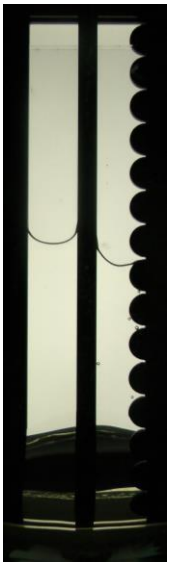
International Space Station Design Challenge

CELERE

Capillary Effects on Liquids Exploratory Research Experiments

WHAT? The curiosity-driven design challenge is an educational program of NASA's Glenn Research Center enabling students to participate in microgravity research on capillary action related to that conducted on the International Space Station (ISS). Students create their own experiments using Computer Aided Design (CAD) with a provided template and tutorial for the freely downloaded version of the *LibreCAD* software. Experiment proposals, which each consist of a single CAD drawing and short entry form, are emailed to NASA. The test cells are then manufactured using the drawings and a computer-controlled laser cutter at no cost to the students. Each experiment is conducted in GRC's drop tower, in which it falls 79 feet and experiences 2.2 seconds of apparent near weightlessness, i.e., microgravity. Video and still images from each drop are provided online for student analysis and the reporting of results, for example in a science fair or class presentation. The image below shows an example experiment (from Columbus, Georgia) during the middle of the drop, where the oil's upward motion is clearly slowed by the scalloped wall in the right channel. The student submitted their analysis reports back to NASA for prize selection and possibly getting the chance to attend a conference.

WHO? The design challenge is for students in grades 8-12, who may participate as individuals or in teams of any size. Teams may include younger students as long as there is at least one team member in grades 812, where this can facilitate the participation of 4-H clubs, Scout troops, etc. The program is limited to students from the United States. It is open to all fifty states, the District of Columbia, Puerto Rico, American Samoa, Guam, the Northern Mariana Islands, and the U.S. Virgin Islands. Students in other countries – even if U.S. citizens - are ineligible, with the exception of those attending DODEA schools for the children of U.S. military personnel. Youth are free to get help from adults, for example in creating their CAD drawing.



WHEN? Proposals must be submitted to celere@lists.nasa.gov by TBD where it is expected that the selected experiments will be conducted during that month. Written reports on the results are due to celere@lists.nasa.gov by TBD. Some participants will be invited to present their results at a technical conference on date.

WHERE? Students participate remotely. But they can interact with NASA by e-mail or teleconferencing. However, some participants will be invited to present on their results at a technical meeting in TBD.

WHY? The design challenge enables students to learn about computer technology and participate in research related to space station science, both of which can inspire the pursuit of STEM careers. Boy Scouts could potentially use the CAD drawing toward completion of the *LibreCAD* design badge. And selection in a nation-wide NASA design challenge is an accomplishment worth noting on college applications!

CONFERENCE? Some CELERE participants - selected based on their experiment design, data analysis, and written report - will be invited to present their results in a student poster session at the next meeting of the American Society for Gravitational and Space Research (ASGSR). It is expected that financial support will be provided to help invited students travel to Denver so that they can present their results.

COST? There is no cost to participate in CELERE other than the optional conference travel.

CAPILLARY ACTION? Capillary action occurs when liquid molecules are more attracted to a surface than to each other. In paper towels, the water molecules move along tiny fibers. In plants (like celery), the water moves upward through narrow tubes called capillaries. Capillary action occurs on Earth but can be difficult to observe - except with small capillaries - because of gravity. But when experiments fall in a drop tower, capillary effects are easy to see and study!

DROP TOWER

In NASA's Drop Tower, your experiment will be dropped down a tall shaft and while it is falling, it will behave as if there is nearly no gravity – of course neglecting the fall! Gravity will still be present, but our sensation of gravity and weight comes from a resistance to its pull, for example because of the floor holding us up. But while freely falling, we feel weightless and that is the basis for many amusement park rides. This works because of the surprising situation where all objects fall at the same acceleration unless acted upon by another force. As one result, the astronauts and the International Space Station fall together (around the Earth) such that the astronauts float within the space station. This happens even though the space station is so close to the Earth that gravity there (in a low-Earth orbit) is only about 10% less than that on the planet's surface. While this is space science, the concept of apparent near weightlessness through free fall, i.e., microgravity, was put to practical use in the late 1700s when shot towers were first built to produce superior shot for hunting. In those towers, droplets of liquid lead became spherical because of the surface tension resulting from the liquid's attraction to itself. You can learn more about microgravity at:

http://www.nasa.gov/centers/glenn/shuttlestation/station/microgex.html
http://www.nasa.gov/audience/foreducators/microgravity/home/index.html

GLENN RESEARCH CENTER (GRC)

A hub for ingenuity and innovation, the Glenn Research Center, located in Cleveland Ohio, designs and develops innovative technologies that advance NASA's missions. The GRC has world class facilities on their two campuses including wind tunnels, drop towers, vacuum chambers, a research aircraft hangar and facilities that simulate various space environments. A highly skilled workforce of over 3,000 scientists, engineers, technicians, administrative and support staff work on researching and testing new technologies in six areas of expertise.

- Aircraft Propulsion
- Communications Technology and Development
- Space Propulsion and Cryogenic Fluids Management
- Power, Energy Storage, and Conversion
- Materials and Structures for Extreme Environments
- Physical Sciences and Biomedical Technologies

Now you can design your own microgravity experiment and investigate capillary action just like GRC Researchers and the astronauts. Begin by visiting the CELERE web site at CELERE - ISS Research Design Challenge | Glenn Research Center | NASA and reading the handbook and tutorial.

QUESTIONS? See the website* or e-mail the challenge staff at celere@lists.nasa.gov.