



Smithsonian

Living and Working in Space



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Table of Contents

Out of This World.....	4
The Right People for the Job	6
Home Sweet Space Station	10
A World of Work	14
Life in Space	18
Back on Earth and Beyond.....	26
STEAM Challenge.....	28
Glossary	30
Index	31
Career Advice	32

Out of This World

Bzzzz! Your alarm goes off, singing its familiar wake-up song. You open your eyes, yawn, and stretch your arms. It's time to start another day.

You unstrap yourself from your sleeping bag and float over to the bathroom. You grab your toothbrush, toothpaste, and a small bag of water that sticks to the wall with Velcro®. You squeeze a bit of water from the bag, but it slowly floats away from you.

“Not again!” you say. Fortunately, the rogue droplet doesn't get very far. You catch it and watch as it seeps into the toothbrush bristles. Success! Very carefully, you squeeze a bit of toothpaste onto your brush. It stays put. Yes! Maybe, just maybe, you're starting to get the hang of this microgravity thing.



Astronaut Clayton Anderson watches a water droplet float.

Floating water (and floating everything) is just one of the many challenges astronauts face when they are living and working in space. When people are hundreds of kilometers from Earth, things work a little—sometimes a lot—differently!

The first astronauts in space only stayed for a short time to explore and do experiments. But now, scientists have the technology to send astronauts into space for over a year. Astronauts have everything they need to live and work in space.



Astronaut Samantha Cristoforetti drinks from a food packet.



Flight engineer Karen Nyberg demonstrates how fruit floats.

Astronauts are up to 5 centimeters (2 inches) taller in space because gravity does not put as much pressure on their spines.

The Right People for the Job

There is an old saying: “It’s a tough job, but someone has to do it.” This can apply to living and working in space. Living in space might sound like it would be a dream come true. Who wouldn’t want to eat breakfast while floating 385 kilometers (240 miles) above Earth? But living in space is a lot of work. It can take up to two years of training and physical fitness before a person is ready for this important job.

The men and women who train to become astronauts are called astronaut **candidates**. Many people apply for this **coveted**, or **desired**, position. Very few are chosen. How few? The last time a call was put out for astronaut candidates, more than 18,000 people applied, but only 12 were chosen. Those are some tough odds!

The people who are chosen to be astronauts are the best of the best in their fields. They come from different career backgrounds. Some are teachers, engineers, scientists, or doctors before they become astronauts. However, to be chosen, they all need degrees in science, technology, engineering, or math.

A large photograph of an astronaut candidate in an orange jumpsuit and helmet with a headlamp, crawling through a narrow, rocky, brown cave-like tunnel. The candidate is smiling and looking towards the camera. In the top right corner, there is a faint, stylized graphic of a gear and some circular elements.

An astronaut candidate climbs through a cave to adjust to the cramped living conditions in space.

A circular inset photograph showing astronaut Reid Wiseman in a blue flight suit and helmet, practicing with a large, silver, cylindrical tool. He is wearing a harness and has an American flag patch on his sleeve. Another person in a blue hard hat and plaid shirt is standing next to him, observing. The background is a bright, industrial-looking space.

Astronaut Reid Wiseman practices using tools before going to space.

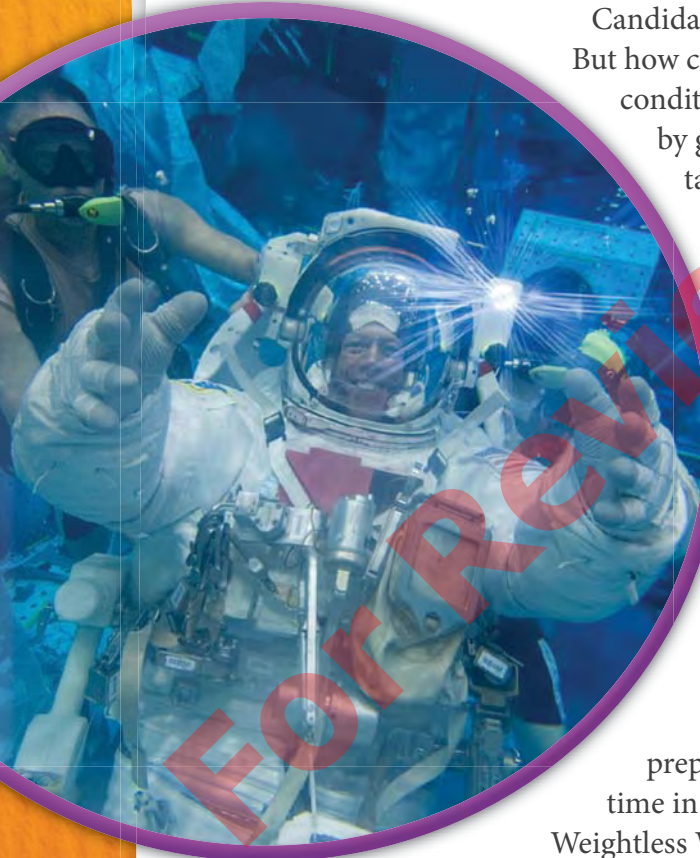
Time to Train

Astronaut candidates train for space at NASA's Johnson Space Center in Houston, Texas. They take classes to learn everything they need to know for their time in space. They learn all about the space shuttles they will ride in and about the space station where they will live.

Candidates also take classes to learn Russian. This helps them communicate with their fellow astronauts from Russia. They also take classes to learn what to do during an emergency.

Candidates practice being in low gravity. But how can someone practice for this condition on Earth? The answer is by going underwater. Candidates take scuba lessons and do a lot of work in a deep tank called the Neutral Buoyancy Laboratory (NBL). Being in the tank feels a lot like being weightless in space. Underwater, your body feels light. People can move heavy objects easily. This is the same in space. Any jobs that need to be done in space are first practiced several times in the NBL.

Another way to get the body prepared for space is to spend time in a special airplane called the Weightless Wonder. This aircraft rises and falls as it flies. It allows people inside to feel weightless for 20 to 30 seconds at a time. Many people feel sick while in the aircraft, earning it the nickname "Vomit Comet." It can even make experienced astronauts lose their lunches!



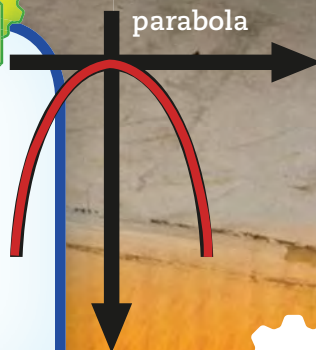


Astronaut candidates experience weightlessness on the Weightless Wonder.

MATHEMATICS

One Sick Ride

The Weightless Wonder flies in a series of parabolas, or curves. This gives passengers the feeling of being weightless. To create each parabola, the plane makes a steep climb into the sky, and then dips down sharply, over and over again. As the plane drops, the passengers feel weightless. It is a similar feeling to what people experience when driving along a hilly road—only much more extreme!





STEAM CHALLENGE

Define the Problem

Conditions in space are much different from life on Earth! Scientists and engineers have developed tools and equipment to help astronauts live and work in space. Some experiments involve astronauts collecting specimens during spacewalks. Your task is to design and build a specialized tool that improves the daily lives of astronauts in microgravity.



Constraints: Your tool must be no longer than 30 cm (12 in.).



Criteria: Test your design by having a friend use it successfully.





Research and Brainstorm

How are conditions in space different from conditions on Earth? What are some examples of tools and equipment that help astronauts adapt to life in space?



Design and Build

Sketch a design of your tool. What purpose will each part serve? What materials will work best? Build the model.



Test and Improve

Demonstrate how your tool works. How might you change your tool to make it work better? Modify your design and try again.



Reflect and Share

What other materials can you use to build this new tool? How will your tool make astronauts' lives easier in space? What other types of tools might be useful to astronauts who live and work in space?

