



Into the void

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Introduction. Surviving in void conditions, such as the extreme vacuum of outer space, presents an incredible challenge for most life forms due to the absence of atmosphere, extreme temperatures, and cosmic radiation. However, there are several microorganisms known as extremophiles, that have demonstrated remarkable resilience and the ability to survive in environments that mimic the conditions of outer space. Some well-known organisms are capable of surviving in void conditions, as we will see in the next section.

Deinococcus radiodurans. Often referred to as the "Conan of bacteria", *Deinococcus radiodurans* is renowned for its extraordinary resistance to radiation, desiccation, and other extreme environmental stresses (Huyghe 1998). It has been shown to survive exposure to the vacuum of space and cosmic radiation, making it a model organism for studying extremophile biology and potential life on other planets (Ott et al 2019).

Bacillus subtilis. This common soil bacterium has been extensively studied for its ability to form endospores, dormant and highly resistant structures that enable survival in harsh conditions. *Bacillus subtilis* has been shown to survive exposure to simulated space conditions in laboratory experiments, highlighting its potential for space exploration and astrobiology research (Wassmann et al 2012).

Tardigrades (Water Bears). While not microorganisms, tardigrades are microscopic, water-dwelling animals known for their exceptional resilience to extreme environments, including vacuum and radiation. They can enter a cryptobiotic state, where metabolic activity ceases, allowing them to survive desiccation and other environmental stresses (Petrescu-Mag 2016).

Archaea. Some species of archaea, particularly those belonging to the genera *Halobacterium* and *Methanosarcina*, have been found to exhibit tolerance to extreme conditions resembling those of outer space. These organisms thrive in environments with high salinity, acidity, or temperature extremes and may possess adaptations that confer resilience to vacuum conditions (Moissl-Eichinger 2011).

Cyanobacteria. Certain species of cyanobacteria genera, such as *Chroococcidiopsis* and *Nostoc*, are known for their ability to survive in extreme environments, including deserts, hot springs, and Antarctica. Some cyanobacteria have been shown to endure exposure to simulated space conditions, suggesting potential for survival in extraterrestrial environments (Mosca et al 2021).

Final Remarks. While these organisms have demonstrated resilience to void-like conditions in laboratory experiments, the harsh environment of outer space presents numerous additional challenges, such as cosmic radiation, microgravity, and lack of nutrients, which may further impact the survival and viability of life forms. Nonetheless, studying extremophiles capable of surviving in extreme environments provides valuable insights into the limits of life and the potential for life beyond Earth.

Conflict of Interest. The author declares that there is no conflict of interest.

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