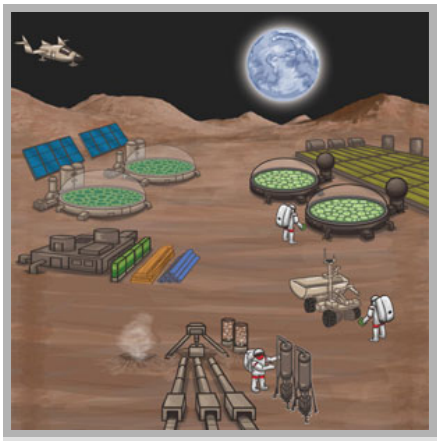
Why Synthetic Biology Could Be the Key to Space Travel

Don't pack everything you need for a space mission. Just pack enough bacterial to build things for you.

By Charles Q. Choi



Colonies on the moon or Mars could use synthetic biology to produce food, fuel, medicines and building materials.

Graphic courtesy of Journal of the Royal Society Interface

November 7, 2014 4:30 PM

Here's one reason why space missions are soexpensive: For every pound of payload launched into space, you've got to launch another 99 pounds, mostly in the form of fuel. As a result, it can cost $10,000 to put a pound of payload into Earth orbit.

That's a big problem for a long-term space missions to Mars or beyond, which would require bringing along incredible amount of fuel and supplies. No surprise, then, that the hot topic among many space exploration experts is to make as much use as possible of the materials available at your destination so explorers don't have to bring everything with them.

According to a new study investigating this idea, synthetic microorganisms could help make this a reality. Scientists reasoned that synthetic biology might help missions save costs by using these organisms to recycle waste and harvest useful materials at the destination, reducing the supplies that astronauts have to bring with them. The researchers investigated the potential impact of what they call "space synthetic biology" on a hypothetical six-person, 916-day round trip to Mars, involving 210 days of travel each way and a 496-day stay on a Martian surface habitat.

One key product that synthetic organisms could manufacture is fuel. "Fuel will be about two-thirds of the mass on an Earth-to-Mars-to-Earth mission," says study lead author Amor Menezes, a systems engineer at the University of California, Berkeley. Menezes suggests the microbe Methanobacterium thermoautotrophicum could generate high-quality methane and oxygen fuel, reducing the mass of the manufacturing plant needed to fuel the return trip from Mars by 56 percent. The carbon dioxide that astronauts breathe out could also be used to manufacture additional fuel, perhaps for use in jetpacks.

Food is another target—for example, crew meals constituted nearly two-thirds of the payload of a recent supply mission to the International Space Station, the researchers say. Menezes and his colleagues suggest that using nutritionally rich food made from bacteria known as Spirulina, the amount of food for a Mars could be reduced by 38 percent. The researchers do note that astronauts would likely tire of Spirulina food after a while, and suggested synthetic biology could also enhance and diversify the flavors and textures of this food—and maybe even help improve astronaut health.

Synthetic organisms could manufacture helpful materials, too. The researchers suggest bringing along

the bacteria Cupriavidus necator, which could synthesize the biopolymer polyhydroxybutyrate (PHB). Space explorers could then use this material to 3D-print structures and devices they need rather than bringing them along. Using this approach, the scientists say, space colonists could build a 4,200 cubic-feet structure and bring along 85 percent less material.

Space explorers could even use bacterial to help them make new medicines. That's helpful because pharmaceuticals astronauts bring on missions can expire go bad in space—radiation can lead 73 percent of solid drugs to expire after 880 days. By using genetically engineered microbes to manufacture the painkiller acetaminophen, astronauts could completely replenish their stocks of that drug within a few days.

"Biology gives you the potential for a closed, self-renewing system," says synthetic biologist Jeffrey Way at Harvard University, who did not take part in this study but has done similar research. "All you need is solar energy and everything else could be recycled."

TAGS: space, space travel, bacteria, synthetic biology

Related Stories

Scientists Create Synthetic Yeast Chromosome (And Unlock the Future of Beer)

Did the Soviets Actually Build a Better Space Shuttle?

The 7 Ships of the New Space Age

PM/AM: See You in Space

Analysis: Why Companies Such as Virgin Galactic and Orbital Take Risks and Endure Losses

3D Printing is Headed to Space