

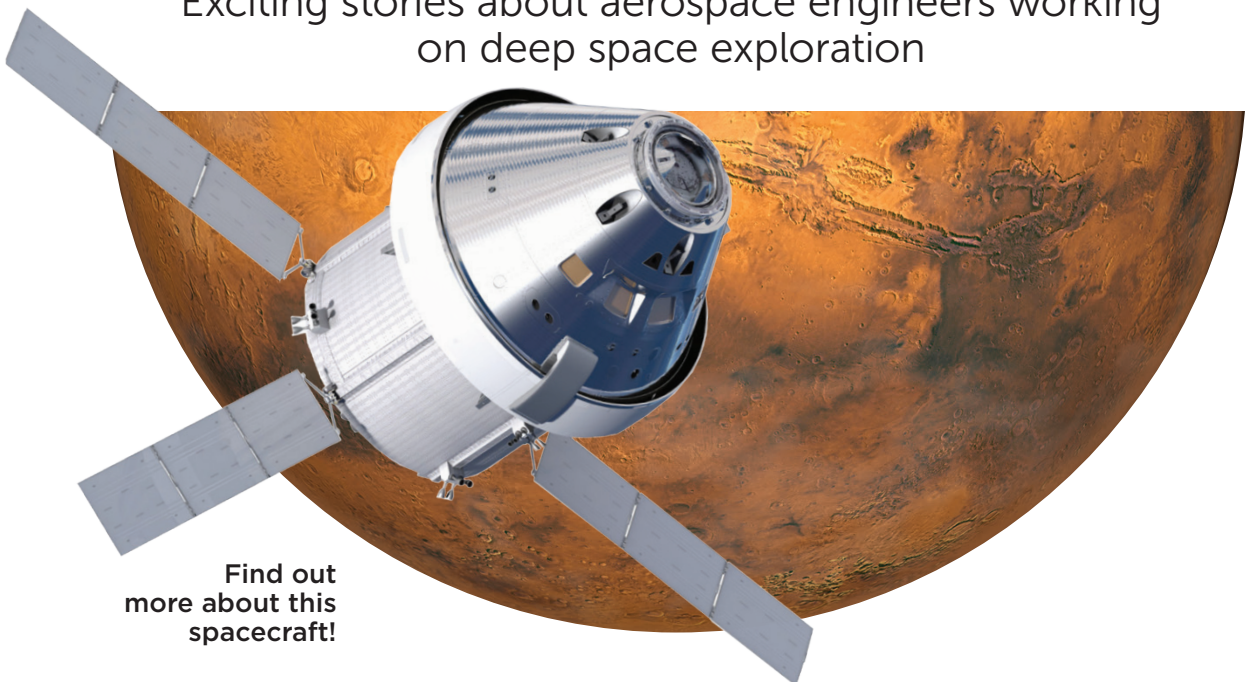
EXPLORING Aerospace Careers



How do
astronauts
take out
the trash in
space?

Mission to Mars

Exciting stories about aerospace engineers working
on deep space exploration



Find out
more about this
spacecraft!

WHAT HAPPENS TO TRASH IN SPACE?

To explore deep space, astronauts need a way to get rid of their garbage.



6

Number of months it will take to get to Mars

Imagine you're an astronaut on a mission more than 100 million miles away. You're crewing a spacecraft, exploring distant planets—and every single day, you're producing trash. But what do you do with it? You can't exactly put it in cans outside your back door, like you do at home!



That's one engineering challenge facing NASA, as it prepares to send the next generation of astronauts to the moon and even to Mars in the 2030s, farther than humans have ever traveled before. On closer missions, like to the International Space Station, a resupply vehicle collects the crew's garbage every four months and brings it back to Earth or **incinerates** it. But with upcoming "deep space" missions, that's not possible. And jettisoning trash out of the spacecraft isn't an option, because that would be like polluting in space.



24,700 mph

How fast
Orion reenters
Earth
from space!



Flushed Away

In zero-gravity space, going to the bathroom is tricky! A new space toilet uses a funnel-shaped suction fan to draw waste and smelly gases away from the body.

To create the parts, engineers relied on **additive manufacturing**, a process where multiple layers of material—in this case, metal powder—are “printed” to create a solid three-dimensional object.

MY AEROSPACE CAREER

OUT-OF-THIS-WORLD JOB

Space Systems Engineer



MOHAMMED HASAN,
space systems engineer at
Collins Aerospace

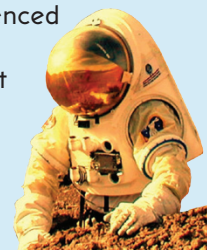
What do you do in your job? I design and build support systems for manned spacecraft, including Orion. In other words, I help keep astronauts alive and comfortable in the harsh environment of space. One of my recent exciting projects was helping to create a special space suit for Mars.

What inspired you to work in the aerospace industry? I've always been curious about the solar system and

whether humans can inhabit planets besides Earth. I still dream of traveling to a different planet.

What are some of the obstacles you faced breaking into such an exciting field?

I had a hard time getting a first job and earning respect because I didn't have experience. It was a little bit discouraging. But I stayed persistent and confident. I joined professional organizations, went to conferences to network, and attended a lot of workshops to teach myself new skills. Eventually more experienced engineers came to trust and believe in what I could do.



For NASA's new spacecraft called Orion, engineers at Collins Aerospace worked on solving the problem of how to dispose of garbage. There's plenty of it: A four-person crew can produce two cubic feet of trash every day, the amount that would fill a tall garbage can in your kitchen. Much of that is plastic, since everything the crew eats or uses comes shrink-wrapped. Astronauts also use a *lot* of wet wipes. Since there's zero gravity in space, there's no running water, so they use the wipes to clean themselves and the surfaces around them.

The solution: a special trash compaction system that can compress those two cubic feet of trash into a disc the

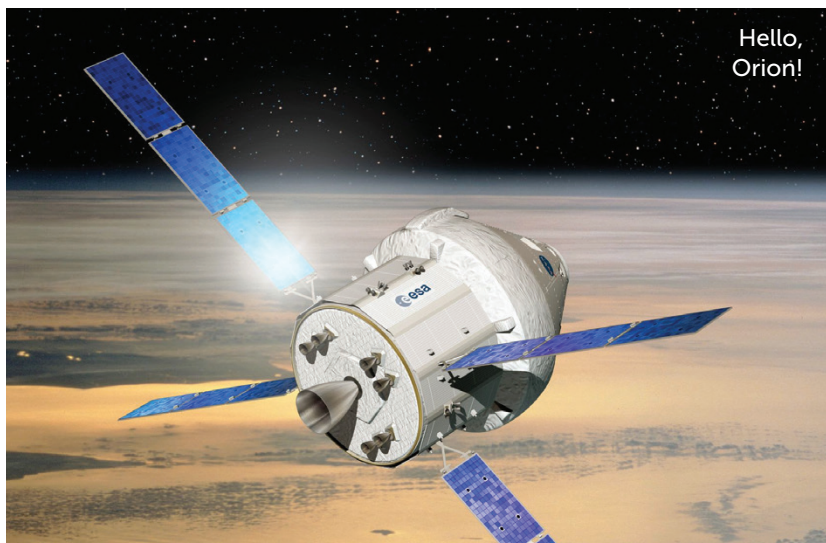
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Number
of crew members
on Orion

size of a small pizza. Before they go to sleep, astronauts can put their garbage in a special cylinder, close the door, and press a button to start the compaction process. It takes 10 hours to complete (including several hours for the discs to cool down) and reduces trash volume by an astonishing 93 percent. Instead of having 25 bags of garbage to send back in a recovery vehicle, the crew might have one bag half full of flat discs. Astronauts can stack the discs until they're ready to be hauled away, or even use them to line the spacecraft as an extra layer of protection against radiation.

The compaction process also gives off some air and water, and a vacuum sucks up these valuable **recoverable resources** so they can be purified and recycled in the spacecraft. That's helpful because sending extra supplies to deep space takes time.

The engineering team will continue to work on the design process and make the compactor more efficient and reliable. They're currently developing a nonstick coating for the trash chamber so gunk won't stick to the walls.



Getting to the Red Planet

It's been over 50 years since Americans sat riveted to their black-and-white TV sets, watching a human being take a first step on the Moon. Wouldn't it be amazing if in your lifetime, you could watch people take their first steps on Mars?

NASA is planning for this event with the creation of its new cutting-edge spaceship, Orion. The safest, most technologically advanced spacecraft ever built, Orion will take astronauts into deep space, to a variety of destinations—potentially even to the Red Planet—and into a new era of space exploration.

To take humans so far away, Orion needs to be flexible and independent. "We want to make sure the spacecraft helps the astronauts be as self-reliant as possible," says Danielle Richey, systems engineer and architect at Lockheed Martin, the aerospace company that's building Orion. That means the spacecraft must have the technology to know its precise location and be able to get back to Earth without help. Because

Mars is so far away, there's a time delay communicating between Earth and the crew. So Richey, who worked on the software for Orion, collaborated

with her fellow engineers to create extra fail-safe systems. This ensures that if anything malfunctions, there are backups.

Next steps include sending a rover to Mars in 2020 to look for signs of past life and to test technology

for humans to explore the planet, and sending astronauts to deep space to explore an asteroid by 2025.

Another concept that's in development is Mars Base Camp, which could orbit the Red Planet with the provisions astronauts need, since they can't possibly carry all their supplies on Orion. "It's like going on a road trip with your family," says Richey. "You don't have everything you need inside the car, but you'd pack backup supplies in the trunk. Mars Base Camp is like the trunk." For example, astronauts would be able to 3D-print a tool or replacement part they need.



Danielle Richey