

NASA BioSentinel: Deep-Space Radiation Study

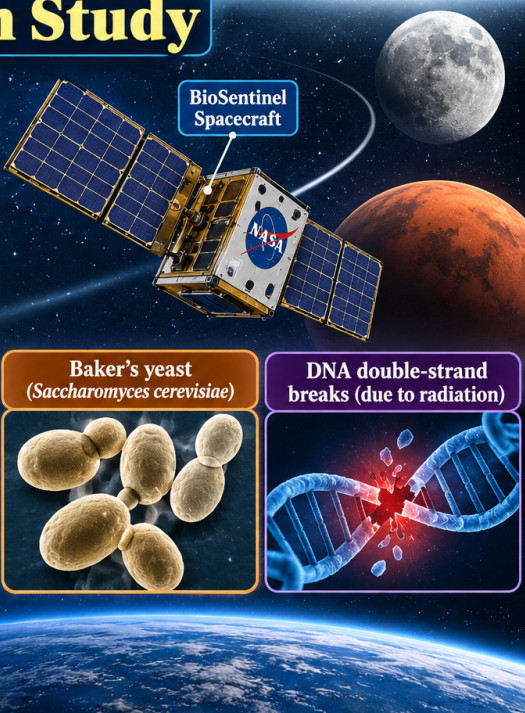
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Why in News?

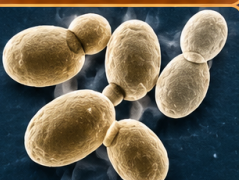
NASA's BioSentinel spacecraft, launched in 2022, traveled beyond Earth's magnetic field and passed the Moon to investigate the effects of deep-space radiation on living organisms.

NASA BioSentinel: Deep-Space Radiation Study

1		Mission	BioSentinel
2		Agency	NASA
3		Research institution	NASA Ames Research Center
4		Launch year	2022
5		Organism used	Baker's yeast (<i>Saccharomyces cerevisiae</i>)
6		Primary objective	Study biological effects of deep-space radiation.
7		Major biological concern	DNA double-strand breaks.
8		Mission outcome	Yeast failed to grow, but radiation data were collected.



BioSentinel Spacecraft



Baker's yeast
(*Saccharomyces cerevisiae*)



DNA double-strand
breaks (due to radiation)

- The spacecraft transported yeast cells as biological samples to examine radiation-induced DNA damage.
- However, the yeast cells did not proliferate, likely due to expiration prior to launch.
- Despite the failure of the biological experiment, the spacecraft's radiation detector successfully collected deep-space radiation data.

NASA's BioSentinel Mission

- BioSentinel is a small, cereal-box-sized CubeSat developed by NASA.
- It was designed to study the biological effects of deep-space radiation on living organisms.

- It travelled beyond Earth's protective magnetic environment and flew past the Moon.
- **Developed by** - NASA Ames Research Center, California, USA.
- **Launched in** - 2022.
- **Objectives**
 - To study the effects of deep-space radiation on living organisms.
 - To understand radiation-induced DNA damage and cellular repair mechanisms.
 - To generate scientific data to support the safety of future human deep-space missions.

Rationale for NASA's Selection of Yeast

- NASA selected *Saccharomyces cerevisiae*, commonly known as baker's yeast, as the model organism.
- Yeast is widely utilized in scientific research due to the significant similarities between its cellular and DNA repair mechanisms and those found in humans.
- **Significance**
- **DNA Damage Studies** - Deep-space radiation has the potential to induce double-strand breaks in DNA.
- **DNA Repair Mechanisms** - Yeast cells contain well-characterized mechanisms for repairing damaged DNA.
- **Human Health Research** - Investigations using yeast facilitate understanding of the biological effects of radiation exposure relevant to human health.
- **Model Organism** - Yeast is amenable to laboratory study and possesses well-characterised biological mechanisms.

The Importance of Studying Deep-Space Radiation

- **Earth's Magnetic Protection** - Earth's magnetic field establishes a protective environment surrounding the planet.
- This field deflects numerous charged particles that originate from the Sun and other cosmic sources.
- The Earth's magnetosphere significantly reduces radiation exposure for astronauts operating in low Earth orbit.
- **Radiation Risks in Deep Space** - Astronauts traveling beyond Earth's protective magnetic environment are exposed to significantly higher levels of radiation, including:
 - **Galactic Cosmic Rays (GCRs)** - These are high-energy particles that originate outside the Solar System.
 - **Solar Energetic Particles (SEPs)** - These are high-energy particles released during solar eruptions.
 - **Major Health Risks**
 - DNA damage and mutations.
 - Increased cancer risk.
 - Cellular and tissue damage.
 - Potential long-term health complications.

Key Findings and Mission Outcomes

- The yeast cells aboard BioSentinel did not exhibit growth, which may be attributed to their expiration prior to launch.
- As a result, the planned biological experiment did not yield the anticipated outcomes.
- Nevertheless, the radiation detector onboard continued to collect data on the deep-space radiation environment.

Significance

- **Astronaut Safety** - Assesses deep-space radiation risks and supports development of effective shielding for Moon and Mars missions.
- **Space Biology Research** - Enhances understanding of DNA damage and cellular repair, improving safety for long-duration space missions.

Reference

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