International Space Station
Design Challenge

CELERE

Capillary Effects on Liquids Exploratory Research Experiments

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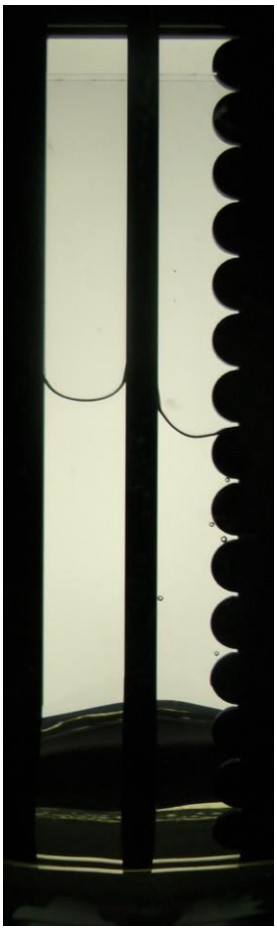
WHAT? The design challenge is a joint educational program of NASA and Portland State University (PSU) enabling students to participate in microgravity research on capillary action related to that conducted on the International Space Station (ISS). Students create their own experiments using Computer-Aided Design (CAD) with a provided template and tutorial for *DraftSight* software, which can be downloaded for free. Experiment proposals, which each consist of a single CAD drawing and short entry form, are e-mailed to NASA. The test cells are then manufactured by PSU using the drawings and a computer-controlled laser cutter. Each experiment is conducted in PSU's Dryden Drop Tower, in which it falls 22 meters (73 feet) and experiences 2.1 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 channel wall (in the right channel).



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 8-12, where this can facilitate the participation of informal science clubs, Scouts, etc. The program is limited to students from the United States, but is open to all fifty states, the District of Columbia, Puerto Rico, American Samoa, Guam, the Northern Mariana Islands, the U.S. Virgin Islands, and all DODEA schools for the children of U.S. military personnel (i.e., schools of the U.S. Department of Defense Education Activity). Citizenship is not required. 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 March 1 (*where there is only a single 2017 deadline in contrast to past years*). It is expected that selected experiments will be conducted during that month. Participants are also invited to present their results on Oct. 28 at a conference in Seattle; see the next page.

WHERE? Students participate remotely, without travelling to PSU or NASA. But they can interact with NASA by e-mail, teleconferencing, or video conferencing.

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 use the CAD drawing toward completion of the *Drafting* merit badge. And selection in a nation-wide NASA design challenge is an accomplishment worth noting on college applications!

CONFERENCE? CELERE participants are invited to present their results in a student poster session at the 2017 meeting of the American Society for Gravitational and Space Research (ASGSR, www.asgsr.org) on Sat., Oct. 28. Limited financial support will be available for non-local teams to travel to Seattle for this purpose.

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? When an experiment falls down PSU's Dryden Drop Tower (shown on the left), it behaves as if gravity has nearly vanished – of course neglecting the fall! Our sensation of gravity and weight comes from a resistance to its pull, for example because of the floor holding us up. While freely falling, we feel weightless and that is the basis for many amusement park rides. This works because all objects fall at the same acceleration unless acted upon by another force. As one result, the astronauts and the ISS 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 the gravity is only about 10% less than that on the planet's surface.

PSU? Prof. Mark Weislogel of the Portland State University (PSU) is a world leader in the study of capillary action and with NASA support has had such experiments conducted in drop towers and on the space shuttle, Russia's *Mir* space station, and the International Space Station (ISS). His ISS research has included both the Capillary Channel Flow (CCF) experiment and Capillary Flow Experiment (CFE), depicted below with astronaut Sunita Williams. Weislogel was also the lead developer of the ISS's Capillary Beverage (space) cups.

SELECTION? While it may not hold for 2017, thus far 100% of the proposals received have been selected for fabrication and testing because of the limited number of entries. So the odds of selection are quite high!

QUESTIONS? See http://spaceflightsystems.grc.nasa.gov/CELERE/ or e-mail celere@lists.nasa.gov.