Botany experiment will try out zero gravity aboard space station

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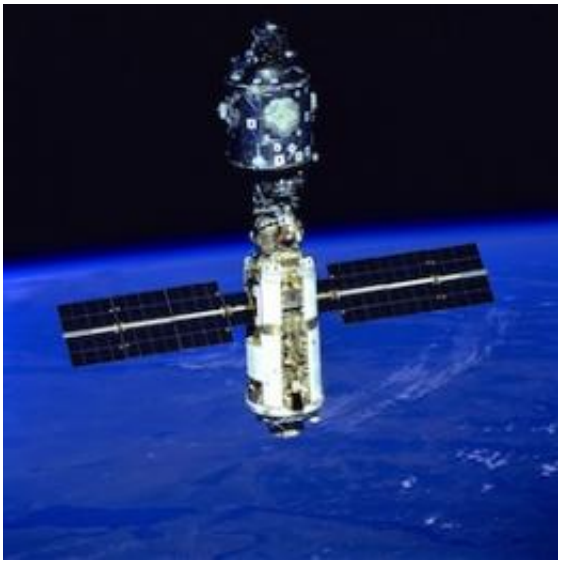


Professor Simon Gilroy will be sending a canister of plants to the International Space Station in March to test how well they do in a zero-gravity environment. The long-term goal is to integrate plants to grow food and purify the air and water, and microbes as the waste-processing system, into future space travel. Credit: NASA

(Phys.org)—Gravity: It's the law in these parts. But to reach the stars, humans may have to learn to live outside the law.

"Gravity is the most pervasive thing on the planet, and it's always been there," says Simon Gilroy, University of Wisconsin-Madison botany professor. "Terrestrial biology has evolved with this constant force in the

background, and when you remove it, things start to happen that you wouldn't necessarily think of."

Surprises are not welcome in space, especially surprises that interrupt the supply of vital oxygen, water and food.

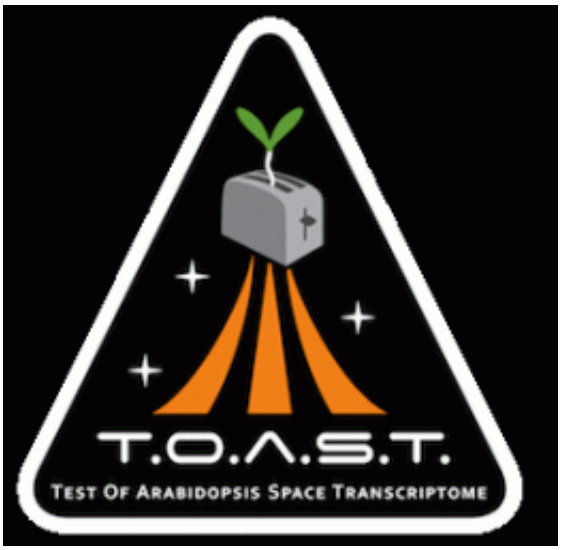
For travel beyond a narrow envelope around the Earth, the connection to those supplies is—for all intents and purposes—severed. It just takes too many resources to deliver supplementary meals and air as astronauts stray farther and farther from home.

"The only life support system we know that works really, really well is the Earth's, and that is built around plants and microbes," Gilroy says. "It's not 100 percent clear it will work, but the long-term goal is to integrate those tools into space missions: plants to grow your food and purify the air and water; microbes as the waste-processing system."

In March, Gilroy hopes to contribute a small piece of the knowledge that may support such a life-sustaining system by sending a canister full of plants to the International Space Station. Both engineered mutant and unadulterated versions of Arabidopsis—known commonly as mouse-eared cress, and to researchers as "the lab rat of plant biology," says Gilroy—will make the trip to study the effect of low-oxygen conditions on the plants' genes.

Without the pull of gravity, plant roots are going to have the same problem that makes a lava lamp a lot less fun in space.

"The reason is buoyancy," Gilroy says. "The goopy stuff in a lava lamp heats up, expands and gets less dense. Buoyancy moves it up in the lamp, where it cools down and sinks. And it all starts over."



Buoyancy depends on relative differences in volume and weight, and is driven by gravity. Without buoyancy, there's no convection, and on Earth convection helps mix gases in the atmosphere.

"If you were just lying on your back in the International Space Station, the gases that you're breathing out—if there [were] no other things like fans to move the air—would just sit there around your head," Gilroy says. "You would suffocate, because there's no mixing to replace the oxygen you use up."

Plant roots use oxygen, too. They burn it along with glucose to make energy to drive a growing plant. But the little bit of convection-driven gas mixing plants count on in Earth's soil doesn't happen in space, and the available oxygen gets used up.

For a plant, this low oxygen level is akin to what happens when a neighboring river spills its banks. Corn in a flooded field can survive a few days, but eventually the water will replace air pockets in the soil.

"Just like humans, plants suffocate and die," Gilroy says. "Plants can grow in space, but it may be that they don't grow very well. And one of the reasons is trying to cope with this oxygen depletion."

Gilroy's lab studies the way plants deal with stress, including the signals plant cells pass to one another in times of trouble—like during a flood.

"If I flood a plant, within seconds, cells in that plant will be sending signals to other cells all over, saying, 'We need to get our act together to deal with this,'" Gilroy says.

Gilroy's lab will send Arabidopsis seeds to the International Space Station aboard a SpaceX Dragon capsule scheduled to launch in March. The seeds will germinate in space in a small container called Biological Research in a Canister (BRIC). After eight days of growth in a gravity-free environment, astronauts will stop the plants' development with a dose of a chemical fixative and tuck the whole BRIC in a deep freeze.

The entire frozen BRIC will return on the same Dragon craft it rode up, and be turned over whole to Gilroy—who will then treat it like his firstborn child.

"As everyone who has done space shots has told us: you will never let those samples out of your sight once they're back," says Gilroy, whose experiment is funded by NASA. "They're just too valuable."

Arabidopsis grown in a NASA lab that simulates space station conditions (aside from lack of gravity) will be compared to the space plants for physical and genetic differences.

"We should be able to say this is the fingerprint of what low-oxygen looks like," Gilroy says. "We'll be able to say these plants in space look like the plants that were grown on the ground in this particular low

oxygen concentration."

That will contribute to the understanding of long-term plant growth in space, and put future space travelers a hair closer to the company of plant life.

"This is that bit of the science where we're beginning to tease apart the system, beginning to understand the components that we can put together to great use," Gilroy says.

Provided by University of Wisconsin-Madison