nasa.gov for a copy of this form if needed.

g. Logo Use

Please supply NASA with high-resolution logo files, preferably as .png, .jpg, .eps, or .ai, for your institution(s). Please submit both versions in which your school logo and name are displayed horizontally and a version in which the logo and name are stacked vertically. You may also provide a public-facing link to these files if they are publicly available.

10. Additional Requirements for Student Projects in the NBL

a. Tools

- All tools must be operable with extravehicular activity (EVA) gloved hands.
- Tools must not have holes or openings which would allow/cause entrapment of fingers.

b. Electrical Power Requirements

- Acceptable Power Sources:
    - 12VDC 25A power source supplied by the NBL.
    - Up to 30VDC or less marine-grade AGM sealed batteries for devices being submerged underwater.
    - Up to 30VDC ROV batteries for devices not submerged underwater.
- The interface connection will consist of positive and negative female banana plug connections (see below).

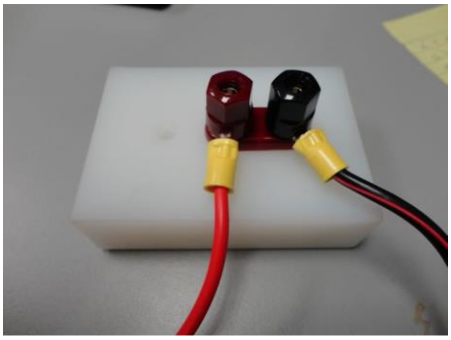

Figure 1: NBL Banana Plug Receptacle (electrical power)

Figure 2: Example Banana Plug Connectors

- Tool must incorporate a verifiable barrier to electric shock. A 25A fuse should be incorporated into the cable from the project to the power supply.
    - We highly recommend that the fuse be located near the power supply end of the cable.

        - Do not locate the fuse internal to your project. The proper fuse must be visually verified, or the project will not be allowed underwater.
    - Use adequate strain relief to help mitigate detachment of the umbilical (where it attaches to the vehicle). Ensure the strain relief does not interfere with the operation of the vehicle (e.g., block movement of a rudder).

c. Pneumatic Power Requirements

- Student projects will be allowed to connect to the NBL's compressed air system:
    - Pressure — 125 psig.
    - NBL Shop Air Connector details:
        - Grainger: Coupler Plug, M(NPT), Item #1HLZ8, Mfr. Model #A73440-BG.
            - Note: female P/N is 1HLZ9.
        - Quick Coupler Body, (F)NPT, Steel Item #1HUK7, Mfr. Model #A73410-BG.
        - JSC Engineering will supply the umbilicals.

d. Other Requirements

- Environmental Condition — NBL Pool Use:
    - A totally submerged condition in water that contains a range of 0.5 to 3.5 parts per million of free chlorine.
    - Ambient temperature range: +82°F (27.8°C) to +88°F (31.1°C).
    - Some of the projects may be tested on the pool floor at a depth of 40 feet.
- Acceptable Materials for use in the NBL:
    - Allowable materials: typical engineering metal alloys (e.g., stainless steel, aluminum, titanium), plastics, composites, or soft good materials are acceptable for short-term testing in the pool.
    - Allowable lubricants, coatings, foam, or adhesives are shown in Appendix A and Appendix B.
    - Other materials (e.g., gels) must be approved for use in the pool.
- Sharp Edges and Protrusions:
    - Due to the potential for personal injury to diving support personnel and damage to the EVA suit, the mockup components shall not contain sharp edges or be capable of cutting or puncturing items coming into contact with them.
    - Avoid, or protect the handler from, pinch points and/or sharp edges.
    - You should design the hardware to specify manufacturing to remove burrs, break all sharp edges, and round all corners.
- Water Entrapment:
    - You should design mockups and hardware with drain holes or geometry to allow the free flow of air and water as required to support submersion and removal to and from the NBL pool.
- Labels:
    - The hardware provided shall have labels as follows:
        - Mate/de-mate alignment marks, operation indicators, as required.

        - Caution and warning tags for hazard areas (e.g., pinch points, sharp edges, etc.).
        - Hardware identification.
        - We may request additional safety labels following the Test Readiness Review.
- Loads:
    - The hardware must withstand normal handling or kickloads and not present a safety hazard.

11. How to Apply: NASA STEM Gateway

You will submit your proposal on NASA STEM Gateway. Only one member of the team (preferably the team lead) will submit the proposal on behalf of the team. During this process, they will add all team members and faculty advisors by entering their name and email address. To apply, click on the respective link below for the challenge you would like to submit a proposal for.

- Contact Sampling Device
- Softgoods Attachment Device
- Scan, Acquire, Filter, Extract & Track Orion Capsule Search & Rescue Signals (SAFE-T)

12. Technical Scoring Rubric

Below is an example rubric that technical reviewers have used to score the submitted proposal.

Criteria	Points	Comments
Abstract		
Please rate the overall quality of the abstract.	/5	
Design Description		
Was the design explained well?	/5	
Is each requirement sufficiently addressed in the requirements compliance table? One point for each requirement addressed.	/15	
Please rate the effectiveness of the sketches/drawings in explaining the design. Are all images/figures numbered and labeled? (0 if not included)	/5	
What is the likelihood this design will succeed if selected?	/5	
Please rate the overall fidelity of the design.	/5	
Please rate the quality of the manufacturing plan. Is a Bill of Materials included? Is a manufacturing timeline included? Is a manufacturing and assembly location identified? (0 if not included)	/5	
Operations Plan		
Please rate the quality of the test plan.	/5	
Safety		
Are safety concerns fully addressed?	/5	
Does the Hazard Analysis sufficiently identify and control all hazards? (0 if not included)		
Was the **functional** testing and analysis plan explained well?	/5	
Was the **safety** testing and analysis plan explained well?		
Please describe any safety concerns.	N/A	(Open ended question)
Technical References		
Are technical references provided and complete?	/5	
General		
Please rate this proposal as a technical document. (In terms of format, professionalism, ease of reading, etc.)	/5	
Any other feedback for the students.	N/A	(Open ended question)

Appendix A: NBL Materials List

NBL Approved Foam Material List

Material Designation	Manufacturer
DOW Polystyrene Highload 60 Grade Blue Foam (64 lb/ft^3 buoyancy)	Ryder Insulation Corporation
Last-A-Foam (20 lb/ft^3 buoyancy)	General Plastics Manufacturing Corporation

NBL Approved Coatings Material List

Product	Suggested Vendors
Carboline 139 (Paint)	Carboline Company
Carbomastic 15M500 and 890	Carboline Company
Dupont 25P	Briggs Weaver
Ethone M-0-N (Marking Ink)	
Ethone M-5-N (Marking Ink)	
Ethone M-9-N (Marking Ink)	
Hi-Solids Catalyzed Epoxy	The Sherwin-Williams Company
NSP 120	NSP Specialty Products
Plasite 7122 (Paint)	Wisconsin Protective Coatings Corp.
UT Plast Super (non-epoxy)	UTP Welding Technology

NBL Approved Lubricants

Material Designation	Manufacturer
Braycote 601	Castrol Specialty Prod.
Braycote 602	Castrol Specialty Prod.
Braycote 803RP	Castrol Specialty Prod.
Christo-lube MCG-117	Lubrication Tech. Inc.
Halocarbon 25-10M	Halocarbon Corp.
Halocarbon 25-20M	Halocarbon Corp.
Halocarbon 25-5S	Halocarbon Corp.
Halocarbon 25-5SI	Halocarbon Corp.
Halocarbon 27S	Halocarbon Corp.
Halocarbon X90-10MS	Halocarbon Corp.
Krytox 280 AC	Dupont
Krytox 240 AC	Dupont
LOX-8	Fluoramics Inc.
Lubricant/Tef-Gel PTFE 9002-84-0	Utility Safety Systems Inc.
Mobil - 28	Mobile
SAF-T-EZE	SAF-T-EZE Div, STL Compound Corp
Tiolube 460 Dry Film Lubricant	Tiodize Co., Inc., Huntington Beach, CA
Tiodize Type II (Titanium Hard Coat)	Tiodize Co., Inc., Huntington Beach, CA

Tiodize Type IV (Tiodize Type I plus Tiolon X40 Teflon Coating)	Tiodize Co., Inc., Huntington Beach, CA

Appendix B: Previously Approved Materials

Acceptable Materials — Supplemental

a. Metal adhesive — Supreme 10HT from Masterbond
    i. Must be fully cured
b. Nylon — Prohibited from the standpoint of reliability for NBL hardware in terms of continuous or long-term submersion but should be acceptable for this application. We could have scrubbed this material from the "prohibited" list for the competition, but the prohibited part was strictly intended for the continuous use of NBL hardware used for EVA training.
c. Nitinol (Nickel Titanium) — approved
d. Loctite Epoxy Plastic Bonder — Can be used in the manufacture of their tool outside of the NBL, once it's cured, there shouldn't be any issue. If they want to use/apply it in the facility, then would need to go through the process for approval, make sure we have the correct safety PPE and precautions, etc.
e. The following are allowed into the NBL as long as they are fully dried and cured:
    i. Krylon Enamel Spray Paint (purchased at Lowes Home Improvement)
    ii. Painters Fine Tip Red Paint Pen (purchased from Walmart) (Oil Based)
    iii. JB Weld (purchased at Lowes Home Improvement)
    iv. Kingspan Insulation R10 Unfaced Polystyrene Foam Board Insulation (Purchased from Lowes Home Improvement)
f. FOAMULAR 150 Extruded Polystyrene Insulation manufactured by Owens Corning (Purchased from Home Depot)

Link: http://www.homedepot.com/p/Owens-Corning-FOAMULAR-150-2-in-x-4-ft-x-8-ft-R-10-Scored-Squared-Edge-Insulation-Sheathing-45W/100320352