

Measurements

In order to accurately scale the solar system, we had to do some math. We had to scale the system so that Pluto would end near the end of the trail.

First, we measured the total distance of the trail, which was about 0.413 miles.

Then, we took the distance to Pluto in miles and divided it by the length of the trail to find the scale factor. That's 3.7 billion divided by 0.413, which is 8,958,837,772. That's not a distance, but the scale factor of how much we need to scale the model.

We then took the distance of Mercury from the Sun, in miles, and divided it by the scale factor. Mercury is about 42,900,000 miles from the Sun, so 42,900,000 divided by 8,958,837,772 is 0.0048.

0.0048 is now the distance along the trail that we need to put Mercury to be precise. Since it's hard to know how far 0.0048 miles is, we converted it to feet. 0.0048 miles is about 25.3 feet, so Mercury is 25.3 feet away from the Sun on our scale.

To summarize: take the distance of the planet to the Sun, in miles, divide it by the scale factor, and convert that number into feet.

The Sun

Age: 4.6 billion years old

Gravity: 2,796% of Earth

Composition

The Sun is a giant sphere of gas and plasma, which is often referred to as the fourth state of matter. It seems to be made of fire the way it looks and heats things up, but there is no fire involved with the Sun. It has many layers, just like the Earth. Those layers, starting from the innermost and going outward, are:

- Core
- Radiative Zone
- Convection Zone
- Photosphere
- Chromosphere
- Corona

The Core is the hottest section of the Sun. It reaches temperatures of 27 million degrees Fahrenheit (27,000,000° F). This is where the Sun's 'engine' is. The Sun creates energy and heat from a process called nuclear fusion. This is the process of combining two light atoms into one heavier atom. This produces energy in the form of heat and particles called photons, which then travel through the other layers. Photons are little packets of pure energy, and they make up light. Once the photons reach the next layer called the radiative zone, they get bumped around and pushed off course. Each time the photon gets bumped, it only travels a few millimeters before it gets hit again. Because of this, it can take hundreds of thousands of years for a photon to reach the Sun's surface and fly through space. The next layer is the convection zone where energy gets cycled, and it extends out to the surface of the Sun. This is where the heat and plasma get caught in loops. These loops catch plasma, bring it up to the surface, and then pull it back underneath. This process creates granules on the surface of the Sun. The surface of the Sun is called the photosphere. It extends several hundred miles above the surface. This is where the light and heat from the Sun escapes out into space. The chromosphere is the next layer, which is almost like an atmosphere for the Sun. Unlike the lower layers, the farther you get from the Sun in the chromosphere, the hotter it gets. This fact has been confusing scientists for a long time, and they aren't sure why this happens. The corona is even hotter than the chromosphere, and

it's the last layer of the Sun. This layer is only visible during a solar eclipse when the Moon passes directly between the Sun and the Earth.

Spacecraft Missions

There has only ever been one mission to the Sun. It is called the Parker Solar Probe, and it was only recently launched in 2018. Because the Sun has so much gravity and heat, it is a difficult challenge to engineer a probe with scientific tools capable of withstanding the environment. The probe only reached the Sun in 2021, when it flew through the corona. In doing so, it reached the fastest speed by any man-made object ever. At its closest point, the probe reached a staggering 430,000 mph. With that same speed, it could make a complete circle around the Earth in just 3.5 minutes. While that is incredibly fast, it's still only 6% the speed of light.

Mythology

Astronomers use a system to name planets and moons in our solar system. They name the planets after Roman gods and goddesses and the Moons after the Greek gods and goddesses. The Sun was named after the Roman god Sol. Sol wasn't necessarily the god of anything, it was simply the personification of the Sun itself.

Because the Sun is so big, the material on its surface takes different amounts of time to rotate. It takes 24.5 Earth days for material around the equator of the Sun to make it all the way around. Material on the top of the Sun takes 34 Earth days to make it around.

Stars are classified in different categories and sub-categories. The main categories are O-B-A-F-G-K-M. O is the biggest and hottest and M is the smallest and coolest. Within each of those categories, there are numbers 0-9 that define how hot the star is. 0 is the hottest and 9 is the coolest star within that category. The Sun is classified as a G2 star, so it is a very average star.

Mercury

Age: 4.5 billion years old

Gravity: 38% of Earth

Composition

The core of mercury is split into two sections. The inner core is hotter and is suspected to be solid metal, while the outer core is molten metal. The total of the two sections takes up almost 85% of the planet's radius. The mantle is the next section, which is a mix of rock and molten material. The surface is the last layer, which features valleys and ridges due to the forces from the Sun stretching and compressing the planet.

Spacecraft Missions

The first spacecraft to visit Mercury was the Mariner 10 mission, launched in 1973. Its mission was to fly past Mercury and Venus and take pictures and collect whatever data it could about the planets, including gravity, infrared images, and many others. The Messenger mission was the next probe to be sent to Mercury. It was launched in 2004 and had the sole purpose of studying Mercury. It reached Mercury in 2011 and spent four years orbiting the planet. It studied Mercury's magnetic field, geology, and chemical composition. It was decommissioned in 2015 when NASA gave it the command to smash itself into the planet and destroy itself. The ESA and JAXA, the European and Japanese versions of NASA, respectively, just recently launched a mission to Mercury. It launched in 2018 and made its first flyby of Mercury in 2021. The mission has a fun name to say: BepiColombo. It hasn't yet begun collecting data, however. The plan is to steer the craft into a proper position and start taking data in 2026.

Mythology

Mercury is the Roman god of travelers and communication. Because he had to communicate messages quickly, he was the fastest god and had wings on his ankles to fly (that is the logo inspiration of the materials and tire company Goodyear). Astronomers named the planet Mercury because it is the closest planet to the Sun and orbits the fastest of all the planets.

Because Mercury is so close to the Sun, it receives a lot of solar radiation. Solar radiation, also called the solar wind even though it really isn't wind, is a term that encompasses heat, light, and radioactivity. It's possible that Mercury has ice on its surface, but it would only be in craters with permanent shadows.

Venus

Age: 4.5 billion years old

Gravity: 91% of Earth

Composition

The composition of Venus is one of the simplest in the solar system. Its core is mostly metallic liquid followed by a rocky mantle very similar to Earth's. The surface hasn't been studied extensively because we can't see it very well because of the atmosphere. The surface should be similar to Earth in terms of terrain, but no oceans, water, or life. The atmosphere is incredibly thick and mainly consists of carbon dioxide (CO₂) and sulfuric acid. Both of those chemicals are deadly for humans, so that combined with the pressure and temperature means Venus is not habitable for humans. During the daytime, temperatures can get as hot as 900° F, which is enough to cook a pizza perfectly in about 7 seconds. The reason Venus is so hot is because of a similar effect to what we call global warming. The thick atmosphere of Venus consists of the right chemicals to trap the heat in. The heat from the Sun is brought in through the atmosphere and can't get out, so it constantly heats up the planet.

Spacecraft Missions

There have been over 20 missions to Venus. The first mission was Mariner 2, which launched in 1962 and reached the planet in the same year. Mariner 2 was also the first mission to venture beyond Earth to another planet. The most recent mission was ESA's Solar Orbiter in 2020, which just made a flyby of Venus and collected brief data. The USSR was more successful than the U.S. at landing missions on Venus. The USSR landed 12 missions on Venus successfully. NASA's only successful landing was the Pioneer Venus 2 mission in 1978, and it only survived for an hour before it was crushed and then melted.

Mythology

Venus is the Roman god of love and beauty. Astronomers named the planet Venus because it is the brightest planet in the night sky and the third brightest object in the sky overall, making it more beautiful to observers.

Venus has a very unique feature that no other planet we've ever discovered has. Venus spins in the opposite direction than every other planet in the solar system. Imagine you're looking down at the solar system, like tops on a table. All the planets spin counterclockwise while Venus spins clockwise. Astronomers aren't entirely sure why this is, but they think Venus was hit by a planet-size object in the early solar system and had its spin flipped.

Venus and Mercury are also special to us on Earth. These two planets have phases, just like the Moon. Because Mercury and Venus are the only planets closer to the Sun than us, they are the only planets that have phases. Although it takes different amounts of time, Mercury and Venus will go through crescent, full, and new phases. Venus is the third brightest object in the sky and the second brightest in the night sky. The only objects brighter are the full Moon and the Sun. Since you can't see the Sun at night, only the full Moon is brighter (it takes about 2 weeks to go from one full Moon to the next full Moon).

Earth

Age: 4.5 billion years old

Gravity: 9.81 m/s^2 (m/s^2 is the standard unit for acceleration)

Composition

Earth has 4 main layers acting similar to Venus. Earth has a solid metallic and rocky inner core with a somewhat molten outer core. Earth has a large mantle of metal and rock. Earth is one of the only planets to have volcanic activity, and we can see that in the form of volcano eruptions and underwater sea vents. The surface is where all life lives. Earth's atmosphere is mostly nitrogen and oxygen with a few other chemicals in small amounts. Earth's atmosphere is one of the only known planets with water vapor (clouds).

Spacecraft Missions

There are no spacecraft missions since we live on this planet. All rocket launches have come from Earth, but none were designed to explore Earth. There are spacecraft in orbit around the Earth, however. Two fully operational satellites include the International Space Station (ISS) and Tiangong, which is China's version of the ISS. NASA recently announced that they plan to de-orbit the ISS sometime around 2030. That means they plan on crashing it back into the Earth and gathering the materials to repurpose them. But as of now, the ISS orbits roughly 254 miles up at a speed of about 4.76 miles per second. That means it completes an orbit around the Earth in 90 minutes, and the astronauts get to witness 16 sunrises and sunsets each day. You can see it occasionally if it passes overhead at night. Given that it comes around the Earth every 90 minutes, it's pretty easy to spot. It looks like a star moving quickly across the sky. There have also been 21 different countries that have had a representative on the ISS.

Mythology

The Roman god of the Earth was named Terra. It isn't the name of our planet, but it's the origin of words like terrain, which describe the Earth.

Contrary to popular belief, the Earth is not a perfect sphere. The most correct shape of Earth is what's called an oblate spheroid, which just means it's a ball that bulges out a little extra around the equator.

The Earth sits at 1 AU from the Sun. We defined an AU, which is an Astronomical Unit, as the distance between the Earth and the Sun. It helps make units work on planetary scales but quickly becomes useless outside the solar system.

The Earth has a very strong magnetic field that protects us from the Sun. The Sun emits solar radiation, discussed in Mercury's section, and it's harmful to life on Earth in large quantities. A magnetic field helps deflect these particles. When the particles fly through space and hit Earth's magnetic field, they get caught and travel towards the north and south poles. When the energetic particles hit Earth's atmosphere later on, the atmosphere starts to glow. This is what causes the northern auroras, called the aurora borealis, and the southern auroras, called aurora australis.

Moon

Age: 4.5 billion years old

Gravity: 17% of Earth

Composition

The Moon is very similar to Venus in terms of composition. The Moon has a metallic but small core followed by a large mantle. The mantle is the source of moonquakes, which is the lunar equivalent to earthquakes. However, these events don't happen in the same way. Earthquakes are caused by tectonic plates rubbing against one another as they drift, and moonquakes can be caused by meteoroids hitting the surface and sometimes the forces from Earth squeezing it. The surface of the moon is unique because we can only see half of it. Unlike other planets and moons, we only ever see one side of the Moon. This is because the Moon is tidally locked with Earth, meaning that the forces from Earth balance the moon so that as the Moon rotates around the Earth, the same side always faces the surface. The opposite side of the Moon, sometimes referred to as the 'dark side' (and the inspiration for many songs) is less cratered and is arguably more visually boring. There are quotes around 'dark side' because it's not always dark. During a new moon, when the moon is in between the Sun and the Earth but not enough to cause a solar eclipse, the other side of the Moon is bright and the side that faces us is dark. There are some craters on the Moon that never see sunlight, and frozen water has been found in some of those places. The ice isn't in large quantities, but astronauts plan on using it for NASA's future Artemis missions.

Spacecraft Missions

Perhaps some of the most famous rocket launches ever, the Apollo missions were designed to beat the Soviet Union to the Moon. Both NASA and the USSR tried to reach the Moon first and take humanity's first steps on the lunar surface. There were 14 launches by NASA in the Apollo missions, the most notable being Apollo 1 and Apollo 11. Apollo 1 was a tragedy to start the series, when a fire broke out on the rocket and killed the three astronauts onboard. Apollo 11 was when we reached the surface for the first time. It was also when the astronauts famously stuck an American flag in the surface of the Moon. However, in order to see the flag, you'd need a telescope with a diameter of over 2 football fields. Not only is that cost-prohibitive, but it's nearly impossible to build because the glass in the middle of the lens would sag due to gravity. The Soviet Union beat NASA to

space, however. In 1961, the Soviet successfully launched the first man in space, named Yuri Gagarin.

In total, there have been over 40 missions to the Moon. Nearly every country that has launch capabilities has sent a mission to the Moon. Because of the frequency of Moon launches and subsequent research, the Moon is the only major object in the solar system that we have a physical sample of.

NASA is currently in the process of planning the Artemis missions, which are a series of missions that will eventually allow humans to live on the Moon. Artemis 1 launched on November 16, 2022. It traveled around the Moon to collect data on potential landing sites and how gravity affects the spacecraft. No one was onboard. Artemis 2 is planned to launch in November of 2024, and it will be the first crewed mission to orbit the Moon since 1972. It will lay down infrastructure for habitat structures and the Gateway. The Gateway is NASA's approach to how astronauts will get to the lunar surface multiple times. It will orbit the Moon and act like how the International Space Station does now. It will also provide infrastructure for missions farther into the solar system, like Mars. Artemis 3 will hopefully land astronauts on the lunar surface. The astronauts will spend roughly a week on the Moon, learning how to survive and stay healthy away from Earth.

Mythology

The Roman god of the Moon was named Luna. She is often referred to as the female companion of the god Sol. Just like Sol, Luna did not "govern" over anything, she was just the embodiment of the Moon.

Mars

Age: 4.6 billion years old

Gravity: 38% of Earth

Composition

Mars is made of a somewhat molten core. Beyond the core is a mantle similar to Earth's in terms of chemical composition and size relative to the whole planet. The surface is the last solid layer. Several rovers are currently on the surface, but not all of them are operational. The rover that landed most recently, Perseverance, has seen strong evidence for liquid water. The Italian astronomer Schiaparelli first described Mars as having what looked like dried-up channels and rivers where water used to flow. Perseverance was sent near one of the channels that Schiaparelli saw and began exploring. It has seen rocks that are almost spherical, leading scientists to believe that water used to flow, and the rocks bumped against each other enough to make them spherical. This process is very similar to putting rocks in a tumbler to polish them. It has also seen different types of rocks that are almost always found in or near bodies of water. There is currently no water on the surface, but there could be reservoirs underground. Mars does have polar ice caps, but they are made of carbon dioxide (CO₂), which is also called dry ice, and aren't truly water. Mars' atmosphere is mostly made of carbon dioxide as well, with trace amount of nitrogen and oxygen. The daytime sky on Mars is orange/red, while sunsets are typically blue. This is almost the opposite of what we see on Earth, with the daytime sky being blue and the sunsets being orange/red. This is because of the size of the particles and the chemical composition of the atmosphere. Larger particles in the atmosphere cause a more orange/red appearance and smaller particles will turn the sky bluer.

Spacecraft Missions

There have been more than 40 missions to Mars. Some of the more famous launches were the rovers NASA sent. Those missions included Viking, Pathfinder, Spirit, Opportunity, Curiosity, and Perseverance. Perseverance was the most recent launch, and it has collected samples of the Martian surface to analyze later. The sample-return mission is planned to launch in 2026. Perseverance was also the first mission to include a small drone called Ingenuity. Ingenuity was the first drone or flying vehicle of any type to be flown on another planet. Scientists weren't sure if the drone would work because Mars' atmosphere is much thinner than Earth's. It

worked entirely as hoped and is still operational and flying on Mars today. Spirit and Opportunity were missions that went extremely well, so much so that the engineers and scientists were unprepared for it. Spirit and Opportunity were sister missions, launched within a few weeks of each other. They were only designed to last about 90 days. But when day 90 came around, both were still operational and functioning properly. So, the scientists had fun with them. They drove them as fast as the wheels would allow, took data they didn't expect to collect, and took pictures they never thought would be possible. Once the rovers had been on the surface for a year, the team in charge took turns guessing whether they would still be functioning the next year. The last transmission from Spirit was on March 22, 2010. The 90-day mission lasted just over 6 years. But Opportunity kept going. Opportunity traveled much farther than expected because it was still operational. The last message came on June 10, 2018. This 90-day mission lasted over 14 years, which was enough time for the kids who watched the rocket launch to grow up and work on the rover as adults. To learn more about this, watch Good Night Oppy on Prime Video.

Moons

Mars has two moons called Phobos and Deimos. The names come from the Greek myth, where Phobos and Deimos (meaning fear and panic, respectively) pulled the chariot of Ares, which is the Greek counterpart of the Roman god of war called Mars. They are both thought to be captured asteroids, so they are very lumpy and small.

Mythology

Mars was the Roman god of war. It got that name because Mars appears as a red color in telescopes, almost like blood. Its two moons are named after Greek gods (see above).

Mars has the largest volcano in the solar system called Olympus Mons. It's a gradual slope up to the summit, but in total it is about 14 miles tall. It last erupted about 25 million years ago, and it doesn't look likely that it will erupt again, but it's possible.

Mars has seasons just like Earth. Each is twice as long as the seasons on Earth, so it takes 2 Earth years to see Mars go through its 4 seasons. The only major visual difference in what happens is that in the spring and summer, the polar ice caps get smaller by melting a little and get a little bigger in the colder seasons of autumn and winter. Clouds can sometimes form in the summertime, but not always.

Asteroid Belt/Ceres

Age: 4.5 billion years old

Composition

There are an estimated 1.5 million asteroids in the asteroid belt. However, because they occupy a large space between Mars and Jupiter, they are not very densely packed. The largest object, Ceres, is only about 75% the size of the state of Texas. However, it makes up nearly 40% of the total mass of the asteroid belt. The second largest object, Vesta, is only slightly bigger than Pennsylvania. Most of the asteroids are much smaller, roughly the size of the rocks that make up gravel. Don't worry about any of these hitting Earth. Astronomers can accurately predict the path of asteroids even if one of them veered off course, which is highly unlikely.

Spacecraft Missions

There have been 15 missions to the asteroid belt. Almost all of them were designed for sample returns, which is taking a sample of an asteroid or comet and bringing it back to Earth. One of the most well-known missions was the extremely recent DART mission. It launched in 2021 and was intended to impact an asteroid. The two asteroids in question were Didymos and Dimorphos. Didymos is essentially stationary and Dimorphos orbited it. The plan was to hit Dimorphos and see how its orbit around Didymos changed. This system was an ideal target because scientists could easily track Dimorphos' orbit and it was large enough to see well. The mission was more than a success. Originally, Dimorphos orbited Didymos every 11 hours and 55 minutes. A successful impact would have shortened the period by at least 73 seconds. But the impact shortened the period by 32 minutes, which was 25 times more than expected. This means that a mission similar to DART could save the Earth from any threatening asteroids in the future.

Jupiter

Age: 4.5 billion years old

Gravity: 253% of Earth

Composition

Jupiter is the nearest gas giant to the Sun. It makes up about 70% of all the planetary material in the solar system. It is made almost entirely of hydrogen and helium, two of the most prevalent gases in the universe. The core is solid, made of heavier gases and compressed hydrogen and helium. The next layer is what is referred to as the fluid layer. It is also made of hydrogen and helium, but it is an exotic fluid because of the pressure. Down in the fluid layer, the enormous atmosphere pushes on the atoms so much that the electrons leave, and it creates a sea of liquid hydrogen that conducts like a metal. This layer slowly turns into the next layer, which is still liquid, but doesn't have the strange properties as the fluid layer since there isn't as much pressure. This 'normal' sea of hydrogen and helium slowly dissipates into a gas surrounding the planet. Because the atmosphere is so turbulent, Jupiter regularly churns up hurricanes that are nearly double the size of Earth. One of those storms, called the Great Red Spot, is at least 342 years old, meaning it was already developed when it was first spotted in 1664 by Robert Hooke.

Spacecraft Missions

There have only been 9 missions to Jupiter so far. Two of them, Voyager 1 and 2, are currently the farthest objects from the solar system. They only recently transitioned into interstellar space, which is the space between stars and out of the influence of our Sun. Another mission, Juno, is still active and sending back pictures of Jupiter every couple of days. There are two future missions, JUICE and the Europa Clipper, that are designed to go beneath the surface of Jupiter's four major moons to look for signs of life and collect all the data they can on the surface of the moons.

Moons

Jupiter's four major moons are special. They are named Io, Callisto, Europa, and Ganymede, and together referred to as the Galilean moons. They're large enough that you can easily see them with a telescope. Io is the most volcanically active object in the solar system. It is covered in volcanoes, and they erupt constantly.

Callisto is the most heavily cratered object in the solar system. Europa has a huge subsurface ocean with about twice as much water as there is in Earth's lakes and oceans. Ganymede is the only moon known to have its own magnetic field, and it also has more water under its surface than on Earth.

Mythology

Jupiter was the Roman god of the sky and the king of the Roman gods. It was given the name because it is the largest of all the planets in the solar system. The Galilean moons are named Io, Callisto, Europa, and Ganymede (see more above). Io was a mortal, or in other words just a normal person. She was in love with Zeus, the Greek equivalent to Jupiter, as many women were. Callisto was an assistant to Artemis, the Greek goddess of hunting and wildlife. Zeus was in love with Callisto, but Callisto was not in love with Zeus. Europa's mythology is more debated, but most historians agree she was one of Zeus' partners. Ganymede was a young man who captivated the gods, so they brought him to Olympus to be one of their assistants.

Saturn

Age: 4.5 billion years old

Gravity: 107% of Earth

Composition

Saturn's solid core is made mostly of heavy metals like iron and nickel. Surrounding it is a layer of rocks and ice that gets compressed by the huge pressure and heat. That layer merges into a small layer of liquid metallic hydrogen, similar to the fluid layer of Jupiter, which slowly becomes non-metallic as you move away from the core. The rest is gaseous hydrogen and helium. Saturn has a unique but not-very-well-known feature in that it has a hurricane in the shape of a hexagon. The hurricane is centered on Saturn's north pole and while the winds whip the material around, the general shape of a hexagon remains the same. It has been there for as long as we have studied Saturn, so we don't know when it started.

Perhaps the most famous object in the solar system, Saturn is well-known for having a stunning ring system. Easily visible in a telescope from Earth, Saturn has a wide ring system composed of 7 different sections. The D ring is closest to Saturn and it is the faintest. Going outward, the C ring is the next section. The B ring is next, and it is the most visible from Earth. The Cassini division follows, and it separates the B ring from the A ring. It got its name because one of NASA's missions, the Cassini probe, flew through this gap on its way past Saturn. The A ring is next, and it is separated from the F ring by the Encke division (pronounced EN-kee). The G ring is completely separate from the rest, and it lies further out than some of Saturn's moons. The E ring is the farthest and it extends many hundreds of thousands of miles out into space and acts almost like a cloud of material.

Spacecraft Missions

There have only been 5 missions that have gone by Saturn. One of them, Cassini, flew through the gap between Saturn's A and B rings. Another mission, Huygens, landed on Titan, which is one of Saturn's many moons. The data it sent back revealed that Titan has rivers and lakes of methane and is one of the few moons in the solar system with an atmosphere.

Moons

Saturn is currently the record holder for the most moons in the solar system at 145. Jupiter only has between 80-95. Titan is one of the most well-known moons. It has lakes and rivers of liquid methane and gravity about 14% of Earth's, so if given the right equipment to survive, you could jump and fly large distances easily. It is the only other place in the solar system with flowing liquid on the surface. Enceladus is another large moon, covered in clean ice which makes it one of the most reflective bodies in the solar system. It is known to have an ocean of liquid water beneath its surface, and in May of 2023 scientists found a plume of water spewing out of the moon and reaching about 6,000 miles into space, which is roughly the distance from Seattle, WA to Santiago, Chile. That's over 20 times the diameter of the moon. Another interesting moon is Mimas, which gained popularity by its strange shape, which looks almost identical to the Death Star from Star Wars.

Mythology

Saturn was the Roman god of agriculture, abundance, and time. Since Saturn is the last planet visible with the naked eye, it was the slowest planet visible, which coincides with being the god of time. Titan was named for the pre-Olympian gods, who were referred to as the Titans, because of its unusually large size. Enceladus was a Greek giant who fought against the Olympian gods. Because Saturn has so many moons, there are numerous other moons with mythology behind them, but Titan and Enceladus are the largest moons of Saturn, so those are the only ones included.

Saturn is a special planet when it comes to density. Because the gases and clouds that make up Saturn are so light, Saturn has a density of less than 1. Water has a density of exactly 1. This means that if you built a large enough tub to fit Saturn and filled it with water, Saturn would float. It's the only known celestial object that has a density of less than 1.

Uranus

Age: 4.5 billion years old

Gravity: 91% of Earth

Composition

Uranus' core is composed of molten metals and rock. Following the core is a layer of solid water, methane, and ammonia. Note the difference between 'solid' and 'icy'. There is no ice near the core because of the pressure and heat. Rather, the pressure smushes the water, methane, and ammonia into a solid form. Past the solids is an ocean of liquid hydrogen. The visible part of Uranus is the atmosphere, composed of hydrogen, helium, and methane. Uranus also has a small ring system astronomers suspected existed. It wasn't confirmed until the James Webb Space Telescope took a picture of Uranus.

Spacecraft Missions

Uranus has only had one mission sent past it, and that was Voyager 2. Voyager 2 flew past Uranus on its way out into the cosmos, possibly to be found by another civilization many thousands of years from now.

Moons

Uranus has 27 moons. Unfortunately, they are all relatively small and they don't have many interesting features.

Mythology

Uranus was one of the primordial gods who was married to Gaia and fathered the 12 original Titans. He was usually called the god of the heavens. Uranus' moons deviate from the standard Greek myth naming. Most of Uranus' moons come from famous artistic works, like Shakespeare and many ancient poems.

Uranus rotates 98 degrees from vertical. Astronomers don't know exactly why this is, but they think it's because a large object hit Uranus sometime in the past and caused it to get flipped on its side. This is the largest rotating inclination of any object we know.

Neptune

Age: 4.5 billion years old

Gravity: 114% of Earth

Composition

Neptune is very similar to Uranus in terms of what it's made of. It has a rocky and 'icy' core, followed by a thick layer of solid water, methane, and ammonia. The atmosphere is a mix of hydrogen, helium, and methane. It has more methane than Uranus, which is why Neptune is so much bluer. Neptune also had a storm called the Great Dark Spot where winds of up to 1,500 miles per hour threw material across the planet. It was gone only 5 years later when astronomers discovered a new dark storm in a different spot. Regular winds on Neptune are around 1,200 miles per hour, so it's not a welcoming planet.

Spacecraft Missions

Neptune has also only had Voyager 2 fly past it. The only other spacecraft to fly near it was New Horizons on its way to Pluto, but it didn't get very close.

Moons

Neptune has 14 moons. The largest, Triton, is a very unique moon. It is the only moon to orbit in retrograde from the planet's rotation. That means if the planet spins clockwise, the moon orbits counterclockwise. Like our own moon, only one side of Triton faces Neptune at all times, known as synchronous rotation or tidal locking. It is also one of the few moons seen to be volcanically active.

Mythology

Neptune was the Roman god of the sea and horses. The planet was named after Neptune because it has a very deep blue color. The Greek counterpart was named Poseidon. Triton was Poseidon's son and was half man, half fish.

Pluto

Age: 4.6 billion years old

Gravity: 6.3% of Earth

Composition

Pluto is mostly rock and ice, with the majority of the planet being the rocky core. The mantle is a mix of ice and rock and there is an ocean of liquid water on top. On the surface is rock and ice. Pluto has a large region on the surface called the Tombaugh Regio that is shaped like a heart.

Spacecraft Missions

The only missions to fly past Pluto were Voyager 2 and New Horizons. New Horizons was designed to study Pluto, but it never landed on it.

Pluto has been tossed in and out of the planet category throughout history. Only in 2006 did astronomers agree what to do with it. The International Astronomical Union (IAU) held a meeting in 2006. They came up with 3 rules that planets must cover in order to be a planet. Those 3 are:

1. It must orbit the Sun

Ok, Pluto does that, so it's ok.

2. It must be big enough for gravity to force it into a spherical shape

Good, Pluto also has that.

3. It must be big enough that its own gravity has cleared out its path around the Sun for any objects similar in size.

Well, Pluto doesn't have that. It sits in the Kuiper Belt, which is similar to the asteroid belt between Mars and Jupiter (just farther out) and has lots of asteroids close to its size around it. In fact, the astronomers who revised these rules came up with the third rule specifically to get rid of Pluto as a planet because they couldn't think of any other rules that they all had. The inner planets are rocky, but the outer planets are gaseous. The inner planets are small, but the outer planets are big. In fact, Jupiter's moon Ganymede is bigger than both Mercury and Pluto. So why isn't Ganymede a planet but Mercury is? Not every planet has a moon, so that won't work. Those 3 rules the IAU laid down are what defines a planet currently, but there are many outliers.

Moons

Pluto has 5 moons. For being such a small planet, it has gathered its share of satellites. The largest moon Charon is half the size of Pluto, which makes it the largest satellite relative to the host object. Our own moon is large, but its only about a quarter of the size of the Earth. Because Pluto and Charon are so similar in size, their gravitational pulls are somewhat similar. This creates what's called a barycenter, where two objects orbit a central point in space. Almost like a teeter-totter, the heavier one object is, the closer the center of mass will be to that object, which is where the barycenter is as well. In fact, since all planets and stars have mass, barycenters are found all other the universe. Take the Earth-Sun system as an example. We don't orbit directly in the middle of the Sun, but ever so slightly off the center. This is because the Sun has so much more mass than the Earth, so the center is extremely close to the Sun, but not precisely on it.

Mythology

Pluto was the Roman god of the Underworld and death. It got its name because it is so far out in the depths of the solar system. Charon was the ferryman who transported the recently dead to the Underworld. Another one of Pluto's moons was named Styx, which is the river that flows through the Underworld.

Proxima Centauri

Age: 5 billion years old

Distance: 4.2 light years

Proxima Centauri is the closest star to Earth other than the Sun. It is a red dwarf star, which means it is old and relatively cool. It isn't cool enough that you could touch it, but it is colder than most stars. Proxima Centauri is part of a system called Alpha Centauri. Alpha Centauri is made of three stars orbiting very close to each other, but Proxima Centauri stays the closest to us.

Even though this is the closest star, it is still extremely far away. Imagine you get permission to fly the fastest airplane towards it. This is the X-15, and it can fly at 4,520 mph. That can get you from Cleveland to Los Angeles in 27 minutes. Or if you want, it can go all the way around the Earth in about 5.5 hours. But you don't want to go to Los Angeles or around the Earth, you want to go to Proxima Centauri. If you maintain a speed of 4,520 mph the whole way there, it would take you 638,461 years to get there.

We developed the signs along the Forest Buchanan trail along with seasonal brochures in the Visitors' Center to increase public awareness of astronomy. While northeast Ohio is one of the cloudiest regions in the United States, it shouldn't deter people from wanting to learn about the night sky and study it. Our ancestors thousands of years ago saw nearly the same night sky we do today, so it's a part of human nature to want to peer into the depths of the universe.

Compiled by Logan Good with assistance from University of Mount Union
Professor Jodi McCullough and Nature Center staff Cali Granger

References:

- NASA. (2023, March 22). *Sun*. NASA. <https://solarsystem.nasa.gov/solar-system/sun/overview/>
- NASA. (2019, February 11). *Mercury*. Solar System Exploration: NASA Science; NASA. <https://solarsystem.nasa.gov/planets/mercury/overview/>
- Welcome to the NSSDCA*. (2011). Nasa.gov. <https://nssdc.gsfc.nasa.gov/>
- NASA. (2019, January 31). *Venus*. Solar System Exploration: NASA Science; NASA. <https://solarsystem.nasa.gov/planets/venus/overview/>
- Garcia, M. (2016). *International Space Station Facts and Figures*. NASA. <https://www.nasa.gov/feature/facts-and-figures>
- NASA. (2019, January 28). *Ceres*. Solar System Exploration: NASA Science; NASA. <https://solarsystem.nasa.gov/planets/dwarf-planets/ceres/overview/>
- NASA. (2018, December 5). *Jupiter*. Solar System Exploration: NASA Science; NASA. <https://solarsystem.nasa.gov/planets/jupiter/overview/>
- NASA. (2019, February 10). *Saturn*. Solar System Exploration: NASA Science; NASA. <https://solarsystem.nasa.gov/planets/saturn/overview/>
- NASA. (2019, January 28). *Uranus*. Solar System Exploration: NASA Science; NASA. <https://solarsystem.nasa.gov/planets/uranus/overview/>
- NASA. (2019, January 28). *Neptune*. Solar System Exploration: NASA Science; NASA. <https://solarsystem.nasa.gov/planets/neptune/overview/>
- NASA. (2018, November 30). *Pluto*. Solar System Exploration: NASA Science; NASA. <https://solarsystem.nasa.gov/planets/dwarf-planets/pluto/overview/>
- NASA. (2014). *NASA's Mars Exploration Program*. NASA's Mars Exploration Program ; NASA. <https://mars.nasa.gov/>

Your Age on Other Worlds | *Exploratorium*. (2023, March 20).
[Www.exploratorium.edu. https://www.exploratorium.edu/explore/solar-system/age](https://www.exploratorium.edu/explore/solar-system/age)

International Astronomical Union | *IAU*. (n.d.). [Www.iau.org. https://www.iau.org/public/themes/pluto/#n4](https://www.iau.org/public/themes/pluto/#n4)

Cessna, A. (2009, August 10). *Mythology of the Planets*. Universe Today.
<https://www.universetoday.com/37122/mythology-of-the-planets/>

The Mythology of Jupiter's Moons. (2021, April 18). Goodnight Moon (ASTR 2110). <https://goodnightmoonastr2110.wordpress.com/2021/04/17/the-mythology-of-jupiters-moons/>

DART. (n.d.). Dart.jhuapl.edu. <https://dart.jhuapl.edu/>