



Tropi

Studying Plant Growth in Space

NASA scientists will send seeds into space to better understand how and why plants grow differently in microgravity. In addition to carrying a third connecting-module, called Tranquility, and a seven-windowed control room for robotics to the International Space Station, STS-130 space shuttle Endeavour and its crew will deliver the Tropi experiment to space. After running two six-day experiments studying the early stages of plant growth, Tropi will return to Earth in STS-131 space shuttle Discovery. Scientists will use data from these experiments to better understand how light and gravity affect plant growth. Future astronauts may be able to grow plants as part of life support systems on long-duration space missions to the moon or Mars.

Mission Overview

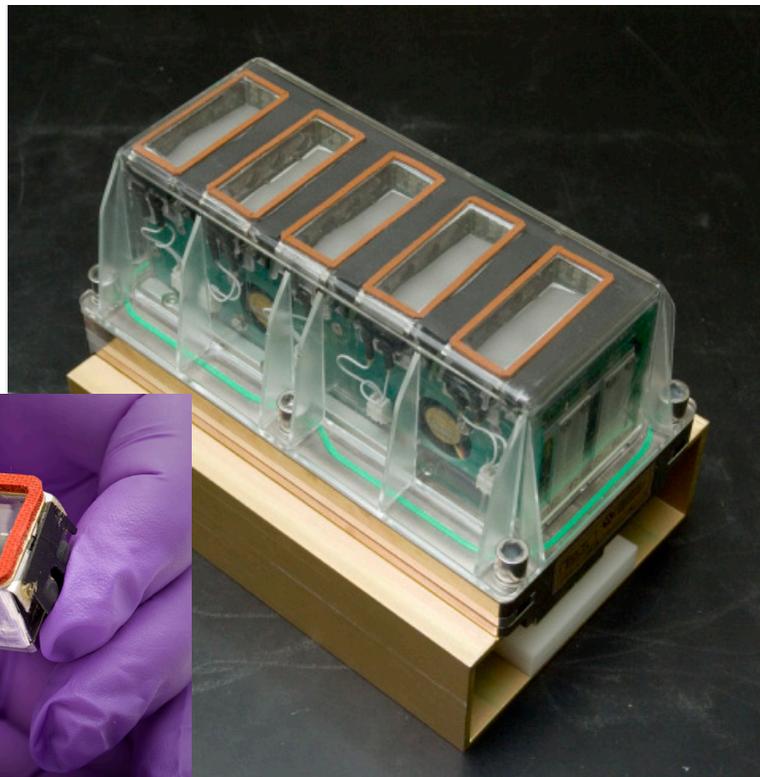
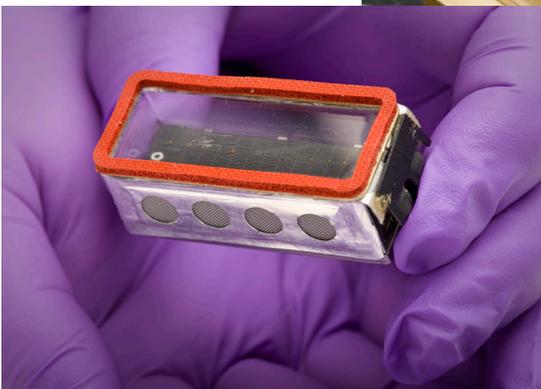
Tropi is a semi-autonomous space-based experiment to study *Arabidopsis thaliana* (thale cress) seedling sprouts to observe their response to light and gravity at a cellular

level. Specifically, the seeds will be grown in microgravity - the weightlessness experienced on the station - or at gravity levels on Earth, the moon and Mars. Tropi derives its name from the term "tropism." For example, phototropism is a plant's growth response to a direct source of light, and gravitropism is its growth in response to the pull of gravity.

The International Space Station Non-Exploration Projects Office at NASA's Ames Research Center, Moffett Field, Calif., along with the principal investigator team at Miami University, Oxford, Ohio, prepared 16 Experiment Containers (ECs), each containing five seed cassettes, by inserting more than 1,000 tiny sterilized seeds crossways onto a gridded membrane. The gridded membrane has lines that measure 3 millimeters-by-3 millimeters to help scientists measure the plants' growth - approximately 10 millimeters during a six-day experiment. Using a microscope and tweezers, scientists precisely embedded the seeds, which are about the size of a grain of sand, into guar gum, an adhesive, to keep

European Modular Cultivation System (EMCS) Experiment Container with five Tropi Experiment Cards (ECs). Photo credit: NASA Ames/ Tom Trower.

A Tropi Experiment Card (EC) with seeds. Photo credit: NASA Ames/ Dominic Hart.



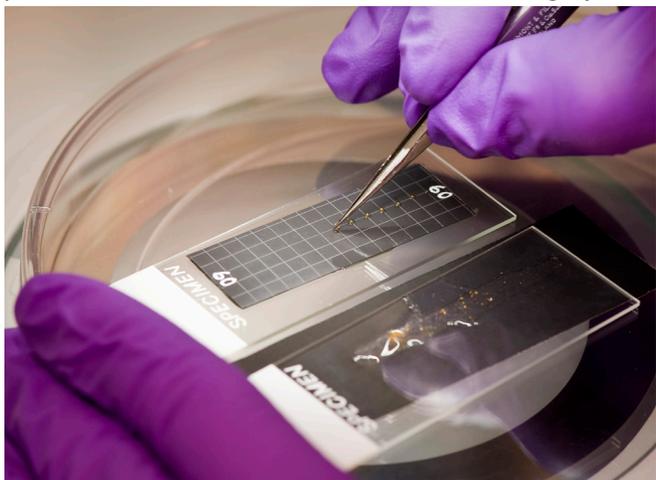
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them in place during their launch, orbit and re-entry phase of the mission.

The European Space Agency (ESA) developed the European Modular Cultivation System (EMCS), a facility focused on plant biology research located on the station that can house up to eight experiment containers at a time. Once in orbit, NASA astronauts Jeff Williams and T.J. Creamer will place the Tropi experiment containers in the EMCS incubator to conduct the experiment in a temperature, humidity, and atmosphere-controlled environment.

Once the experiment begins, the seeds will be continuously spun in centrifuges, to achieve varying levels of gravity, and given fresh water. The first three days are considered the “growth phase” of the experiment, during which the ECs will be exposed to gravity forces equivalent to Earth’s. For the first 32 hours the seeds will remain in the darkness, with the exception of a four-hour exposure to red LED lights. From then until the end of the “growth phase,” they will be illuminated with white LED lights. The last three days of the experiment are called the “stimulation phase,” when they will be “photostimulated” – or constantly exposed to red, blue or a combination of red and blue LED lights and exposed to either microgravity, or levels of gravity found on Earth, the moon or Mars. During the final phase of the experiment, cameras in the centrifuges will take three images per minute to collect the majority of the scientists’ data.

After the experiment is completed, Williams and Creamer will remove the containers from the incubator and take out the cassettes with seedlings. Then they will place the cassettes into the station’s Minus Eighty



Sterilized Arabidopsis thaliana seeds in guar gum adhesive are carefully positioned on a gridded membrane. Photo credit: NASA Ames/Dominic Hart..

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(Degrees Celsius) Laboratory Freezer (MELFI) where they will remain until STS-131 space shuttle Discovery undocks. However, before Discovery undocks, astronauts will place the cassettes in pre-cooled double cold bags as they transfer them from the MELFI to the Glacier freezer on the space shuttle. The samples are frozen to ensure they are preserved and to prevent any ribonucleic acid (RNA) degradation, prior to analysis on Earth.

Tropi first flew to the station on STS-121 and STS-115 in 2006. While these earlier experiments successfully obtained data in microgravity, no moon or Mars gravity levels data were obtained.

Relevance to Space Exploration and Earth Science

During long-duration space exploration, astronauts will need regenerative sources of food, as well as a method to recycle carbon dioxide into breathable oxygen. As new information about how plants grow in microgravity emerges, scientists will refine existing sustainable plant-based life support systems. Further understanding of how plants grow and develop at a molecular level can lead to advancements in agricultural production on Earth.

The Tropi Team

NASA Ames’ International Space Station Non-Exploration Projects Office will manage the Tropi experiment for the Advanced Capabilities Division and Exploration Technology Development Program of the Exploration Systems Mission Directorate at NASA Headquarters, Washington. The Multi-Mission Operations Center at NASA Ames, along with the Norwegian User Support and Operations Centre in Trondheim, will provide mission operations support and receive Tropi science data in real-time. John Z. Kiss, professor and chair of the Botany Department at Miami University, Oxford, Ohio, is the Tropi principal investigator; Richard E. Edelman of Miami University and Melanie J. Correll of the University of Florida, Gainesville, are Tropi co-investigators; Kenny Vassigh of NASA Ames, is the Tropi project manager; Marianne Steele of NASA Ames, is the Tropi project scientist; Tom Luzod of NASA Ames is the Tropi project engineer, David Heathcote of NASA Ames is the Tropi operations lead.

For More Information

The Tropi mission Web site is located at:
<http://spacebiosciences.arc.nasa.gov/STS130.html>