

Developing technologies for biological experiments in deep space

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NASA Ames Research Center is the leader in developing autonomous nanosatellites or CubeSats to address strategic knowledge gaps about the effects of space travel on biological organisms, including GeneSat, PharmaSat, and EcAMSat. Now that NASA has set its sights on human exploration in deep space, such missions require significant technological and biomedical countermeasures to protect astronauts from chronic radiation exposure. CubeSats can inform these countermeasures by querying relevant space environments with model organisms and/or biosensors.

BioSentinel will be the first interplanetary CubeSat to study the biological response to space radiation outside low Earth orbit in almost 50 years. BioSentinel is an autonomous platform able to support biology and to investigate the effects of space radiation on a model organism in interplanetary deep space. It will fly onboard Artemis-1, from which it will be deployed on a lunar fly-by trajectory and into a heliocentric orbit.

BioSentinel, a 6U CubeSat (1U = 10-cm cube), will measure the DNA damage response to ambient space radiation in a model organism, which will be compared to information provided by an onboard radiation spectrometer and to data obtained on the ISS and on Earth. Even though the primary objective of the mission is to develop an autonomous spacecraft capable of conducting biological experiments in deep space, the 4U BioSensor science payload contained within the free-flyer is an adaptable instrument that can perform bio measurements with different microorganisms and in multiple space environments, including the ISS, lunar gateway, and on the surface of the Moon. Thus, nanosatellites like BioSentinel can be used to study the effects of both reduced gravity and space radiation and can house different organisms to answer specific science questions. In addition to their flexibility, nanosatellites also provide a low-cost alternative to more complex and larger missions, and require minimal crew support, if any.