Career Outlook

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Space careers: A universe of options

Domingo Angeles and Dennis Vilorio | November 2016

Studying the effects of gravity on the human body. Building the next generation of telescopes. Explaining discoveries about the solar system in understandable terms. These are just a few examples of the projects that workers undertake in jobs related to space exploration.

Astronauts may be the most well-known space workers, but they hold few of the jobs. (See box.) The logistics of space missions require a large team of workers with a variety of skills. “It takes the persistence and intelligence of designers, engineers, scientists, and storytellers to bring a project together,” says Nasreen Alkhateeb, a multimedia producer for the National Aeronautics and Space Administration (NASA). “The potential of what you’re good at, what you want to do, and what you already know may fit with a career in space.”

This article describes some of the science, engineering, technical, and communications options in space exploration. Keep reading to learn about different types of workers involved in space-related occupations and whether one of these jobs might be right for you. You'll get an overview of these careers, including brief descriptions of occupations, what the work is like, and how to prepare for them.

Exploring space: An overview

For centuries, space exploration was limited to what astronomers could observe from Earth. It wasn't until the mid-20th century that humans began to physically explore space. And U.S. workers continue to be active participants in the research, design, and communications involved in extraterrestrial travel.

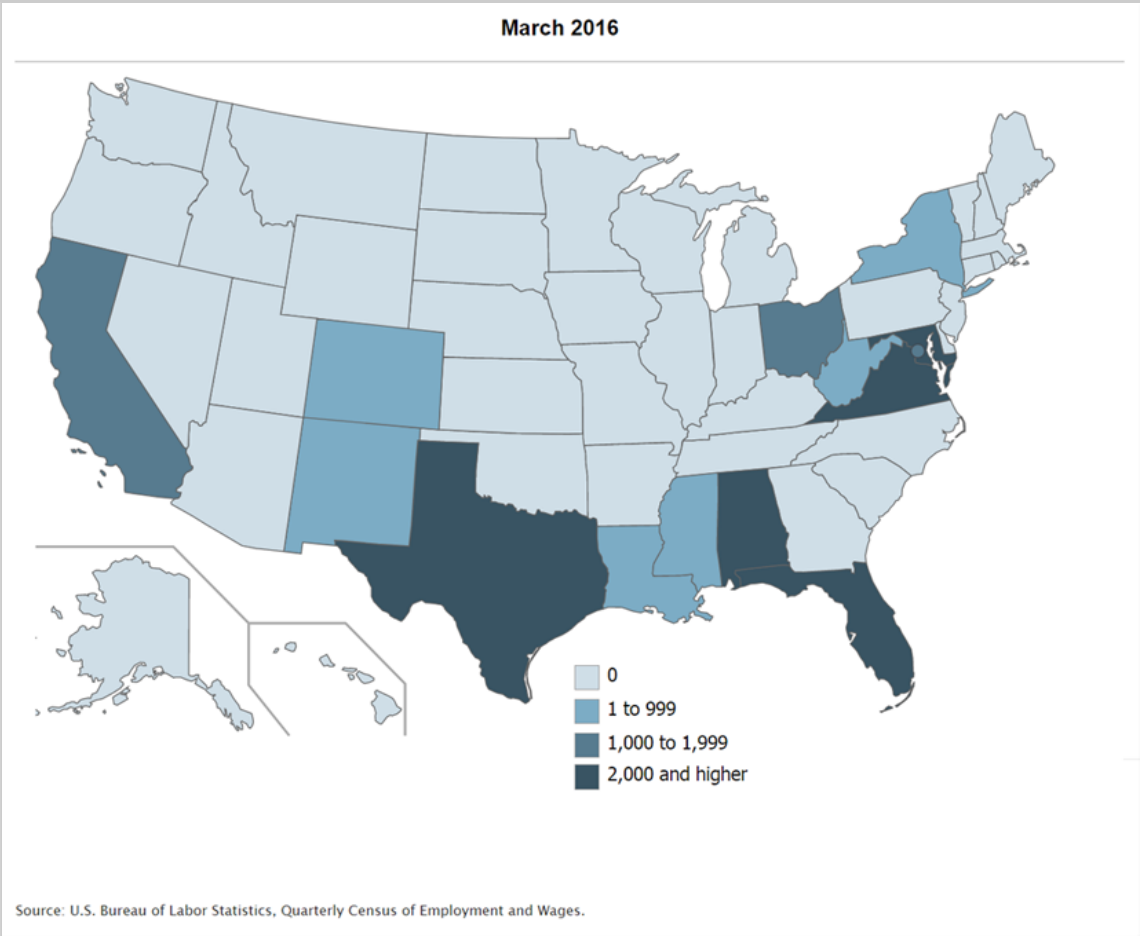
In many ways, space missions build on what the early astronomers learned, often with the same motivations. For example, observations of tiny fluctuations in the light from distant stars helped scientists discover exoplanets orbiting in other solar systems. “It’s important to answer questions like: How does the universe work? Why are we here? Are we alone?” says Maggie Masetti, a social media lead at NASA.

Many of the technologies developed to explore space have also resulted in innovations that benefit our everyday lives. For example, the precision required to cut large mirrors for telescopes has improved laser eye surgery; materials created to soften spacecraft landings were modified for radial tires and memory foam; and research into solar-powered aircraft was adapted to improve solar cells for residential, commercial, and other uses.

NASA, the federal agency that specializes in air travel and space exploration, has about 17,000 workers. And even though most of these workers never leave Earth, they are involved in the projects that do. “A lot of people don’t realize the depth and breadth of what we do,” says Steve Sabia, a user interface designer at NASA. “We have all kinds of missions studying all kinds of phenomena, including earth science and exploring comets, asteroids, neighboring planets, deep space, and so much more.”

Other government agencies that employ workers in space-related occupations include the U.S. Department of Defense, the Federal Communications Commission, and the National Science Foundation. Private companies, including those that contract with federal agencies, employ workers in industries such as aerospace product and parts manufacturing and scientific research and development services.

The U.S. Bureau of Labor Statistics (BLS) Occupational Employment Statistics survey does not collect employment and wage data by detailed occupation in space-related industries. However, the BLS Quarterly Census of Employment and Wages program publishes industry data by county. For example, space research and technology in Harris County, Texas—home of Johnson Space Center—employed 2,920 in March 2016, with average weekly wages of about $2,540. The map shows the location of NASA employment in occupations related to space work.



Space work

Space missions require workers in many different occupations. Scientists, engineers, technicians, and media and communications workers often collaborate on projects. For example, scientists may set a goal, such as being able to observe stars forming. Engineers might then design a product for those observations while working with technicians to make the product. Media and communications workers document the process to share the information with the public.

Scientists

Scientists of all kinds usually specialize in a particular field—and those who work on space projects are no exception. Regardless of their specialty, scientists whose work focuses on space help to answer questions about our universe. Lots of different types of scientists contribute to our understanding of space, including the ones described in this section.

BLS projects about 8,600 job openings overall between 2014 and 2024 for astronomers, atmospheric and space scientists, and physicists. However, this number includes projected openings for these scientists in all types of jobs, not just in space exploration.

Astronomers. Astronomers observe objects within the universe, including planets, stars, and galaxies. They may rely on earth-based equipment, such as telescopes, or on space-based equipment, such as probes, to collect data on celestial bodies. Analyzing the data they collect provides clues to some questions, such as the age of certain planets.

Atmospheric scientists. Atmospheric scientists, including meteorologists, observe weather and climate. They prepare long- and short-term forecasts by analyzing data from computer programs and from instruments such as weather balloons, radar systems, and satellite images. These scientists also may study atmospheric phenomena, such as the Northern Lights and trade winds.

Plasma physicists. These scientists study plasmas, which occur naturally both in interplanetary space and in stars. Their research contributes to our understanding about the universe but also applies to our everyday lives. For example, plasma physicists may study the interaction between the sun and Earth to improve space-weather forecasts, which may help to protect satellites, power transmissions, and aircraft communication systems.

Engineers

Engineers solve problems, often working on teams. Designing a new rocket, for example, may involve the contributions of several types of engineers. Some engineers may design hardware, such as instruments used to collect data. Others may develop stronger materials. Still others may run diagnostics and tests on products they are developing.

BLS projects about 171,900 job openings overall between 2014 and 2024 for aerospace, computer hardware, electronics, and mechanical engineers. This number includes projected openings for these engineers in all types of jobs, however, not just in space exploration.

Aerospace engineers. These engineers design, construct, and test aircraft, missiles, and spacecraft. In their designs, aerospace engineers must consider each environment's limitations. For example, because jet engines don't work in space, where there is no air to push, aerospace engineers instead use rockets, which use liquid oxygen and propellant to build thrust.

Computer hardware engineers. Hardware engineers research, design, develop, and test computer systems and equipment that is used to measure activity in outer space or on Earth. They document their work, writing detailed descriptions of how their designs function so that others may use the products they develop.

Electronics engineers. Electronics engineers focus on specific equipment, such as the instrument panels in aircraft and spacecraft. They may design new components or inspect existing ones to ensure that the equipment is safe. They may also develop maintenance procedures for the components they design.

Mechanical engineers. These engineers often partner with other workers to create products—including sensors, tools, engines, or other machines—that support space missions. For example, mechanical engineers may collaborate with aerospace engineers to develop the steering mechanism on rocket nozzles.

Technicians

Technicians working with engineers or scientists contribute to space exploration in a variety of ways. For example, they might help engineers test designs or determine whether climate conditions are suitable for launching a mission.

BLS projects about 44,400 job openings overall between 2014 and 2024 for aerospace engineering and operations technicians; avionics technicians; and life, physical, and social science technicians, all other, which includes meteorological aides. But this number includes projected openings for these technicians in all types of jobs, not just in space exploration.

Aerospace engineering technicians. These technicians help engineers design, develop, and test products. For example, an engineering technician working on a space rocket might help with an engine test by setting up and conducting tests, recording results, and comparing those results with test objectives for recommending changes.

Avionics technicians. These technicians attend to the communication, navigation, and other systems central to aircraft and spacecraft. Their tasks may include testing electronic instruments, installing instrument panels, and replacing malfunctioning components. They also make a record of any problems and repairs, information engineers may then use for improving future designs.

Meteorological technicians. Meteorological technicians, also called meteorological aides, measure weather or climate-related conditions to produce data for meteorologists. For example, to ensure that conditions are safe for a space launch, these technicians may release weather balloons to assess wind activity in the atmosphere.

Media and communications

Media and communications workers describe the collaboration involved in developing new technologies—and help the public to understand the importance of the work. These workers use a variety of media to convey information, but they have the same goal: to explain the science of projects or discoveries in an easy-to-understand format.

BLS projects about 145,800 job openings overall between 2014 and 2024 for photographers, producers and directors, public relations specialists, and technical writers. This number includes projected openings for these workers in all types of jobs, however, not just in space exploration.

Photographers. The amazing images from space missions are taken by astronauts or special cameras on spacecraft, not by photographers. Photographers for space projects work on earth to capture all of a project's milestones, documenting its progress. The photos become a historical record that shows the project's different phases, from inception to launch.

Producers. Producers are in charge of the budget, the production schedule, and hiring crew members to create educational videos. They may work with directors, who are responsible for creative decisions, and a crew, which may include film and video editors. Videos are helpful for teaching concepts or illustrating processes, such as the steps for assembling a telescope.

Public relations specialists. These workers keep the public informed about space activities and discoveries. For example, they may respond to requests from the media for project details or fulfill requests from schools for educational speakers. Public relations specialists also help prepare the information that is shared through a variety of channels, including news releases and blog entries.

Technical writers. Technical writers often work closely with scientists to present complex information in a way that the public can understand. They may use photographs, diagrams, charts, or other visual material to complement descriptive text.

The highs and lows of space work

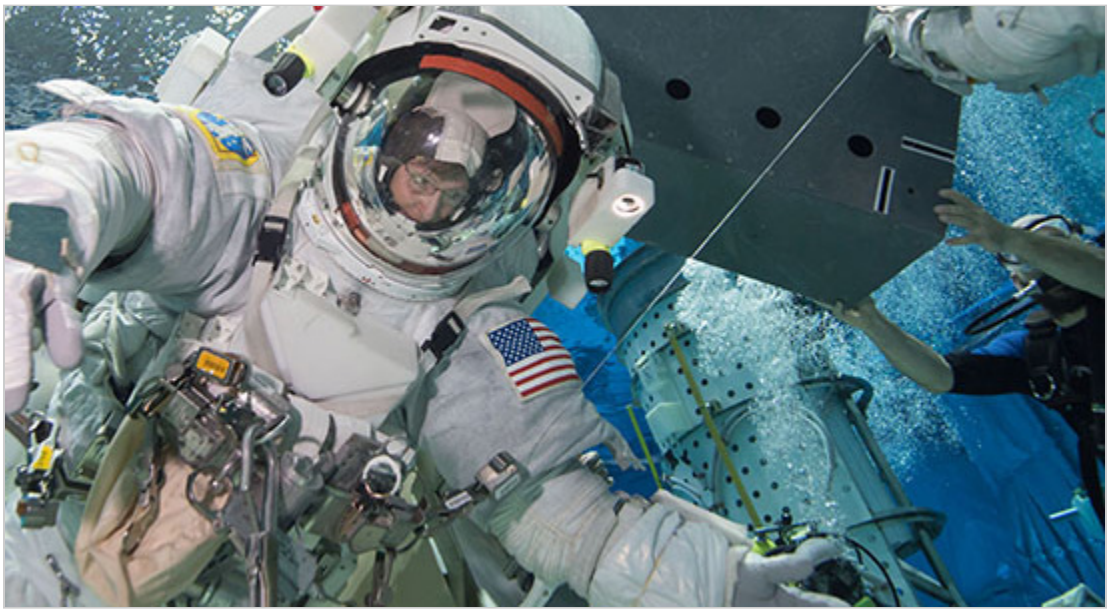
Workers in space careers do a lot of different tasks, but they have similarities when it comes to the rewards and challenges of their jobs.

Rewards

Nearly all the occupations highlighted in this article had median annual wages higher than the $36,200 median wage for all workers in 2015, according to BLS. But because the BLS data for these occupations are across all industries, NASA data may be more relevant for assessing what workers in space occupations earned. In March 2016, the average NASA salary was $119,665. About 60 percent of NASA positions are in professional, engineering, and scientific occupations and are usually at the GS-7 to GS-15 levels in the federal pay scale.

Many workers in space-related careers say that bringing a cutting-edge project from idea to fruition is one of their job's biggest rewards. The thrill of seeing a project's progress in person—as it's assembled and eventually launches into space—is especially satisfying. "I can see the real James Webb Telescope 15 feet away from me," says NASA user interface designer Sabia. "Realizing that it will be folded up and put on a rocket blows me away. I feel immense pride knowing that I was a part of that."

Workers also say they enjoy sharing their interest in space with the community or their peers. They may answer questions from the public, for example, or hear from scientists who are eager to use new tools. These interactions may cover topics outside a worker's area of expertise, which in turn may lead to more collaboration—and help those workers better understand their own projects.



And some workers have opportunities to try experiences that are not part of their job description. For example, to gain first-hand knowledge of how certain activities affect the body, NASA flight surgeon Joseph Dervay sometimes flies in a 2-seat jet and scuba dives in specially designed water tanks with astronauts who are practicing spacewalks. “We’re still learning how to protect the body from the effects of long duration spaceflight,” he says. “I love working on a variety of projects that are relevant to spaceflight, and hopefully the knowledge we gain also benefits health and well-being on earth.”

Challenges

As satisfying as a career in space exploration may be, some of these jobs are stressful. Pushing the limits of science and technology often comes with high stakes: minor errors can be costly, resulting in the loss of multimillion dollar projects—or even lives.

Workers also say that keeping up with technology is a constant challenge. Often, the time required for a project to be planned, built, and deployed means that better options have since become available. Knowing that there are more powerful computers, more precise instruments, and more efficient software programs than what existed in creating a project can make the assignment seem dated before it is released. “You never feel like you’ve mastered your work,” Sabia says, “because it’s always changing.”

And while being in the public eye may be rewarding, being in the bullseye is not. “Even though comments are not directed at me personally,” says NASA social media lead Masetti, “I’m privy to all the criticism we get.”

Launching a space career

Some skills are common across all careers in space exploration. But you might need education, experience, or training specific to the occupation you want to enter. You can begin preparing as early as high school if you’re interested in pursuing space work.

Table 1 shows the education, experience, and on-the-job training that is typically required to enter some of these occupations, according to BLS. Keep in mind that the requirements are general and are not specific to careers in space exploration.

Table 1. Education, experience, and training typically required for space-related jobs

Occupation	Typically needed to enter the occupation		Typically needed to attain competency in the occupation
	Education	Work experience in a related occupation	On-the-job training

See footnotes at end of table.

Scientists			
Astronomers	Doctoral or professional degree	None	None

Table 1. Education, experience, and training typically required for space-related jobs

Occupation	Typically needed to enter the occupation		Typically needed to attain competency in the occupation
	Education	Work experience in a related occupation	On-the-job training
Atmospheric and space scientists	Bachelor's degree	None	None
Physicists	Doctoral or professional degree	None	None
Engineers			
Aerospace engineers	Bachelor's degree	None	None
Computer hardware engineers	Bachelor's degree	None	None
Electronics engineers(1)	Bachelor's degree	None	None
Mechanical engineers	Bachelor's degree	None	None
Technicians			
Aerospace engineering and operations technicians	Associate's degree	None	None
Avionics technicians	Associate's degree	None	None
Life, physical, and social science technicians, all other(2)	Associate's degree	None	None
Media and communications			
Photographers	High school diploma or equivalent	None	Long-term on-the-job training
Producers and directors	Bachelor's degree	Less than 5 years	None
Public relations specialists	Bachelor's degree	None	None
Technical writers	Bachelor's degree	Less than 5 years	Short-term on-the-job training

Footnotes: (1)Excludes computer engineers. (2)Includes includes meteorological aides. Source: U.S. Bureau of Labor Statistics

Skills

Among the most essential skills workers need for any space exploration project is the ability to work well as part of a team. “Any project is such a huge endeavor, and there are so many people involved in the process,” says NASA multimedia producer Alkhateeb. “Ultimately, it could not be completed without the collaboration that happens between people in multiple agencies.”

Interpersonal skills are crucial for sharing discoveries and ideas—including those from people other than colleagues. “Sometimes when you’re working with the public, you see information through their eyes, and it helps you communicate better with your colleagues,” says radio astronomer Doug Roberts.

Workers in space exploration also should be curious, adaptable, and diligent. And they must be able to work well under pressure. For example, a mission's success might depend on completely redesigning a machine component. Engineers and engineering technicians must be able to set aside their frustration with the failed design and solve problems quickly, in order to come up with an alternative.

Other skills may vary by occupation. For example, mechanical aptitude is important for technicians, who may have to assemble detailed electronic components by hand.

Education

Except for photographers, every occupation shown in the table typically requires an associate's, bachelor's, or doctoral degree at the entry level. But you don't have to wait until college to start preparing for a career in space exploration.

Having a strong background in science is helpful for space careers even if you don't want to become a scientist. Biology, chemistry, and physics provide a foundation for understanding the world through observation and experiment. And, if your school offers them, consider taking classes in subjects that involve the solar system or nature, such as astronomy, earth science, and environmental science.

Mathematics and computer science are also useful in many space-related occupations, including those in engineering and science. And communications classes, such as language arts and speech, can help you hone the skills you'll need to work as part of a team on any space project.

College degree programs vary by level and specialty. For example, technicians may need to earn an associate's degree or get certification specific to their training, such as in electronics, control systems, or power testing. Bachelor's and doctoral degree programs may include a range of courses but focus on a major area of study. For example, technical writers must have a solid background in the sciences but also need to be adept at the rules of grammar.

If you want to sample the work before pursuing a space career, apply for an internship. NASA internships are available for high school through graduate-degree students and teachers for fall, spring, summer, and year-long assignments. Full- and part-time opportunities allow participants to engage in scientific or engineering research, development, or operations activities or to assist with administrative or business processes.

For more information

The occupations described in this article are not the only ones involved in space exploration. For example, purchasing managers may plan, direct, and ensure that contracts related to space missions meet the needs of a project.

To learn more about occupations that may work in space exploration, along with hundreds of others, visit the Occupational Outlook Handbook (OOH). Each OOH profile includes detailed information about job duties, wages, job outlook, and more.

Career Outlook has a number of articles that may be of interest if you think you'd like a career related to space. These include:

- Working for the federal government
- STEM 101: Intro to tomorrow's jobs
- Working with big data
- Math at work: Using numbers on the job

Workers in related occupations are also featured in these articles:

- You're a what? Project coordinator
- Interview with a…Mechanical engineer
- My career: Web operations engineer

Astronauts: Famous, but few

Astronauts may have the most visible role in space exploration, but they hold few of the jobs. Currently, there are 45 active U.S. astronauts, according to the National Aeronautics and Space Administration (NASA). Another 28 astronauts are employed by NASA but are no longer eligible for flight assignment.

To become an astronaut, applicants must first be selected for the astronaut candidate program. Among the eligibility requirements for program selection are U.S. citizenship; at least a bachelor's degree in biological science, computer science, engineering, mathematics, or physical science; and at least 1,000 hours or 3 years of experience in piloting a jet aircraft. Eligible applicants are screened and interviewed, with a pool of highly qualified applicants undergoing additional interviews and activities at the Johnson Space Center prior to selection for the program.

The astronaut candidate program takes about 2 years to complete and includes training in areas such as military water survival, robotics skills, and space physiology and medicine. Candidates also spend time in simulation facilities to learn how to work in a space environment. Toward the end of their training, they prepare for their specific mission assignment.

For more details about astronaut selection, the candidate program, and related information, visit NASA's Astronauts Landing Page.

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