

Adventures in microgravity: Students experiment in simulated space-flight conditions

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ASU Dust Devil research team members (left to right) Pye Pye Zaw, Emily McBryan and Dani Hoots hold on during a flight of a modified jet that simulates space flight by creating low-gravity conditions. The team participated in a NASA flight program that provided students opportunities to perform scientific experiments requiring “microgravity” conditions. Photo by: Courtesy of NASA

Six Arizona State University students spent a week in June conducting airborne research in low gravity under the guidance of scientists and engineers at the National Aeronautics and Space Administration’s Johnson Space Center in Houston.

They're members of the ASU [Dust Devils](#), one of 14 teams of students from universities throughout the United States selected from among more than 60 teams that applied to do experiments as part of NASA's Reduced Gravity Educational Flight Program.

Each of the teams' projects required performing experiments in low gravity – or “microgravity” – conditions. The work was done during flights in a modified Boeing 727-200 jet used to train astronauts that is capable of creating microgravity conditions. The aircraft is sometimes called the Weightless Wonder.

Microgravity is the extremely weak gravitational force that is experienced, for example, by people in a spacecraft orbiting the Earth, enabling them to become virtually weightless and to float inside a spacecraft.

Students from the University of Southern California, Yale University, Purdue University, the Massachusetts Institute of Technology, Virginia Polytechnic University and the University of Washington were on some of the other teams conducting the microgravity research.

From dust to solar systems

In flights over the Gulf of Mexico, the Dust Devils were looking at dust electrification and coagulation – how dust particles clump together and bond in [low-gravity](#) environments.

Understanding the ways in which dust particles stick together could be important in revealing the fundamental process that allows solar systems and planets to form, says Dust Devils member Amy Kaczmarowski, who graduated in the spring with a degree in aerospace engineering from ASU's Ira A. Fulton Schools of Engineering.

The team varied the size and composition of dust particles placed inside 12 vacuum chambers containing different combinations of particles of three materials – silica, aluminum and a material believed to be similar to dust on the surface of Mars.

The idea was to examine how varying the size and composition of the particles would affect clumping.

Kaczmarowski carried out experiments with Dust Devil teammates Emily McBryan, a senior aerospace engineering major, Danielle Hoots, a history and anthropology major, team leader and senior Pye Pye Zaw and junior Jacob Higgins, both studying in ASU's School of Earth and Space Exploration, and junior accounting major Craig Hoots.

As microgravity was achieved on the jet, each vacuum chamber was shaken to unsettle the dust it contained. Cameras monitoring activity in the chambers then recorded the behavior of the dust. Some experiments required multiple flights to complete.

It took some self-discipline for team members to keep focused on the experiment amid the excitement of experiencing microgravity.

“It was an absolutely incredible feeling to be floating,” Kaczmarowski says. “It was difficult to keep steady. I was having a lot of fun,” she says.

Soliciting mission support

The team was able to make the trip to Houston by writing an experiment proposal that earned a grant from the NASA Space Grant program, which supports students studying areas of science, engineering and math with applications to space-exploration endeavors.

Another proposal got the students equipment and additional funding

from Kip Hodges, director of the School of Earth and Space Exploration. The team raised more funds for research equipment and travel expenses from family and friends, and from private donors who contributed in response to local news media reports about the Dust Devils' project.

School of Earth and Space Exploration faculty members Steve Desch, Chris Groppi and Srikanth Saripalli assisted the students.

Associate professor Desch helped design the experiment and provided background on the experiment's implications for understanding solar-system formation.

Assistant professor Groppi advised them on engineering aspects of the project, including design of research instruments, and on writing of the research proposal and the project budget. Professor Saripalli supplied some computers and computer software.

Learning the art of experimentation

Besides performing experiments, the Dust Devils toured the Johnson Space Center, during which they got a look at a replica of the Space Shuttle Explorer.

“We learned a lot from this experience, from better ways of designing future experiments to make them easier to handle and work with, to learning how to work with different types of people.” Kaczmarowski says.

“We learned a lot about all that it takes to make a scientific experiment. Specifically, we learned how to try to find a compromise between the cost and the engineering feasibility and the scientific objectives. We also learned a lot about vacuum systems and how finicky they can be. It really

is an art form,” she says.

“We know we were successful in creating the vacuum system, moving the dust, and collecting images during the flight,” Kaczmarowski says.

Now Danielle Hoots will spend the summer performing the bulk of the analysis of the data collected during the Dust Devils’ experiments.

The team is expected to issue a final report to NASA later this summer on the results of the experiment. The report will analyze the experiment’s effectiveness and scientific findings.

Team leader Zaw will be looking at opportunities to obtain future support from the NASA Space Grant program and working to recruit new Dust Devils members to help carry on the team’s work next year.

Provided by Arizona State University

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