

The Solar System

Introduction

When you notice the sun, you're observing one part of our **solar system**. Earth is a part of this system, as are other planets and other objects that move around our sun.

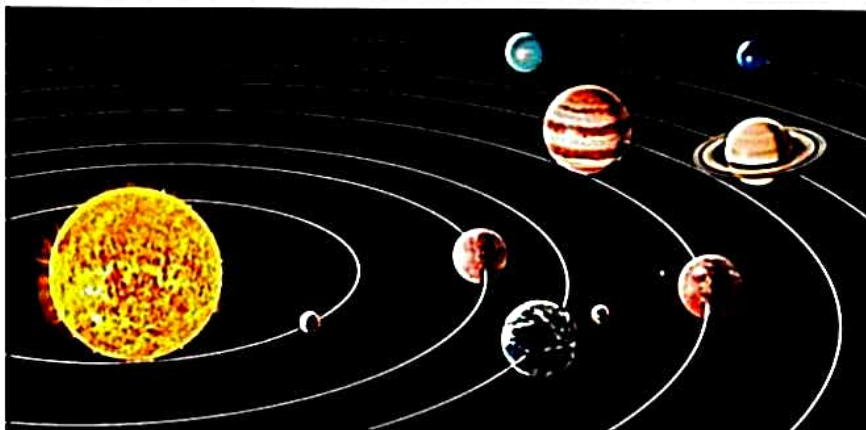
A solar system includes at least one star and the objects that travel around it. Some of these objects are planets, large spheres that move around the star. Other objects in a solar system include moons, asteroids, comets, and particles of rock and dust. The path an object follows around another object in space is called its **orbit**. Objects are held in orbit by the force of gravity.

Our solar system has one star—the sun—and eight planets. Other solar systems have more than one star at their center.

What is the solar system?

solar system, n. a system of objects in space that includes at least one star, planets, their moons, asteroids, comets, and other space debris

orbit, n. the oval-shaped path an object follows as it revolves around another object in space (v. to revolve around another object)



Artists illustrate the solar system to show its main objects and their orbits. But they can't all actually be photographed together. They are millions of miles apart.

Our Solar System Contains Some Rocky Planets

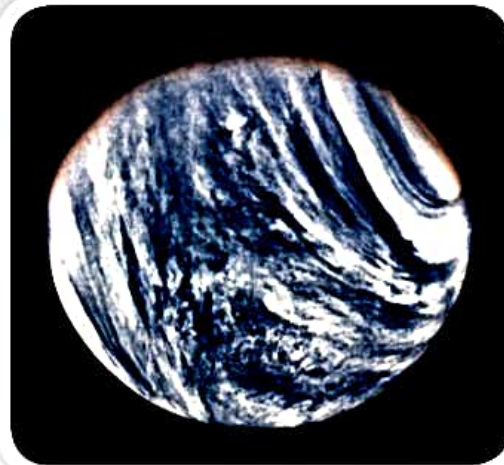
When our solar system formed over four billion years ago, only rocky materials could survive the heat near the sun. Eventually, these rocky materials formed planets. The four closest planets to the sun are made up mainly of rock and metal. Each has a solid surface and is known as a terrestrial planet.

Mercury: Mercury is the smallest of the terrestrial planets and the one that is closest to the sun. How close? It is approximately 35,600,000 miles away! Mercury is only slightly larger than Earth's moon, and it orbits the sun once every eighty-eight days. Its surface is very hot.



An instrument aboard NASA's *Messenger* spacecraft made this image of Mercury's surface.

Venus: Venus may not be the closest planet to the sun, but it is the hottest! That is because Venus has a very dense atmosphere. Sunlight passes through Venus's atmosphere and is reflected off the surface. But then it is reflected back to the surface by the thick atmosphere. Venus is almost 67 million miles from the sun. It is about the same size as Earth and has many of the same features, including mountains and volcanoes. At one time, Venus may have even had a shallow ocean.



This photo from the *Mariner 10* spacecraft shows clouds swirling above Venus's surface.

Earth: Earth, the third planet from the sun, is the only planet known to support life. Earth's temperature, the amount of water on and below its surface, and the mix of gases in its atmosphere all make life possible. Earth also has its own moon. In fact, it is the only planet with just one moon. Mercury and Venus do not have moons, and the remaining five planets have two or more.

Mars: Mars, the fourth planet from the sun, is about half the size of Earth. It has a thin atmosphere and is very cold, with an average temperature of -81°F . The surface of Mars is dotted with mountains, craters, canyons, and volcanoes. There is no evidence, now, that life exists on Mars. But evidence of water on Mars has led scientists to consider that it may have supported life at one time.



What features of Earth do you notice when you look at this image taken from space?



Mars is sometimes called the "red planet" because large amounts of iron in the soil give it a reddish color.

Our Solar System Contains Some Gaseous Planets

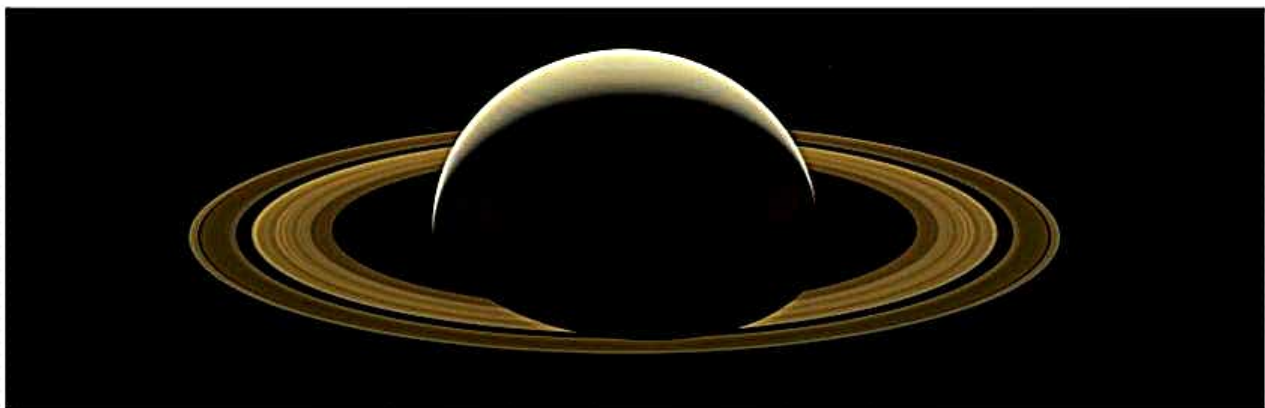
The other four planets in our solar system are classified as either ice giants or gas giants. These very large planets do not have a definite surface. Instead of a rocky ground, they are mostly made up of gases, and only their small cores at the very center are solid.

Jupiter: Jupiter is the largest planet in our solar system. Jupiter also has seventy-nine different moons that we know of! Most people identify Jupiter by its colorful surface and the presence of its Great Red Spot. This spot is actually a huge storm that has been occurring for hundreds of years. The gases in Jupiter's atmosphere are mostly hydrogen and helium, the same elements that make up the sun.



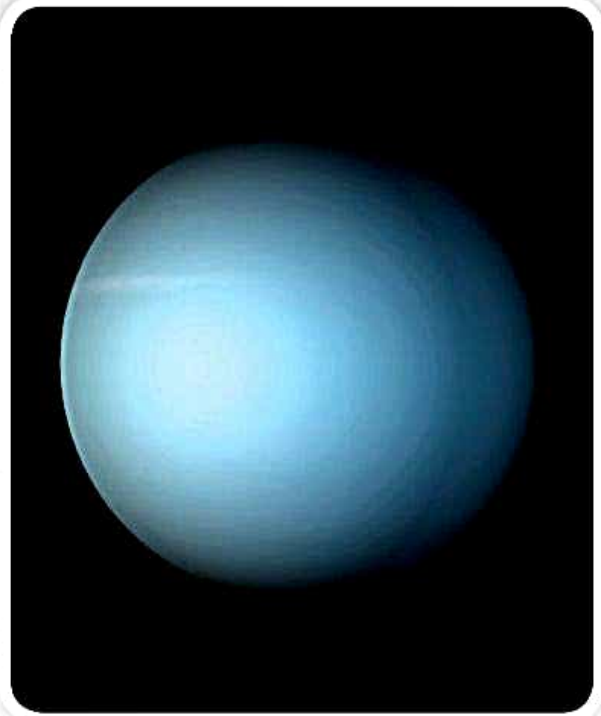
Jupiter is eleven times the width of Earth.

Saturn: Saturn is nearly a billion miles from the sun. Like Jupiter, it is a gas giant that is made up mainly of hydrogen and helium. Saturn is most famous for its rings. Saturn has over fifty moons, and some of them may have the ability to support life.



Saturn's rings are made up of chunks of rock and ice.

Uranus: Uranus is one of the two ice giants. It is made up mostly of water, methane gas, and other materials. Methane is what gives Uranus its blue-green color. Uranus is a very cold and windy planet. Wind speeds can reach up to 560 miles per hour! Like Saturn, Uranus has rings. One characteristic that makes Uranus unique is that it tilts almost completely on its side as it orbits the sun.



Uranus as seen from *Voyager 2*. What gives Uranus its blue-green color?

Neptune: The other ice giant is Neptune, which is also the farthest planet from the sun. Neptune is very dark, windy, and cold. Its winds can reach up to 1,200 miles per hour. Like Uranus and the gas giants, Neptune does not have a solid surface. Its structure is similar to Uranus, with a swirling mixture of water, methane gas, and other materials. Some scientists think there may be a hot ocean deep under Neptune's clouds of gases.

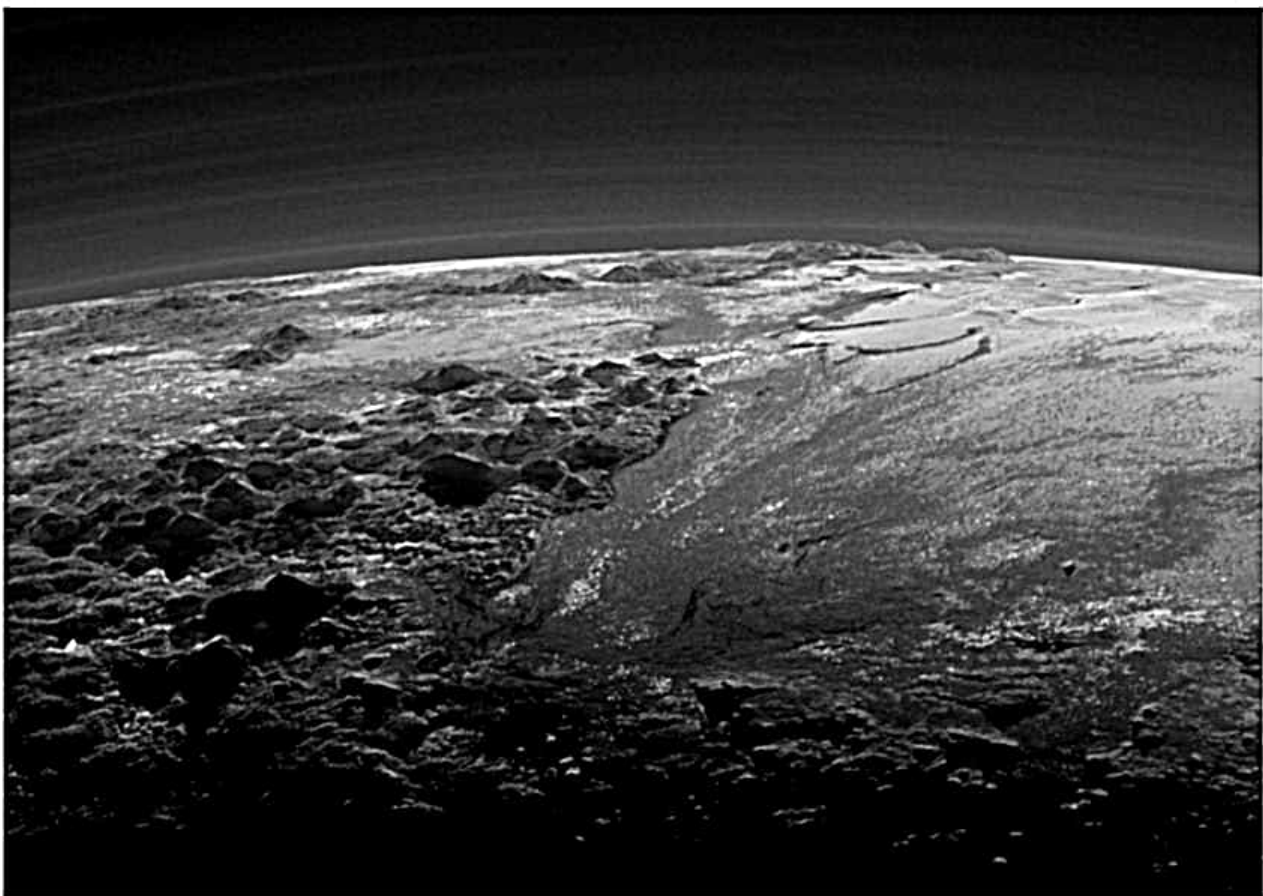


Why are there no rocky features to be seen on Neptune's surface?

Our Solar System Contains Other Space Objects

The sun and planets and their moons are major parts of the solar system. But the solar system contains other objects, too. Some of these objects are dwarf planets. A dwarf planet has some, but not all, of the characteristics of regular planets. Pluto is one example of a dwarf planet. Scientists have identified and named five dwarf planets. They are farther from the sun than Neptune.

Asteroids, meteors, and comets are also part of our solar system, all orbiting the sun and interacting with the planets. These objects range in size from small particles to large bodies that are hundreds of miles across. Comets contain ice and dust. When they are close to the sun, they form a "tail" of gas and other material.

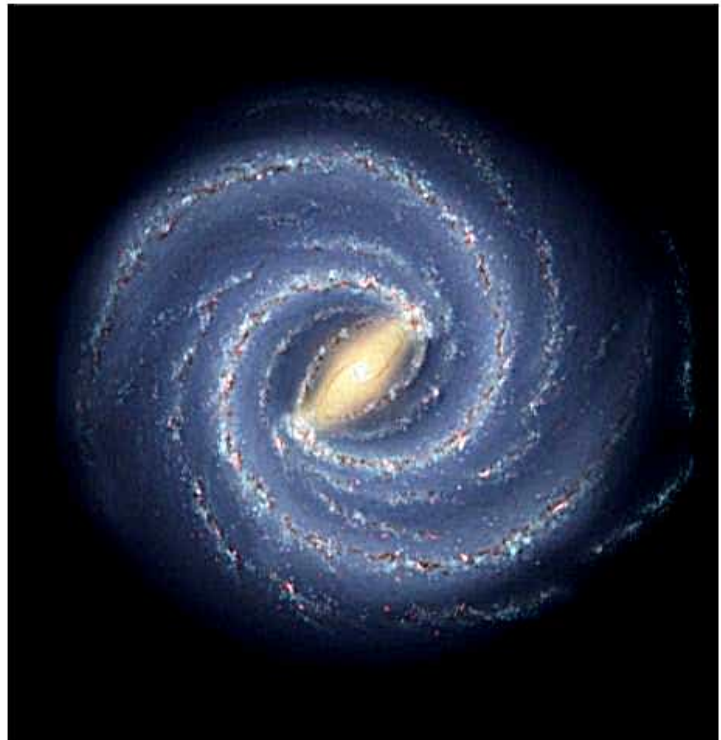


A NASA spacecraft called *New Horizons* captured this photo of Pluto's icy mountains and frozen plains.

Our Solar System Is Part of the Milky Way Galaxy

Our solar system is part of a galaxy known as the Milky Way. The Milky Way is a large, spiral-shaped galaxy that likely contains billions of other solar systems. Our solar system is located on one of the Milky Way's outer arms. All of the stars that you can see in the night sky are part of the Milky Way. Just as objects orbit the sun, our solar system revolves around the center of the Milky Way.

No person or spacecraft has ever traveled outside of the Milky Way to look back and take a picture of it. Scientists have pieced together clues from telescope images and other data to determine the Milky Way's shape and what it is made of.



Think about why the Milky Way galaxy might be named the way it is.

Galaxies Are Part of the Universe

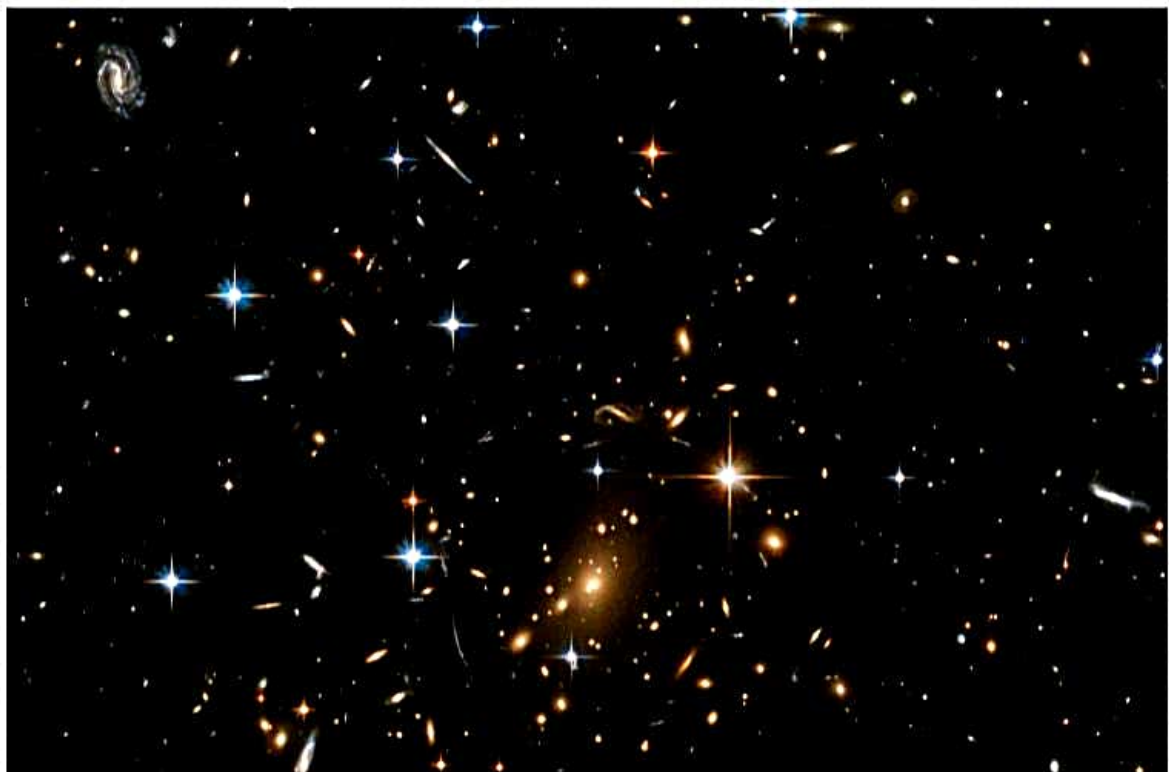
Objects in space move and interact as systems. Scientists study systems and their parts to better understand and explain what they are made of and how they work. The sun, Earth, and other planets are part of a solar system. Our solar system is part of the Milky Way galaxy.

The Milky Way galaxy is one galaxy in a very vast **universe**. The universe contains everything in space, including all forms of matter and energy.

Vocabulary

universe, n. all of the existing matter and energy in space

Over the years, scientists have collected data about the universe. They estimate that it is approximately 13.77 billion years old. It may have begun as a very small ball of hot, dense matter that suddenly exploded. It continues to spread out. How do scientists know this? By observing that galaxies are getting farther apart.



This image from the Hubble Space Telescope captured approximately fifteen thousand of the galaxies in the universe.

People Use Technology to Explore Space

Scientists have been using technology to observe, measure, and explore space for many years now. Over time, people have developed many tools for space exploration, including rovers, probes, satellites, and telescopes. Humans control these instruments from Earth.

Rovers: A rover is a probe that can travel after it has landed. It's a robotic vehicle remotely controlled to study the surface of a planet or moon. Rovers gather samples and collect data. They send information back to scientists on Earth. A rover named *Curiosity* landed on Mars in 2012. One of its purposes is to help scientists determine whether Mars might host tiny life-forms called microbes. *Curiosity* analyzes soil and rock samples. Two earlier rovers, *Spirit* and *Opportunity*, landed on Mars in 2004. They were intended to operate for about three months. But *Spirit* continued to collect data for ten years, and *Opportunity* operated for fourteen years. They found evidence that Mars used to have a watery surface and warmer climate.



In addition to transmitting photos back to Earth, rovers have instruments that determine the chemical makeup of material samples.

Probes: A probe is a kind of spacecraft that is launched from Earth on a rocket and sends information back to Earth via radio signals. Some probes land on other planets or moons and send back data from their landing site. Other probes collect data about the objects they are studying as they fly by without landing. The *Voyager* probes have traveled, and are still traveling, farther than any other spacecraft.

Satellites: A satellite is either a natural or human-made object that orbits another object. Human-made satellites are launched from Earth on rockets and guided into orbit around the objects they are sent to study. Satellites gather data, including photos, and transmit them back to Earth. Satellites take photos of planets, asteroids, and other objects of the universe. They help scientists study parts of the universe that are difficult to explore.

Telescopes: Telescopes are instruments that show faraway objects in greater detail. Telescopes may consist of lenses and mirrors that focus light to magnify images. Or they may collect radio waves from distant objects and use them to construct pictures of the objects. The Hubble Space Telescope was launched into space in 1990. Hubble collects light. It has revealed the formation of stars and images of distant galaxies.



The Hubble Space Telescope took this image of clouds of dust and gas. Scientists call this the Pillars of Creation. They were released during the formation of new stars inside the Eagle Nebula.

Humans Explore Space



John Glenn climbs into the *Friendship 7* spacecraft.

Probes, rovers, satellites, and telescopes are spacecrafts that travel without humans on board. But there have also been spacecraft that have taken human crews into space. Women and men from many different nations have orbited Earth, and some even visited the moon.

On May 5, 1961, Alan Shepard became the first American to travel to space. He flew aboard the *Freedom 7* spacecraft, and the flight lasted about fifteen minutes. This mission gave scientists valuable information about how the human body behaves during space travel. It also helped them identify and fix problems with space flight equipment and procedures.

Just a few months later, John Glenn became the first American to completely orbit Earth. He circled the Earth three times in just under five hours inside an aircraft known as *Friendship 7*.

Words to Know

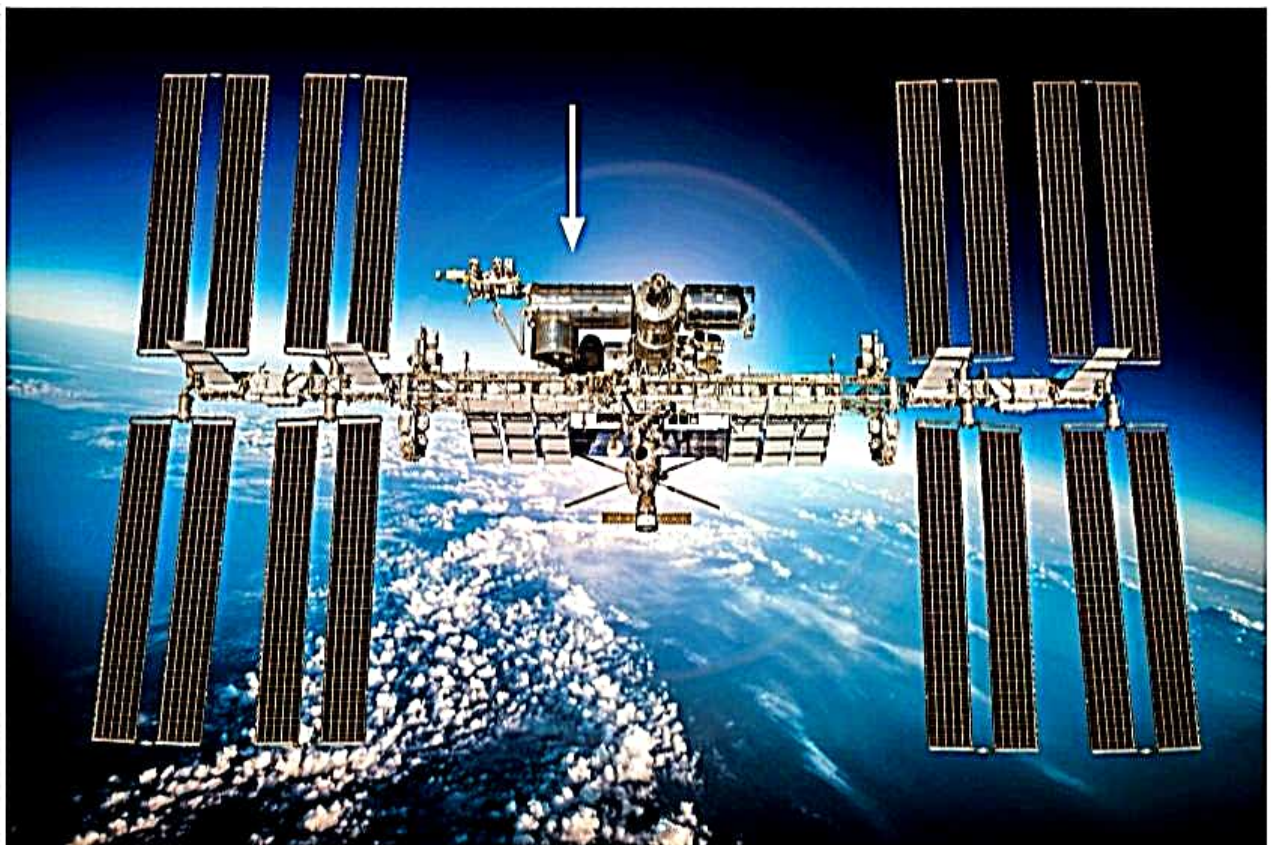
A *crew* is the person or group of people who carry out duties aboard a vessel.

Uncrewed spacecrafts do not carry people.

Crewed missions have people onboard.

Humans first landed on the moon on July 20, 1969, during the Apollo 11 mission. American Astronauts Edwin “Buzz” Aldrin and Neil Armstrong landed their lunar module, the *Eagle*, on the moon’s surface in an area known as the Sea of Tranquility. They spent two hours on the moon. During this time, they collected rock and soil samples. They also conducted experiments to learn more about the moon’s environment.

Space Station: Did you know that there is a place in space where humans can live for days, weeks, or even months? The International Space Station (ISS) is a moving laboratory in space. It orbits Earth once every ninety minutes. Scientists from around the world arrive at the ISS via spacecraft. Then they live there while they conduct experiments in physical science, Earth science, and biology. If you go outside on a clear night, you may be able to see the ISS as it travels across the sky!



Astronauts live and work inside the tube-shaped modules of the station for months at a time. The section that the arrow points to in this picture is about the size of a school bus.