Systems Engineering Education Discovery Program: NASA Utilization of Undergraduates to Conduct Reduced Gravity Flight Research

Sara W. Malloy, *Johnson Space Center*

Fig. 1. *Student teams conduct research during a reduced-gravity flight.*

Each year, teams of undergraduate students from across the country converge at NASA's Johnson Space Center (JSC) for the unique opportunity to conduct scientific research in a reduced gravity environment. As participants of the Reduced Gravity Education Flight Program, these teams spend approximately 4 to 6 months prior to their arrival at JSC designing and testing their experiments at their home institutions. Once they arrive for their flight week, they undergo physiological training, hardware inspections, and flight-readiness orientations before they are allowed to accompany their experiments onboard a modified Boeing 727 aircraft. During flight, the students conduct their experiments and gather data while the aircraft completes 30 parabolic maneuvers over the Gulf of Mexico. Each parabolic pattern provides roughly 18 to 25 seconds of microgravity (figures 1 and 2).

This innovative program has had a clear impact on student participants. By supplementing traditional undergraduate coursework with an exciting field experience, the Reduced Gravity Education Flight Program exposes students to real-world applications, research experience, and career possibilities. Consequently, student participants have reported a renewed passion for the study of science and technology, an enhanced dedication to pursuing a career in science and technology, and a stronger motivation to acquire an advanced degree.

In 2008, program managers for the Reduced Gravity Education Flight Program recognized the potential to expand this innovative program beyond a student outreach opportunity and partnered with the Systems Engineering Education Discovery (SEED) Program to make this happen. Unlike the original undergraduate student program in which student teams devise a research project of their own choosing, the SEED Program pairs student teams with a NASA engineer to work on a research topic of immediate relevance to NASA. The NASA engineer acts as the research lead and mentor, guiding the students remotely until they arrive at JSC for their flight week. This program's design continues to provide all of the benefits to student participants of the original undergraduate student program, while advancing NASA's mission and goals through the completion of needed research. In 2010, the SEED Program received applications from 23 institutions and ultimately selected 13 student teams to collaborate with a NASA engineer on a research project. Because the focus of SEED is on increasing student awareness and competencies in systems engineering, all research projects were selected based on their efficacy in teaching systems engineering concepts. Examples of assigned research

Systems Engineering Education Discovery Program: NASA Utilization of Undergraduates to Conduct Reduced Gravity Flight Research

continued

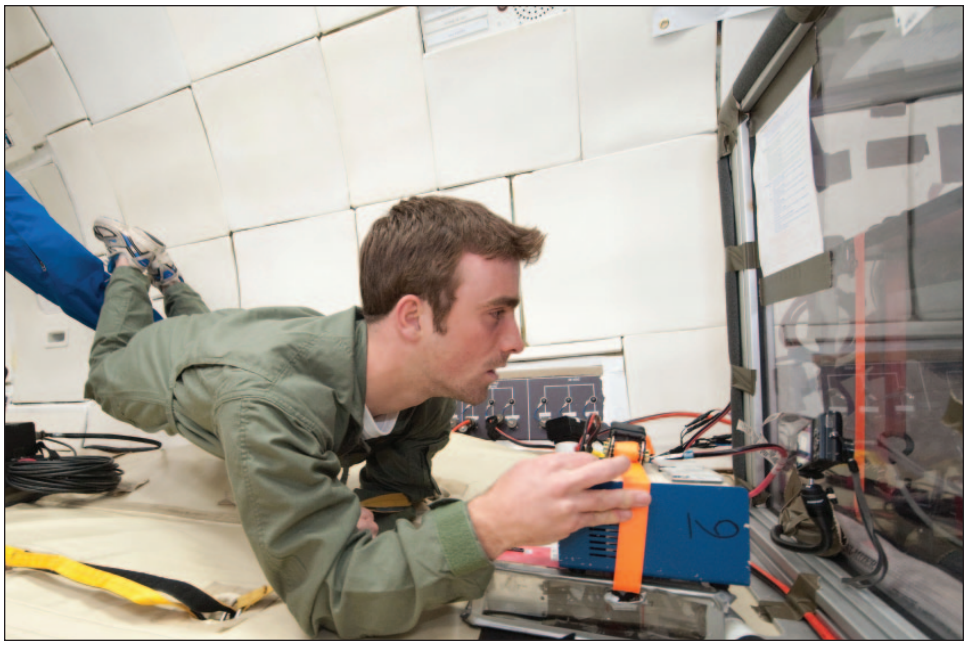

Fig. 2. *A student conducts research during a reduced-gravity flight.*

topics included: measuring the dielectric properties of lunar regolith; dynamic wheel traction concepts in lunar gravity; investigation of propellant sloshing and zero-gravity equilibrium for the Orion Service Module propellant tanks; and Human Research Program subjects such as a bubble-free injection syringe and effective sharps containment in space environments.

Regarding the success of the SEED Program and its contribution to NASA research, one former NASA SEED project lead/mentor stated: "It took some effort to start, since we had to bring [the students] up to speed about the project, but they have understood the application well and have taken it farther than what we expected. We are very impressed with some of the ideas that the students have conceived. In fact, they are most likely going to get us more data than what we anticipated in the beginning. We are grateful that we will be able to collect data for our project in microgravity. The fact that we will have experimental data collected in microgravity will strengthen our argument and validate our design."