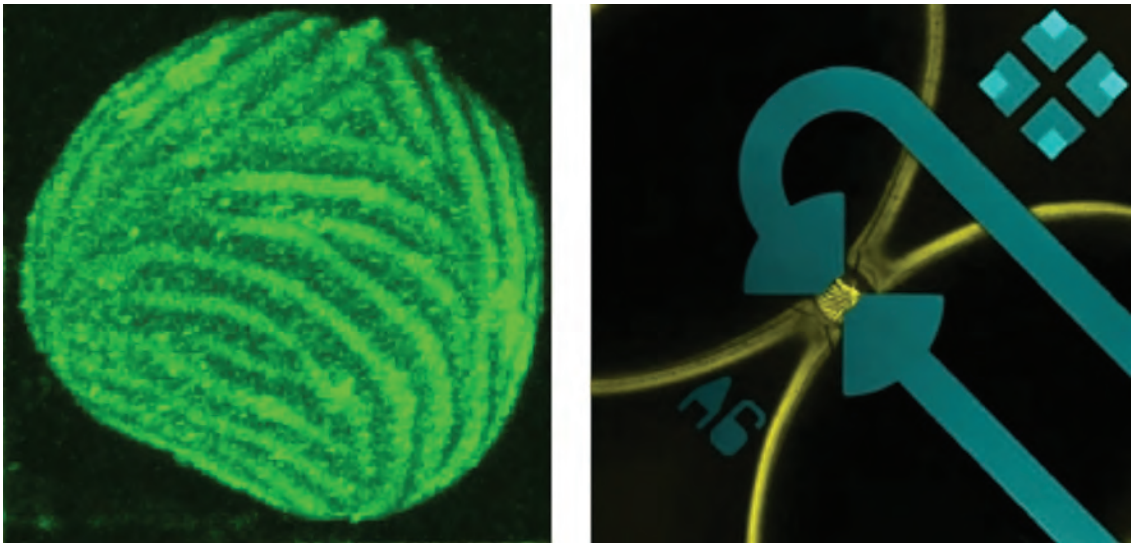
NASAfacts

SporeSat

Investigating the Gravitational Threshold for Calcium Ion Channel Activation using a Nanosatellite Platform-Based Lab-on-a-Chip

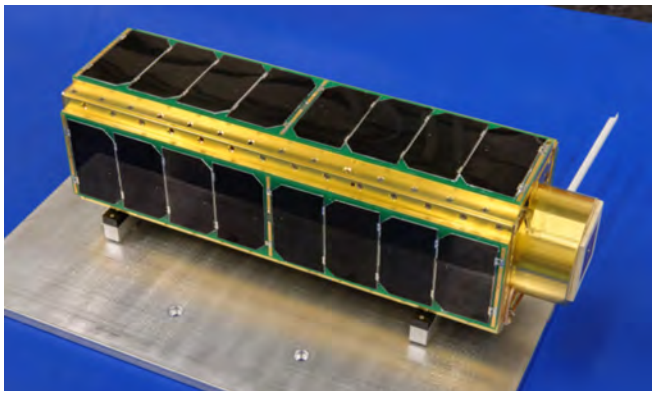
SporeSat is an autonomous, free-flying three-unit (3U) spacecraft that will be used to conduct scientific experiments to gain a deeper knowledge of the mechanisms of plant cell gravity sensing. SporeSat was developed through a partnership between NASA's Ames Research Center and the Department of Agricultural and Biological Engineering at Purdue University. Purdue University Principal Investigators are Amani Salim and Jenna L. Rickus. Stan Roux and Mari Salmi, both from the University of Texas at Austin, are Co-Investigators on the project. SporeSat launches on March 16 onboard the Space Exploration Technologies (SpaceX) Dragon spacecraft and will deploy into Earth's orbit before the spacecraft arrives at the International Space Station.

SporeSat's space biology science experiment will investigate the effect of gravity on the reproductive spores of the fern, *Ceratopteris richardii*. Some plants, including *C. richardii*, use gravity to determine direction and to guide their roots to grow down into the earth where they find nutrients for growth. Calcium is important to overall plant growth and development, but it also plays a role in the process of sensing gravity and signaling the response of downward plant growth. To better understand the role of the on/off modulation of cellular calcium ion channels in gravity sensing, the SporeSat experiment will measure the effect of different artificial gravity levels on calcium concentrations that result from the opening and closing of these channels. Specifically, the SporeSat experiment will utilize three lab-on-a-chip devices, called BioCDs, that integrate the sensors that allow for real-time measurement of calcium signaling at each of the variable gravity treatments planned for the experiment. In the microgravity environment of Earth orbit, two of the BioCDs spin to exert a range of artificial gravitational forces on the spores during the experiment; the third BioCD remains



Single C. richardii spore (left) and photo of calcium ion measurement microelectrodes on either side of a single spore (right).

Three BioCDs are contained in two rotating assemblies and one Standby Assembly (TVPM). Image Credit: NASA / Dominic Hart



The SporeSat Spacecraft. Image Credit: NASA / Dominic Hart

stationary as a microgravity control. Each disc-shaped BioCD holds up to 32 spores. The gravitational response of the fern spores will be monitored by measuring the activity of their calcium ion channels.

The SporeSat mission will be flown using a 3U nanosatellite weighing approximately 12 pounds and measuring 14 inches long by 4 inches wide by 4 inches tall. SporeSat utilizes flight-proven spacecraft technologies demonstrated on prior Ames nano-satellite missions such as PharmaSat and Organism/ Organic Exposure to Orbital Stresses (O/OREOS) Nanosatellite as well as upgrades that increase the hardware integration capabilities with SporeSat science instrumentation. In addition, the SporeSat science payload serves as a technology platform to evaluate new microsensor technologies for enabling future fundamental biology missions.

The investigators at Purdue University were respon-sible for development of the science payload, specifically the lab-on-a-chip device that supports and measures the fern spore ion channel activity and, in collaboration with NASA Ames, for measurement electronics circuit board assemblies.

NASA Ames was responsible for overall management and hardware development to include the thermal, power, electrical, and mechanical subsystems of the payload including the mini centrifugal subsystems; integration and test of the payload, and for interfacing the payload with an upgraded nanosatellite spacecraft with updated flight software. NASA Ames was also the lead in the design, fabrication and testing of the payload elements.

The SporeSat spacecraft is contained within a Poly Picosatellite Orbital Deployer (PPOD) during launch, which also deploys the satellite once it is in orbit.

SporeSat was competitively selected for NASA's CubeSat Launch Initiative in 2012. The mission is funded as part of the Space Biology Program at NASA Ames Research Center. Funding for Space Biology comes from the Space Life and Physical Sciences Research and Applications Division within the Human Exploration and Operations Mission Directorate at NASA Headquarters.

For more information on SporeSat, please visit:

http://www.nasa.gov/centers/ames/engineering/projects/sporesat.html

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