Sequencing DNA in space

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Ever since the first strands of DNA were sequenced in the 1970s, researchers understood the profound significance of analyzing genetics for a wide range of medical and biological research.

DNA sequencing is used to identify forms of life; to study how different organisms are related and how they evolved; to pinpoint genetic diseases in individuals and to develop pharmaceutical treatments for maladies. It's even used for crime-fighting.

Now, thanks to an experiment just delivered to the International Space Station, it may be possible to do all these things in space.

On July 20th, 2016, a SpaceX Dragon supply ship docked with the ISS carrying thousands of pounds of supplies. Among the items onboard was a hand-held DNA sequencer named "MinION."

Developed by Oxford Nanopore Technologies, MinION works great on Earth. NASA's Biomolecule Sequencer investigation will find out if it works just as well in microgravity.

Kristen John of NASA's Johnson Space Center says, "The goal is to take a technique widely used here on Earth, and test it in the spaceflight environment of the ISS, so that one day it could possibly be used in crew health applications or even for the detection of life on Mars."

DNA sequencing has never been done in space before and, if the Biomolecule Sequencer investigation is successful, it could be a big deal.

Sarah Castro-Wallace of the Johnson Space Center mentions just a few of its uses:

"In the past, we've had visible fungi growing on the ISS, and we want to identify that fungi without having to return a sample to Earth," she says. "Is it benign or something to be concerned about? Knowing what it is, the microbiologists can recommend how best to deal with the issue."

As a self-contained spacecraft, the ISS slowly and inevitably collects microbes carried onboard by astronauts, on the surfaces of supplies, inside foodstuffs—it's a bit of a microbial zoo. A DNA sequencer can help identify those microbes as well as testing the cleanliness of air and water.

Castro-Wallace says, "About 85% of the water on the station is recycled, from urine, condensate, sweat, everything. Is it being processed to where it's microbially clean? We want to know in a more real-time way if that water processor working."

Principal Investigator Aaron Burton of the Johnson Space Center notes that astronauts themselves could benefit from sequencing: "You can look at DNA for permanent changes, what spaceflight is doing to your DNA long-term, but also by looking at the RNA, you can see how the human body or other organisms are reacting in real-time."

During the Biomolecule Sequencer investigation, crew members will sequence the DNA of bacteria, viruses, and rodents from samples prepared on Earth that have known genomic characteristics. Researchers on Earth will run parallel experiments on the ground to evaluate how well the hardware is working.

The USB-powered sequencer – about the size of a small candy bar – is tiny compared to the large microwave-sized sequencers used on Earth.

Castro-Wallace says, "Most sequencers in Earth-based labs involve optics, fluorescence, lasers and other vibration sensitive components that are not suited for spaceflight or microgravity. There is huge power consumption at play with those as well."

MinION, on the other hand, has minimal moving parts and plugs directly into a laptop or tablet, which supplies power to the device and collects the sequencing data. Unlike terrestrial instruments whose sequencing process can take days, this device's data is available in near real-time; analysis can begin within 10-15 minutes from the application of the sample.

Burton says, "The space station and Earth are [on opposite ends of a] gravity continuum, so if the device works on Earth and in microgravity, then it should work in any environment in between like an asteroid or Mars."

Let the sequencing begin!

Provided by NASA