2019 DROP TOWER CHALLENGE
Plant Watering in Microgravity

WHY? Future long-duration space missions will require crew members to grow their own food, so, understanding how to water plants in microgravity is an important step toward that goal – and for understanding how plants behave in such an environment. A key factor in this design challenge is that plant roots need both water and air for the plant to grow and delivering sufficient quantities of both water and air in the apparent absence of gravity is challenging because water and air don't mix well together.

WHAT? Teams of grade 9-12 students are challenged to design and build an object or flow channel that will allow air to penetrate towards the bottom on at least one side (hydrophobic surface) while liquid climbs along a different side (hydrophilic surface) during the microgravity free fall in NASA's 2.2 Second Drop Tower. This can be achieved via geometry (i.e. ice cream cone shape), coatings or a combination of geometries that take advantage or shapes and/or coatings.

- The challenge begins as each team prepares their proposal (short entry form with conceptual drawing(s)) and e-mails it to Ed-DropTower@lists.nasa.gov.
- If selected for testing, the team builds their unique test objects based on information provided on the challenge website.
- The objects are then sent to NASA where they will be put in vessels of water and dropped 24 meters (79 feet). During the fall, the objects and water will experience 2.2 seconds of apparent near-weightlessness, i.e., microgravity.
- Video results are then provided for student analysis and the preparation of a written report that is submitted to NASA.

- Student teams will be evaluated on both their report and success with the challenge. NASA will then invite the top-performing teams to present their results in a student poster session at the 2019 meeting of the American Society for Gravitational and Space Research (ASGSR).

For an introduction to the research to enable farming in space, check out these videos:
www.youtube.com/watch?v=y9aR2-7sOjg
www.youtube.com/watch?v=M7LslyCX7Jg
Meanwhile, educator resources with relevant classroom activities can be found at:
www.nasa.gov/audience/foreducators/spacelife/topics/plants/index.html
A social-media option for following the ongoing research includes:
www.facebook.com/spacebiology.
A researcher's Guide to Plant Science on ISS:
https://www.nasa.gov/sites/default/files/atoms/files/np-2016-06-016-jsc_plant_research_mini_book508c.pdf

WHO? The design challenge is for students in grades 9-12, where teams will be favored over individuals in selection. The program is limited to students from the United States, but citizenship is not required. It 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. Students are free to get help from adults, for example in building their experiment hardware. An organization (e.g., school, science center, 4-H club, Scout troop) may submit no more than five proposals, where it is envisioned that no more than two will be selected from a single organization.

WHERE? NASA anticipates selecting the top performing teams to attend the fall 2019 ASGSR conference (for which the location and dates have yet to be announced) and with a possible addition of 1-2 additional teams local to the conference (i.e. less than 150 miles). The microgravity tests will be conducted in the 2.2 Second Drop Tower at the NASA Glenn Research Center in Cleveland, Ohio. Research participation is remote, and teams will interact with the NASA staff by e-mail.

WHEN? Proposals are due by November 20, 2018 and can be submitted any time before that deadline. Team selections will be announced by mid-December. The team-built test objects should be sent to NASA when ready but must arrive at NASA by no later than February 15, 2019. The objects will be tested in the Drop Tower in February and March, where the video results will be provided to the teams following the testing. The student analysis of the results will form the basis for a written report that is due to NASA by May 1. In mid-May, NASA will announce the challenge winners and invite them to present a poster on their research at the ASGSR's fall 2019 conference. Receipt of proposals and team-built objects will be acknowledged by email.

CONFERENCE? The top-performing teams will be invited to prepare and present a poster about their research in a student session during the 2019 meeting of the American Society for Gravitational and Space Research (ASGSR). The conference location and dates have yet to be announced, but the student session will be on a Saturday, presumably in October or November. Awards will be presented to teams on that day for both challenge success and the poster presentations. ASGSR is expected to provide limited travel support to the invited non-local teams who present their results at the meeting.

DROP TOWER? While falling down NASA's 2.2 Second Drop Tower an experiment behaves as if gravity has nearly vanished! Our sensation of gravity and weight comes from a resistance to its pull, for example because of the floor preventing us from falling. If we are freely falling (e.g. after jumping off a diving board), we feel weightless, and free-fall is the basis for many amusement park rides. This occurs 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 at the Earth's surface.

QUESTIONS? E-mail the challenge staff at Ed-DropTower@lists.nasa.gov.