



SSEP Mission 20 to ISS: Selected Flight Experiments, Communities, Teams, and Abstracts

Contact: Jeff Goldstein, SSEP National Program Director, 301-395-0770, jeffgoldstein@ncesse.org

A total of **41 proposals** were submitted from student teams across the 4 communities participating in Mission 20 to ISS. Of those **38 proposals** were forwarded for review by **Step 1 Review Boards** in each of the communities. Each Step 1 Review Board selected up to three finalist proposals, which were submitted to the **National SSEP Step 2 Review Board**. On March 31, 2025, the Step 2 Review Board met via Zoom, reviewed all **12 finalist proposals**, and selected one proposed experiment to fly for each of the 4 communities, for a total of **4 flight experiments, which will fly on SpaceX-35**. It is noteworthy that the 41 proposals received reflected a total of **158 grade 11-16 students fully engaged in experiment design**.

1. Alexander City, Alabama

Investigating the Effects of Microgravity on the Early Root Development Rate of Radishes

Grades 13-14, Central Alabama Community College

Co-Principal Investigators: Allie Scott, Benton Stegall, Noah White

Collaborators: Adlyne Benton, Gracie Deason

Teacher Facilitator: Jeremy Carr

Proposal Summary:

Our experiment aims to study the growth of radish seeds in microgravity and understand how space conditions affect plant development. By investigating changes in growth rates, this experiment will provide valuable insights into how microgravity influences plant biology. The findings are crucial for long-term space missions, where growing food in space is essential for sustainability. This study will also advance our knowledge to help us better understand plant adaptations in space contributing to the development of effective space agriculture strategies. Understanding how plants grow in space will help design better food production systems for astronauts on missions beyond earth and may also offer insights for improving agricultural practices on Earth in resource-limited environments. Our data will come from the root/shoot length and weight and will conclude if life in space under microgravity conditions can be beneficial or if growth is negatively impacted because of the environment.

2. Fort Morgan, Colorado

Effects of Zero Gravity on The Germination of Radishes in Hydrogel

Grade 14, Morgan Community College

Co-Principal Investigators: McKayla Cranford, Cierra Lebsock

Teacher Facilitators: Bill Miller, Steve Sjostedt

Proposal Summary:

The ability to grow plants in microgravity is critical for the sustainability of long-term space missions. This study examines the effects of zero gravity on the germination and early

development of radish (*Raphanus sativus*) seeds grown in a hydrogel medium. Radishes are selected for their fast growth cycle and potential as a space crop. The experiment aims to assess how microgravity influences germination rates, root orientation, and nutrient absorption compared to Earth-based controls. Radish seeds will be embedded in a hydrogel medium within the FME/mini lab. A hydrogel system will ensure consistent hydration without the complications of free-floating liquid. The experiment will be conducted in a microgravity environment aboard the International Space Station (ISS), with identical control experiments carried out on Earth. It is expected that radish seeds will germinate successfully in microgravity but exhibit altered root growth patterns and possibly delayed or inconsistent development. The findings of this research will contribute to understanding how plants adapt to space conditions, providing valuable insights for developing hydroponic and aeroponic cultivation systems in extraterrestrial environments. These results will play a key role in advancing space agriculture and supporting long-term human exploration beyond Earth.

3. Melbourne, Florida

Hydrogel Radiation-Shielding Viability Under the Influence of Microgravity

Grades 14-16, Florida Institute of Technology

Principal Investigator: Leighton Karpinia

Investigators: Leyla Avant, Sampada Koirala

Collaborators: Emily Matheson, Caroline Moore

Teacher Facilitator: Dr. Andrew Palmer

Proposal Summary:

This proposal aims to study polyvinyl alcohol (PVA) hydrogels' structural stability and radioprotective properties in microgravity. The study aims to test whether microgravity-induced aggregation affects the integrity of hydrogel networks, which could affect their ability to diffuse radiation effectively. A dehydrated hydrogel sample will be sent to space along with a separate water reservoir. Upon reaching microgravity, the water will be introduced to allow the hydrogel to swell and form its intended structure. Since hydrogels are colloidal suspensions stabilized by hydrogen bonding and polar interactions, microgravity could disrupt these forces, causing polymer aggregation. If aggregation occurs, the hydrogel's ability to function as an effective radiation shield may be diminished due to uneven polymer distribution. Once the experiment concludes, the samples will be returned to Earth for analysis. Structural integrity will be evaluated through dynamic light scattering, electron microscopy, and mechanical tensile testing. Hydrogels, known for their highly absorbent and flexible 3D polymer networks, have gained interest in biomedical and space applications, including drug delivery, tissue engineering, and radiation shielding. This study will help us understand how the amount of water in a hydrogel and its materials affect its ability to block radiation. The results could lead to better hydrogel materials for protecting astronauts from space radiation and making special dressings that shield patients during cancer treatments.

4. Knoxville, Tennessee

The Effects of Space Travel on Seed Germination and Plant Stress Responses

Grades 15-16, University of Tennessee

Co-Principal Investigators: Nathan Tucker, Devin Vitello

Teacher Facilitator: Dr. Kellie Walters

Proposal Summary:

When seeds are exposed to the conditions of space travel, the stress this exerts on them is enough to affect their viability to germinate and health once sprouted. To successfully transport seeds to new planets or on extended space missions, researchers must understand the risks and develop strategies to mitigate potential damage. This project aims to determine if there is a type of seed commonly brought into space that is the least susceptible to the damage caused by space travel. Ten species of seeds, (lettuce, kale, arugula, spinach, broccoli, pac choi,

tomatoes, basil, chili peppers, *Arabidopsis*) will be exposed to simulated radiation and microgravity. There will be two groups of seeds that experience these conditions individually, a group that experiences both, and a control group experiencing neither. After treatment, researchers will germinate seeds and measure their morphological characteristics and germination rate. Seedlings will then be snapfrozen. Half will be measured for reactive oxygen species to determine plant stress, and the rest will be analyzed by SDS-PAGE to determine the change in gene expression. For the second trial, five seed groups will be sent to space on the ISS, and the simulated treatment back on earth will be repeated to better match the conditions and duration of exposure to the ISS trial. This experiment will provide better information about the types of seeds that are best suited for space travel and hopefully identify the seeds that will need extra protection during missions.

The Student Spaceflight Experiments Program (SSEP) is a program of the National Center for Earth and Space Science Education (NCE SSE) in the U.S. and the Arthur C. Clarke Institute for Space Education internationally. It is enabled through a strategic partnership with Nanoracks, LLC, which is working with NASA under a Space Act Agreement as part of the utilization of the International Space Station as a National Laboratory. SSEP is the first pre- college STEM education program that is both a U.S. national initiative and implemented as an on-orbit commercial space venture.

The Center for the Advancement of Science in Space (CASIS) is a U.S. National Partner on the Student Spaceflight Experiments Program.