Astronauts demonstrate CRISPR/Cas9 genome editing in space
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Now, Stahl-Rommel and colleagues have developed a new method for studying DNA repair in yeast cells that can be conducted entirely in space. The technique uses CRISPR/Cas9 genome editing technology to create precise damage to DNA strands so that DNA repair mechanisms can then be observed in better detail than would be possible with non-specific damage via radiation or other causes. The method focuses on a particularly harmful type of DNA damage known as a double-strand break.

The researchers successfully demonstrated the viability of the novel method in yeast cells aboard the International Space Station. They hope the technique will now enable extensive research into DNA repair in space. This study marks the first time that CRISPR/Cas9 genome editing has successfully been conducted in space, as well as the first time in space that live cells have undergone successful transformation—incorporation of genetic material originating from outside the organism.

Future research could refine the new method to better mimic the complex DNA damage caused by ionizing radiation. The technique could also serve as a foundation for investigations into numerous other molecular biology topics related to long-term space exposure and exploration.

"It's not just that the team successfully deployed novel technologies like CRISPR genome editing, PCR, and nanopore sequencing in an extreme environment, but also that we were able to integrate them into a functionally complete biotechnology workflow applicable to the study of DNA repair and other fundamental cellular processes in microgravity," said senior author Sebastian Kraves. "These developments fill this team with hope in humanity's renewed quest to explore and inhabit the vast expanse of space."

First author Sarah Stahl Rommel adds, "Being a
part of Genes in Space-6 has been a highlight of my career. I saw firsthand just how much can be accomplished when the ideas of innovative students are supported by the best from academia, industry, and NASA. The expertise of the team resulted in the ability to perform high-quality, complex science beyond the bounds of Earth. I hope this impactful collaboration continues to show students and senior researchers alike what is possible onboard our laboratory in space.”

Co-author Sarah Castro-Wallace says, "It was an honor to support Genes in Space-6. I am still blown away by the incredible sophistication of the science that was realized when an organism was transformed, its genome edited with CRISPR/Cas9 to cause breaks in the DNA, followed by its growth to allow for DNA repair, and, finally, its DNA sequenced, all in the spaceflight environment onboard the ISS. The ability to perform this all-encompassing, end-to-end investigation is a huge step forward for space biology. This caliber of work speaks to both the exceptional students and the Genes in Space Program."


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