Engineering for Outer Space

Stephanie Wilson
NASA Astronaut

After earning a bachelor's degree in engineering science from Harvard University and a master's degree in aerospace engineering from the University of Texas at Austin, Stephanie Wilson was selected by NASA for the Astronaut Candidate training program. She has since logged three spaceflights totaling over 42 days. Today, Wilson, the second African American woman to travel in space, supports the International Space Station operations as an engineer within the Astronaut Office while awaiting her next spaceflight assignment.

A family of engineers

My father is an engineer, and I have many cousins who studied engineering. I was always interested in devices and understanding how components work. I liked asking questions and being able to solve problems, and I was interested in design.

In junior high school, I had an assignment to interview someone who worked in an interesting field. I interviewed Dr. Jay Pasachoff, an astronomy professor at Williams College, which is close to my hometown. He took the time to talk with me about what an astronomer does and about his research. I was fascinated by his work. I decided that studying aerospace engineering would be a good way to combine my interests in space and engineering.

Astronaut in training

In college, I took a statics and dynamics class as part of the engineering curriculum, and I liked the dynamics portion. After college, I worked at Martin Marietta for two years as a loads and dynamics engineer on the Titan IV launch vehicle. I went on to study structural dynamics and vibration control in graduate school, where my research focused on the control and modeling of large, flexible space structures.

Afterward, I worked at NASA's Jet Propulsion Laboratory (JPL) on the Galileo spacecraft. I also participated in JPL's new employee mentoring program, where I met Dr. Eugene Trinh. Dr. Trinh had flown as a payload specialist for NASA, and I was able to talk with him and learn about the astronaut application process, what the training entailed, and his space flight experiences. It helped to talk with someone who had already flown in space, who had been able to achieve the same goals I aspired to achieve.

At JPL, I worked in a fast-paced mission control environment, and I had to make real-time decisions about the spacecraft, which was approaching orbit around Jupiter. I think that experience contributed to my acceptance to the astronaut program.

NASA

Stephanie Wilson in the Destiny U.S. Laboratory of the International Space Station during space shuttle Discovery's STS-121 mission

The ride of a lifetime

In 2006, I was a member of the crew of the Space Shuttle Discovery during its 13-day mission to the International Space Station (ISS). I had been training and waiting for my first flight for about ten years—NASA had grounded shuttle flights for over two years after the Columbia tragedy—so I was very excited to launch and to have the opportunity to execute my portion of the mission. We launched on July 4. It was an 8.5-minute ride, and it was the ride of a lifetime.

I sat on the mid-deck, so there weren't any windows, but I could hear the fuel from the solid rocket boosters burning. It makes a whistling sound, like a firecracker, and there's a lot of vibration from the solid rocket boosters. The acceleration builds up to almost 2Gs, and then it trails off when the boosters are going to separate. The rest of the ride is very smooth. About 30 to 40 seconds before the engines cut off, the acceleration builds up to about 3Gs and then we're weightless. It's quite a sensation. The engineers wanted close-up pictures of the shuttle's external tank, and it was my job to obtain the photos while another crewmember recorded video, so I had to very quickly get out of my seat, grab the camera equipment, and float up to the flight deck to photograph the external tank.

The view outside the window

The view in space is spectacular. If we have a few moments, our favorite thing to do is to look out the window, especially now that there's a cupola module on the Space Station that provides a panoramic view. On my first flight, we flew over the southern tip of South Africa at night, over Cape Horn, and we could see these noctilucent clouds—very thin, wispy, high-altitude clouds that you can't see from the ground.

Being in space gives you an appreciation for the majesty and awesomeness of Earth. The colors are so vivid. To fly over the deserts, which are a deep red, or the oceans, which are a deep blue-green, is phenomenal.

Tracy Caldwell Dyson, Naoko Yamazaki, Dorothy Metcalf-Lindenburger, and Stephanie Wilson in the cupola window of the ISS during Discovery's STS-131 mission, which set a record for the most women in space at one time

NASA

Some assembly required

Ensuring that all the components of the Space Station fit together—especially when they were made by different international companies—was challenging, as was doing the integrated hardware and software testing with all of the components. Assembling the ISS in orbit had its own challenges. Some of the biggest challenges of engineering in space, however, relate to knowing how much testing to conduct on the ground to ensure successful integration in orbit. But it worked out very well. The ISS has been a wonderful orbiting laboratory.

Problem-solving on the fly

One of the most exciting missions for me took place in 2007 during the assembly of the ISS. One of our objectives was to move the solar array from the middle of the ISS to the far end on the port side, and when we started to unfold the solar array, one of the guide wires snagged and tore the array. There was a lot at stake because the solar array had to power the future European and Japanese laboratory modules.

It was an Apollo 13-like moment. The entire control team of electrical and mechanical engineers, astronauts, and robotics specialists came together to figure out a repair plan using only materials we had on board the ISS. We fabricated what we called "cufflinks" to hold the torn parts of the solar array together—just like regular cufflinks hold the cuff of a shirt together—so that it could be unfolded.

During an unplanned spacewalk, astronaut Scott Parazynski inserted the cufflinks into the array. He was in a foot restraint and tethered to the end of a boom that's normally used to inspect the shuttle; the boom itself was attached to a robotic arm. Dan Tani and I were the robotic arm operators, and we had to fly a procedure we had never seen before in training. It involved some very complex maneuvers, and we had to work very quickly.

We were so excited when we learned that the array could be used at full capacity. It was wonderful to see what teams can do when they work together to solve an engineering problem, especially when resources are limited.

Continuing education

Even after we're trained in ISS systems, we have ongoing training to keep our skills fresh. I take engineering classes on the ISS system, science classes in biological techniques, and aviation and resource management training aboard a T-38 jet trainer. As a Space Station crew member and Mission Control Capsule Communicator, I also receive Russian language training and ISS simulation training.

Currently, I'm part of a team that's working to determine how many crewmembers can be accommodated on the ISS. NASA's Commercial Crew Program is a new public-private approach to developing spacecraft and launch systems that can carry crews to the ISS. When Commercial Crew vehicles fly to the ISS, they may bring two to four additional crew members. Our effort assesses the impact of these additional crew members on ISS resources with respect to things like removing excess carbon dioxide, the use of exercise equipment, the number of toilet facilities, radiation- and noise-protected places to sleep, and stowage for all the needed items.

Next-gen engineering

To get to Mars, we need the intellect and the energy of the next generation. We need advanced engine technology for the six-month cruise phase between Earth and Mars. We also need advances in radiation protection and shielding to protect the crew and shield the vehicle from deep-space radiation during the cruise phase. We need the next generation to get involved in STEM and to join us at NASA.

If you're interested in aerospace engineering, I encourage you to take all the math and science courses you can and participate in math and science fairs and clubs. Visit NASA facilities and aerospace companies, perhaps during an open house, and talk to aerospace engineers. The people I talked to and the mentorship I received were very important in helping me achieve my goals. ■

Learn more at nasa.gov/mission_pages/station.
Follow Stephanie Wilson on Twitter @Astro_Stephanie.