



SSEP Flight Experiment Proposal Guide SSEP Missions to the International Space Station Background for Student Proposers

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1. Introduction

The Student Spaceflight Experiments Program (SSEP) was designed to be an authentic research program for students. We wanted to let students take ownership in a real science investigation of their own design, and to truly be given the opportunity to slip on the shoes of real scientists. We also wanted to do it in a way that generated excitement for not just students, but for their teachers, parents, and entire community. What better way than to provide students the opportunity to design and propose real microgravity experiments, with one selected from your community to launch to the International Space Station (ISS) and be conducted by an astronaut?

SSEP is about providing a window on the real process of science, and hopefully inspiring many of the participating students to consider becoming part of the next generation of scientists and engineers.

For a student team participating in the SSEP, the opportunity boils down to some very specific tasks—

- *Background Research*: gaining an understanding of the kinds of science experiments that can be conducted in microgravity;
- *Knowing Your Equipment*: gaining an understanding of the operation of the mini-lab in which student experiments will fly, and the constraints imposed by its operation in space, and flight operations to and from orbit;
- *Critical Thinking*: posing a good scientific question, and developing a hypothesis that can be tested with an experiment in orbit;
- *Experiment Design*: creatively designing an experiment, procedures for how it is to be conducted, and what analysis will be performed once it is returned to Earth, in order to address the initial scientific question you posed;
- *Submitting a Proposal like a Real Scientist*: writing a 5-page proposal that effectively communicates the science you are proposing to conduct in orbit, and submitting the proposal to a real proposal review board;

And if your experiment flies (if your proposal is accepted as the winning proposal for your community)—

- *Conducting the Experiment:* testing and optimizing your experiment before flight; assembling the mini-lab(s) for your ground truth experiment(s) and the flight mini-lab that will fly aboard the International Space Station; preparing your experiment samples (fluids and/or solids) in the exact concentrations and volumes that have been approved by NCESSSE; placing the samples inside the experiment mini-labs; shipping the flight mini-lab to Houston for payload integration; conducting your ground truth experiment(s) at the same time the astronauts are conducting your flight experiment; and harvesting your experiment samples from the mini-labs after the flight mini-lab returns to Earth;
- *Data Analysis:* analyzing your samples from both flight and ground mini-labs and comparing the results. This allows you to compare the results of the experiment conducted in microgravity to that conducted in the normal gravity environment on the surface of Earth;
- *Data Interpretation and Reporting of Results:* based on the experimental analysis, seeing if you can reach some conclusion to the scientific question you originally posed, and writing a paper as specified by your teachers, and/or presenting at the SSEP National Conference in Washington, DC;

And if your experiment doesn't fly—

- *Conducting your ground truth experiment:* you can still conduct your experiment on the ground and report on your experiment design, data analysis, and results, as well as hypothesize what you might have seen in microgravity and why, at your science fair or some other venue that your community makes available. In fact, you and your team are still invited to the SSEP National Conference in Washington, DC, where you can present your experiment design and ground truth results.

This program is truly designed to let students *BE* scientists.

2. Requirements for Your Student Team:

Here are the basic requirements for submitting a proposal:

- a. *A Teacher Facilitator:* There must be a teacher serving as a “Teacher Facilitator” for each submitting student team. It’s fine for a single educator to be the facilitator for multiple student teams.
- b. *Team Members:* It is possible that the students on a team have different levels of responsibility. This is often the case for a professional science research team.

You can choose to identify up to 3 levels of student participation:

- *Co-Principal Investigators*—students that are taking a leadership role in designing the experiment, or are involved in all aspects of designing the experiment,

- *Co-Investigators*—students whose job is to address important specific aspects of the experiment, and
- *Collaborators*—students with a supporting role on the team, providing either resources or expertise as needed.

There is always at least one Co-Principal Investigator (if just one, then designated the Principal Investigator) who provides the leadership for the team. However, if all students on the team reflect equally shared responsibilities, then it is appropriate to designate all team members as Co-Principal Investigators.

You will be identifying your team structure on the Student Team Members Page. The template for this page is part of the SSEP Proposal Guide.

- c. *Responsibilities:* The experiment is to be designed, and the proposal written, by the student team and not by the Teacher Facilitator, another teacher, parent, researcher, or other adult, so that the experiment is student-designed and student-proposed.

However, we recognize that the student team will need lots of help with their thinking from the team’s Teacher Facilitator, other teachers, and both local area and national researchers. This is not only encouraged but is really important if students are to get the needed guidance on the process of scientific inquiry, experimental design, how to do background research in relevant science disciplines, and on writing the proposal. In fact, we strongly urge each student team to contact local and national professional scientists and have them act as science advisors on the proposal. These researchers can provide invaluable guidance to the team in all areas of experiment design, such as: quickly identifying weaknesses and possible solutions with an initial experiment design, long before proposal writing begins; helping the team obtain samples (fluids and solids) for the experiment, which might not be available to schools but are available to universities and research facilities; guiding the development of appropriate analysis methods for the returned samples; and making available sophisticated laboratory equipment for analysis.

Regarding writing the proposal, a student team might consider a single writer, with content provided from across the team, so there is a common voice and writing style. The Teacher Facilitator, and any science advisors, can serve as editors but **not** as writers.

3. Evaluation of the Proposal:

Proposals will undergo a 2-step proposal review process. All proposals received from across your community will be first reviewed by a local Step 1 Review Board, which is convened by your community. The Step 1 Review Board, consisting of teachers and professional researchers in your local area, will select 3 finalist proposals to be sent to the National Center for Earth and Space Science Education. We will then convene a Step 2 Review Board that will meet at the Smithsonian in Washington, DC, to select the flight experiment for your community, as well as the flight experiment for each of the other participating communities.

Both Review Boards will use the same proposal evaluation criteria. As is the case with real science proposals submitted by scientists, proposals need to be evaluated on a point system. The proposal with the highest number of points wins the competition.

Proposals submitted to SSEP will be evaluated in three areas with the total possible number of points equal to 100.*

Area of Evaluation	Number of Points
a. Question to be Addressed by the Experiment	25
b. Experiment Design	50
c. Communication Skills	25

TOTAL POSSIBLE: 100

All reviewers are provided a formal list of objectives that should be met in each of the 3 areas of evaluation, so they can assign points. This list is what is called the “evaluation criteria”. If you would like to see the formal evaluation criteria, your teacher should have a copy. If your teacher does not, have them contact your community’s SSEP Community Program Director who can guide them to the document where the formal evaluation criteria is found – the “Flight Experiment Proposal Guide: Background for Teachers” document in the Document Library.

After the Step 2 Review Board has completed their review, all 3 finalist student teams in your community will receive written feedback on their proposals. The review comments are meant to provide the Board’s view of how well the proposal delivered against the formal evaluation criteria. The Board spends a lot of time providing thoughtful feedback for each proposal, far more than is typical of Boards reviewing professional research proposals. This is an important part of the SSEP, since the feedback is a teachable moment which allows student teams to reflect on their proposal, assess how well they addressed the review criteria, and take note of what is expected as part of a formal research proposal submission and review. This is science as it is truly conducted by the professional research community.

Note that a professional research team will learn from the feedback from the Review Board, and likely resubmit an improved proposal for the next announcement of opportunity. We have in fact had cases where a SSEP student team did not get their experiment selected for flight, but their community participated in the next SSEP flight opportunity. The same team then resubmitted an improved proposal based on the Review Board feedback, and did get selected as the flight experiment the second time.

*Note - because the point scores are only used by the Review Board to help in the selection of the winning proposal, the actual point scores are not provided to the student teams after the review.