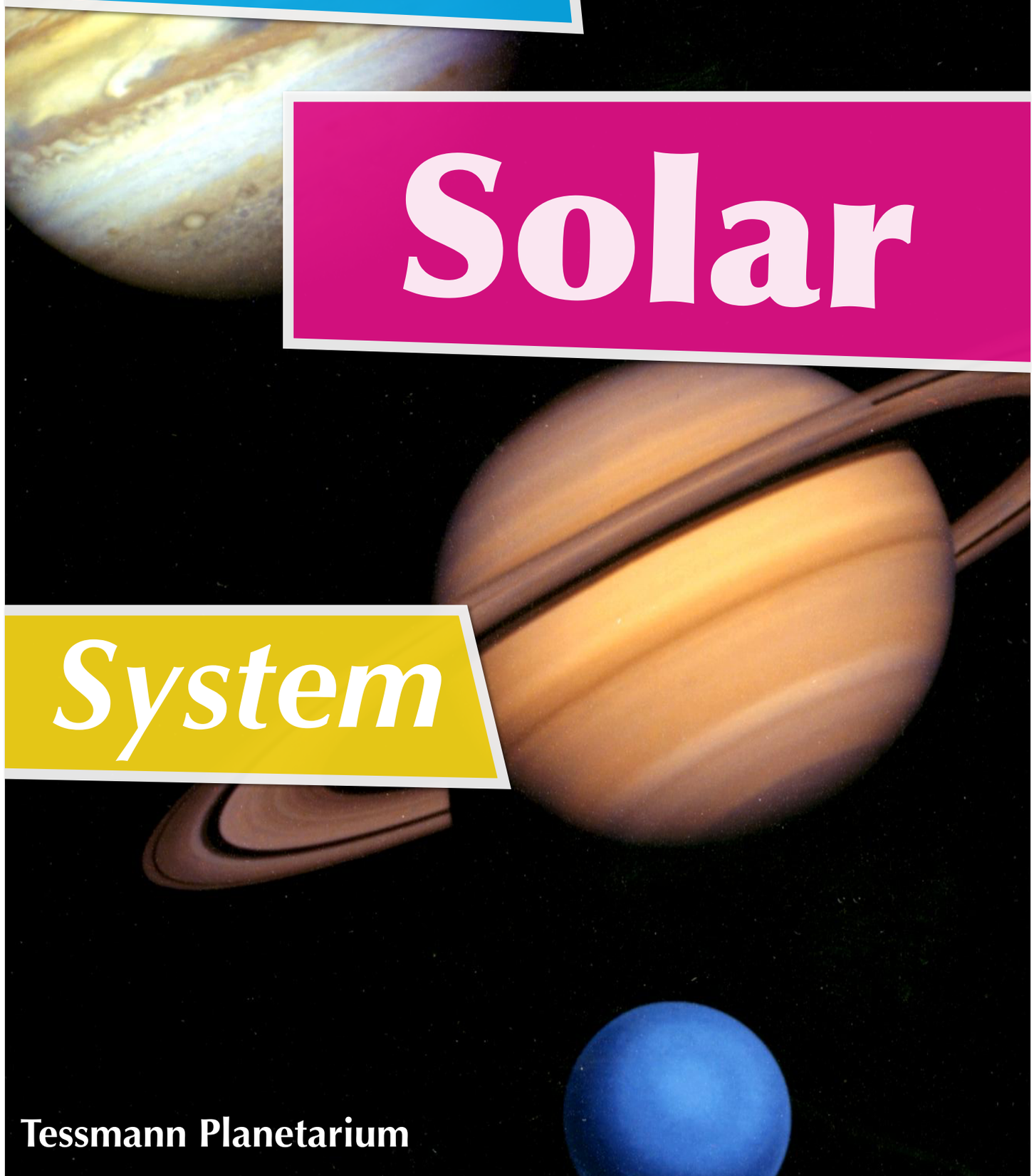
GUIDE TO THE

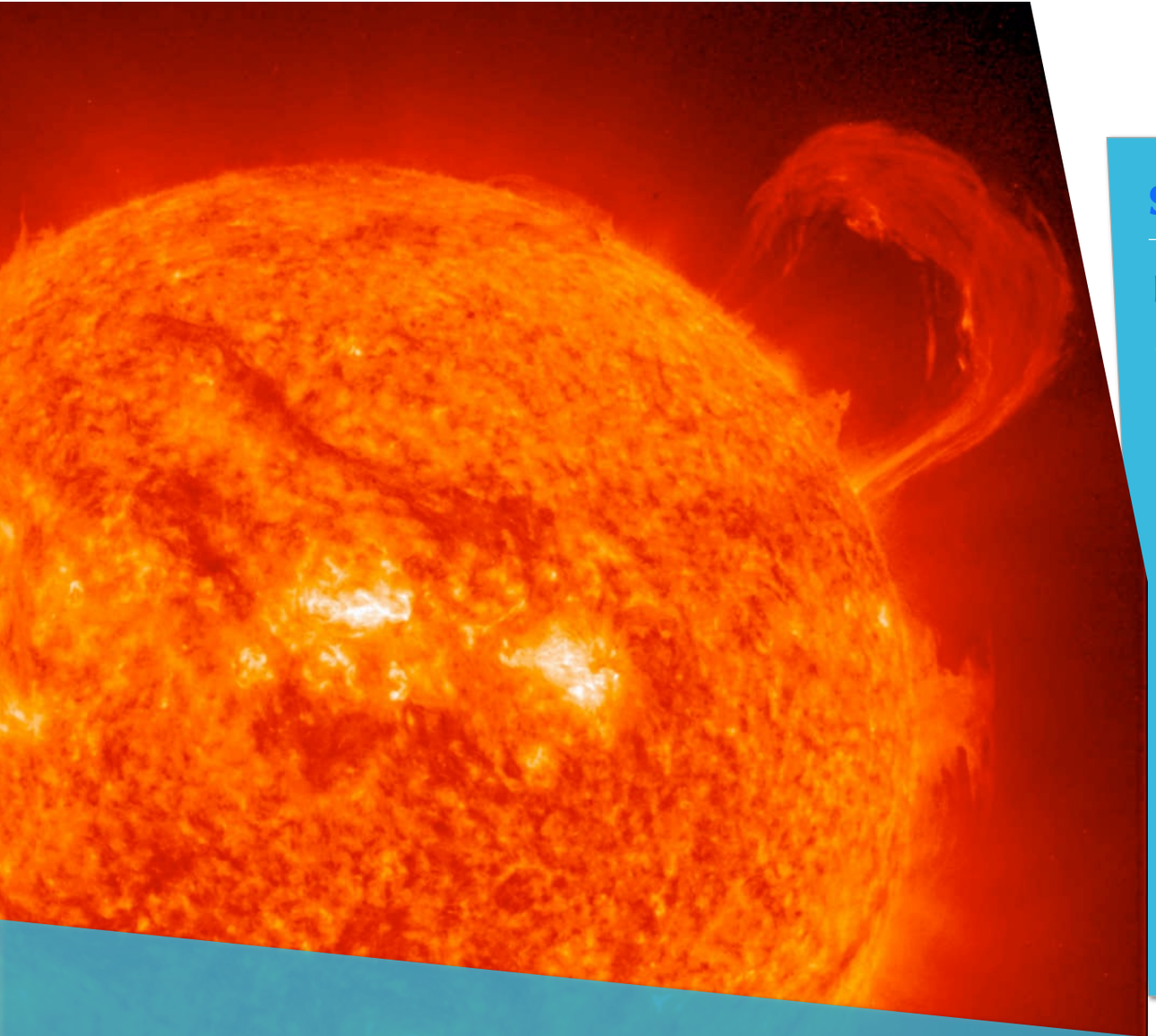
Solar System



Tessmann Planetarium

The Sun and Inner Planets

The Sun makes up about 99.8% of the mass in the solar system. This means that almost the entire mass of the solar system is in the Sun.



The Sun

Sun Facts

Diameter: 864,000 miles across (109 times the Earth's diameter)

Surface Temperature: 9980° Fahrenheit (F)

Core Temperature: 27,000,000° F

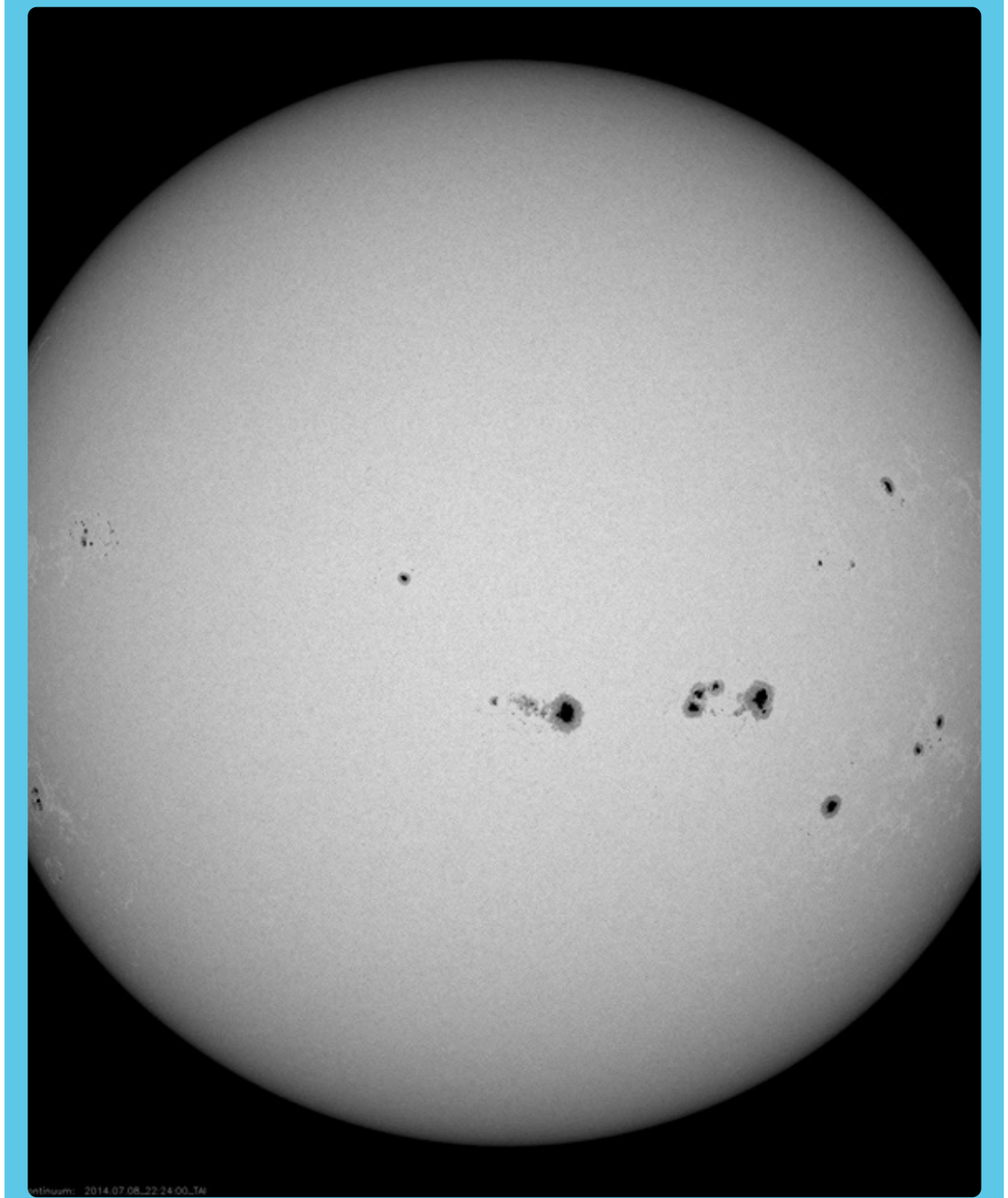
Duration of Rotation (Solar day): 27 to 31 days

Composition: Made up mostly of hydrogen (70%) and helium (28%) and other (2%)

Important spacecrafts: Solar Dynamics Observatory (SDO), Solar and Heliospheric Observatory, Solar Terrestrial Relations Observatory (STEREO), Parker Solar Probe and many others.

Also known as: Sol

The Sun is a Yellow Dwarf Star



We depend on the Sun for life. It is our source for life's key ingredients: warmth and light. The dark marks on the surface are sunspots. Giant flares and prominences often erupt from the surface.

The Sun is the center of our solar system; all the planets in our system orbit around the Sun in a flat orbital plane called the ecliptic.

1,200,000 Earths can fit into the Sun.

The Sun outshines about 80% of the stars in the Milky Way. However, there are many stars that are much bigger and brighter than our Sun. Our Sun is a mere runt compared to the biggest of these.

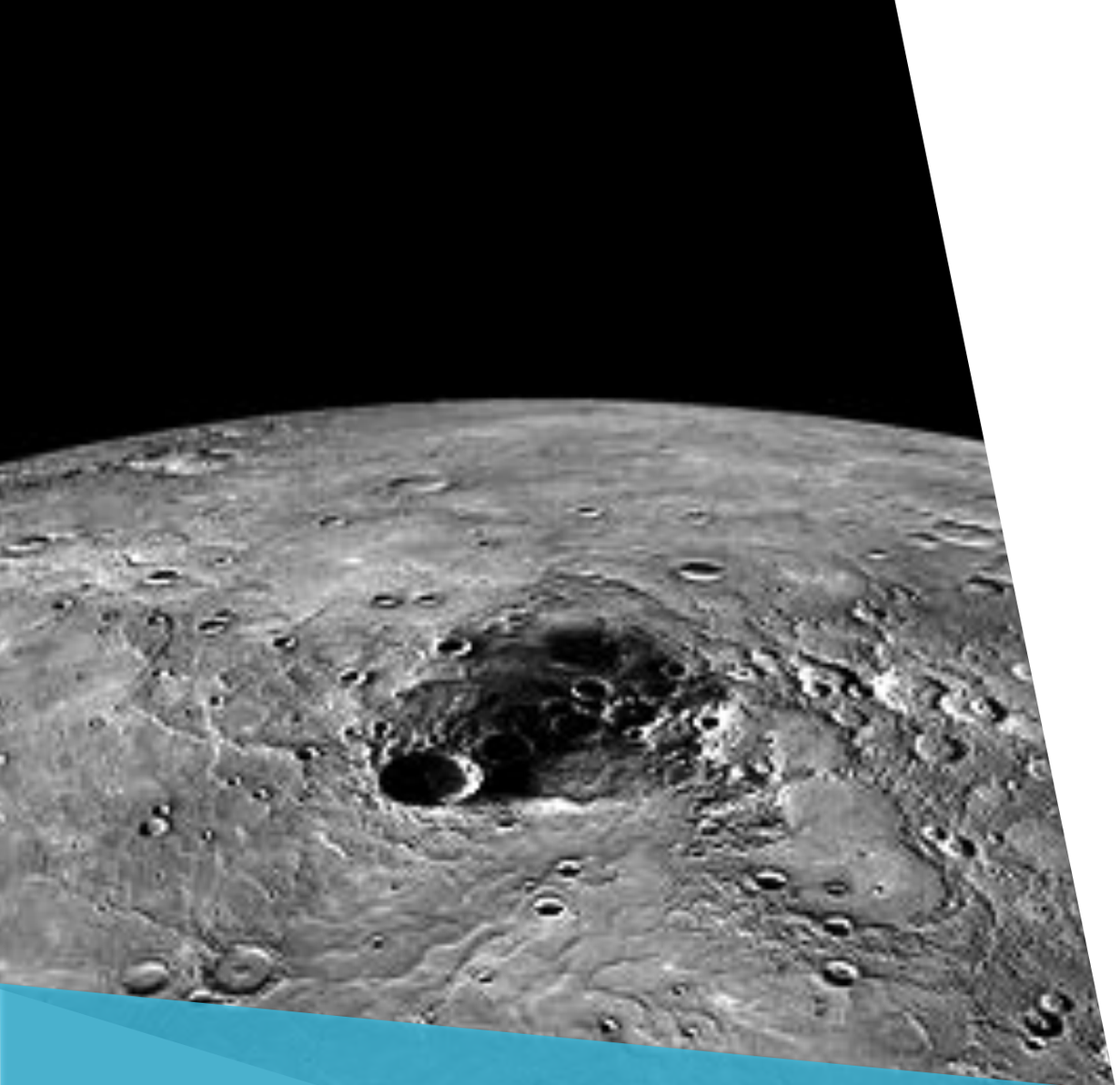
The Sun is a G type star that takes about 225 million years to make one orbit around the Milky Way. It is known as a yellow dwarf, although its color is actually more white than yellow. It generates energy through nuclear fusion in its core.

The Sun is located in the Orion arm of the Milky Way.

Sunspots are areas of strong magnetic activity and lower temperature on the surface of the Sun. Some Sunspots are larger than the Earth, but Sunspots are not always present on the Sun.

A solar wind is ejected from the Sun. It is made up of plasma – high energy protons and electrons that can escape the immense gravity of the Sun. The solar wind is responsible for the northern and southern lights.

The Snow Solar Telescope on Mt. Wilson in Pasadena, California, was one of the first telescopes designed to seriously study and understand the Sun. The telescope was moved from Wisconsin to Pasadena in 1904 and is still in operation today.



Mercury

Mercury Closest to the Sun

Moons: None.

Distance from Sun: 36 million miles (35,983,035 miles) or 0.39 AU (see page 8 to learn more about AUs)

Diameter: 3031 miles (0.38 Earth's diameter)

Temperature range: 300 below 0° F (side facing away from Sun) to 700 above 0° F (side facing Sun)

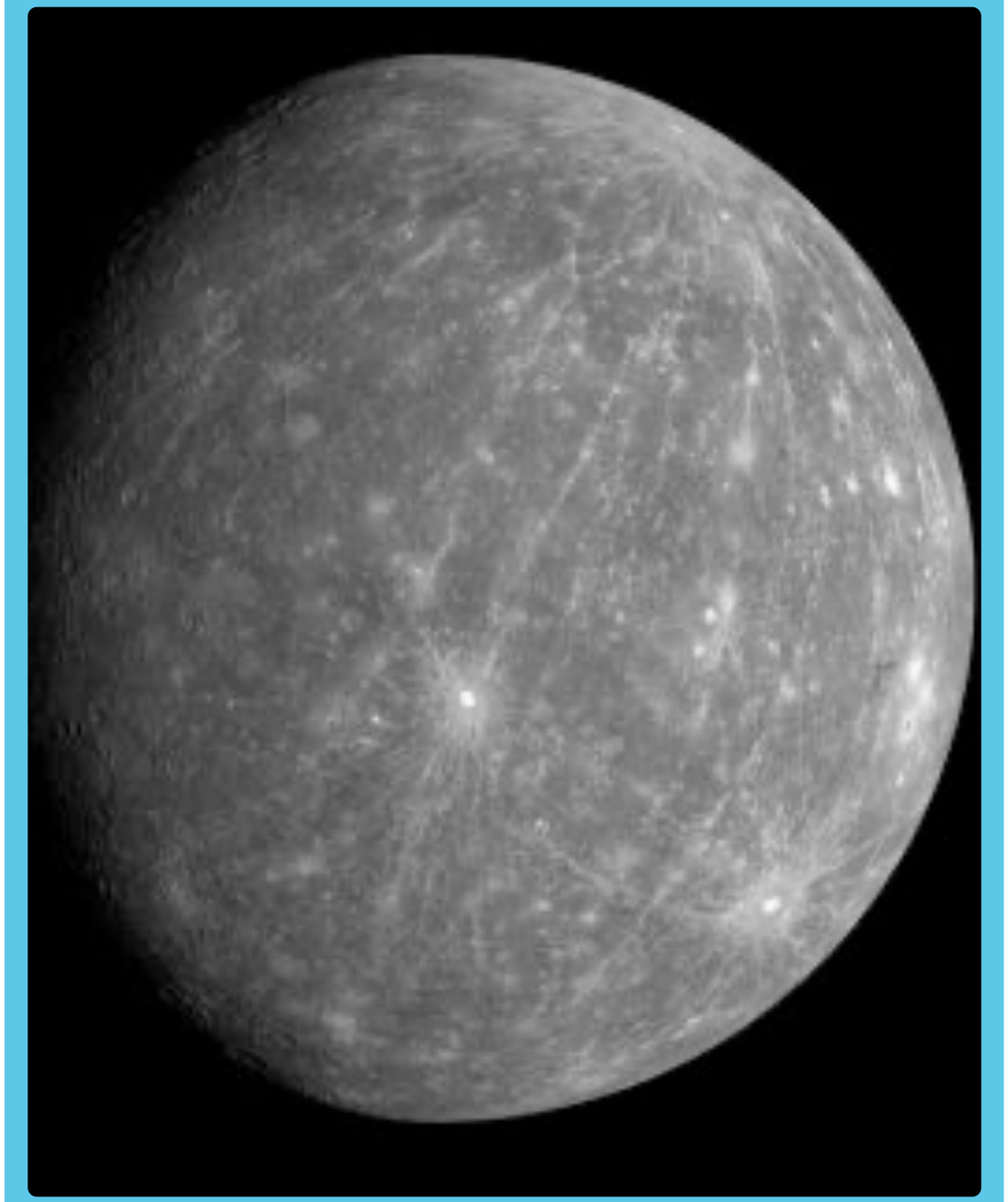
Duration of orbit around Sun (Mercurian year): 88 days

Duration of Rotation (Mercurian day): 58.65 Earth days

Important spacecraft: Mariner 10, Messenger

Also known as: Hermes and Apollo (Greek), Chen Xing (辰星) the Hour Star (ancient Chinese), Nabu (Babylonian)

Mercury is the smallest planet.



The Messenger spacecraft discovered that Mercury has shrunk about 8 miles over the centuries.

The Greeks believed Mercury was two different planets. They called Mercury Apollo when it appeared in the morning and Hermes when it appeared at night.

Mercury is a Roman name. Mercury moves very quickly around the Sun, so it was named after a fast moving Roman god.

Ice was discovered in a crater at its north pole by the Messenger spacecraft. Mercury is a rocky planet composed mostly of silica and has an iron core. Silica is the material that is found in sand, cement, crystals and quartz.

Mercury is very close to the Sun and the intensity of the Sun had eroded away the top 8 miles of Mercury's surface. Most of what is left is Mercury's iron core.

Mercury has no atmosphere. It once had volcanic activity and its plains deformed as the planet cooled.

It is the smallest planet in the solar system— smaller than Jupiter's moon Ganymede and Saturn's moon Titan.

Venus

Venus the Mysterious

Moons: None.

Distance from Sun: 67 million miles (67,237,981 miles) or 0.72 AU

Diameter: 7521 miles (just slightly smaller than Earth)

Temperature: constant 800° F

Duration of orbit around Sun (Venusian year): 224 Earth days

Duration of Rotation (Venusian day): 243 Earth days

Significant spacecrafts: Venera (Russia), Pioneer, Mariner and Magellan (USA), Venus Express (ESA)

Also known as: The morning star, the evening star. Greeks called it Phosphorus when it was visible in the morning and Hesperus when it was visible in the evening. Romans called it Lucifer (morning) and Vesper (evening).

Previous page: Radar image shows Venus without clouds

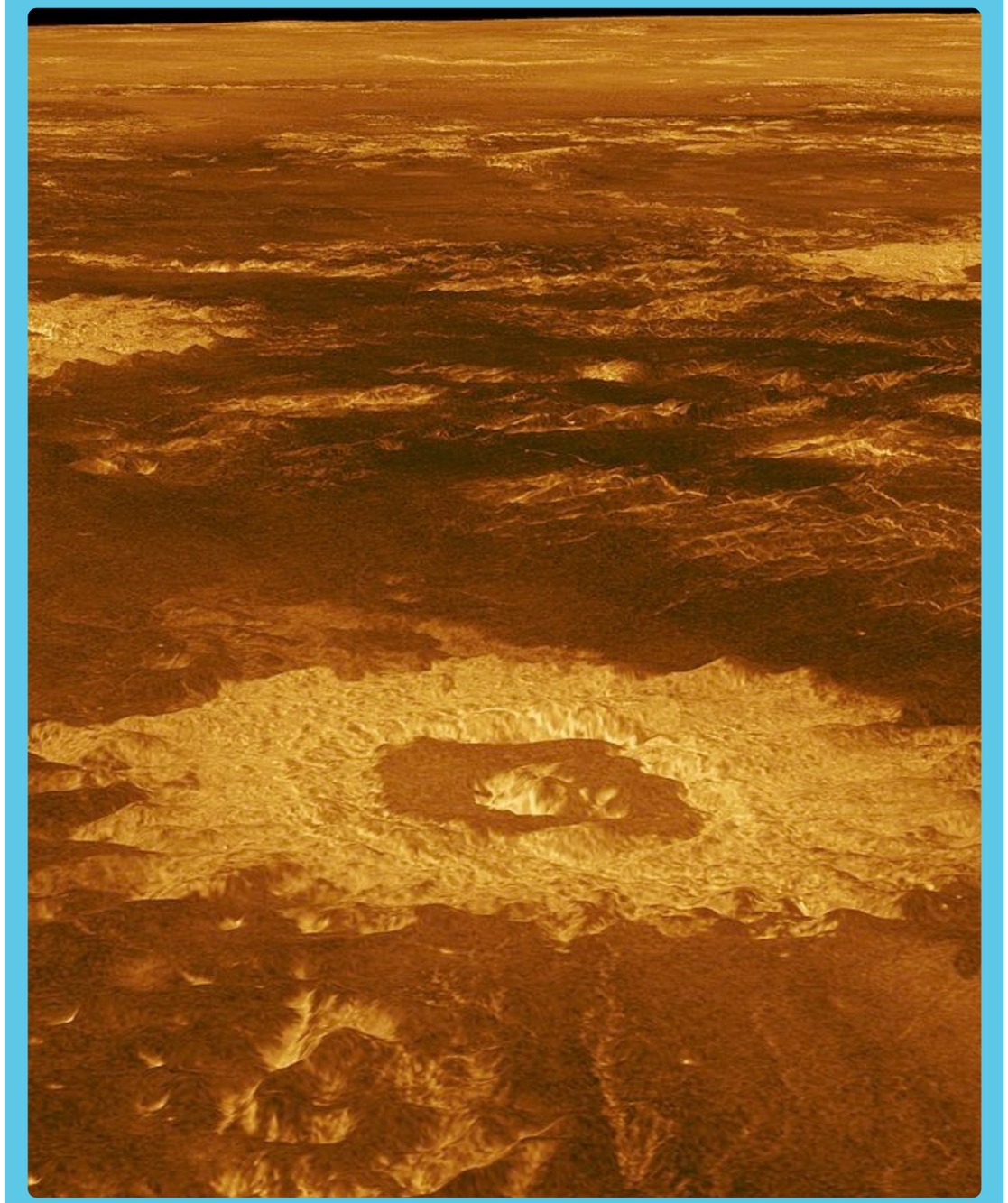


Photo of an impact crater on Venus, imaged by radar.

The Greeks and Romans believed Venus to be two different planets. They called Venus Phosphorus or Lucifer when it appeared in the morning and Hesperus or Vesper when it appeared at night.

Venus is rocky planet covered with lava from ancient volcanic eruptions (and possibly more recent eruptions, too) and has has flattened volcanos called farras.

The atmosphere is primarily made of carbon dioxide and has thick clouds in the atmosphere made up of sulphuric acid. The clouds create a "greenhouse effect" – a blanketing effect that holds onto heat. Venus has a temperature of 800° F and is even hotter than Mercury.

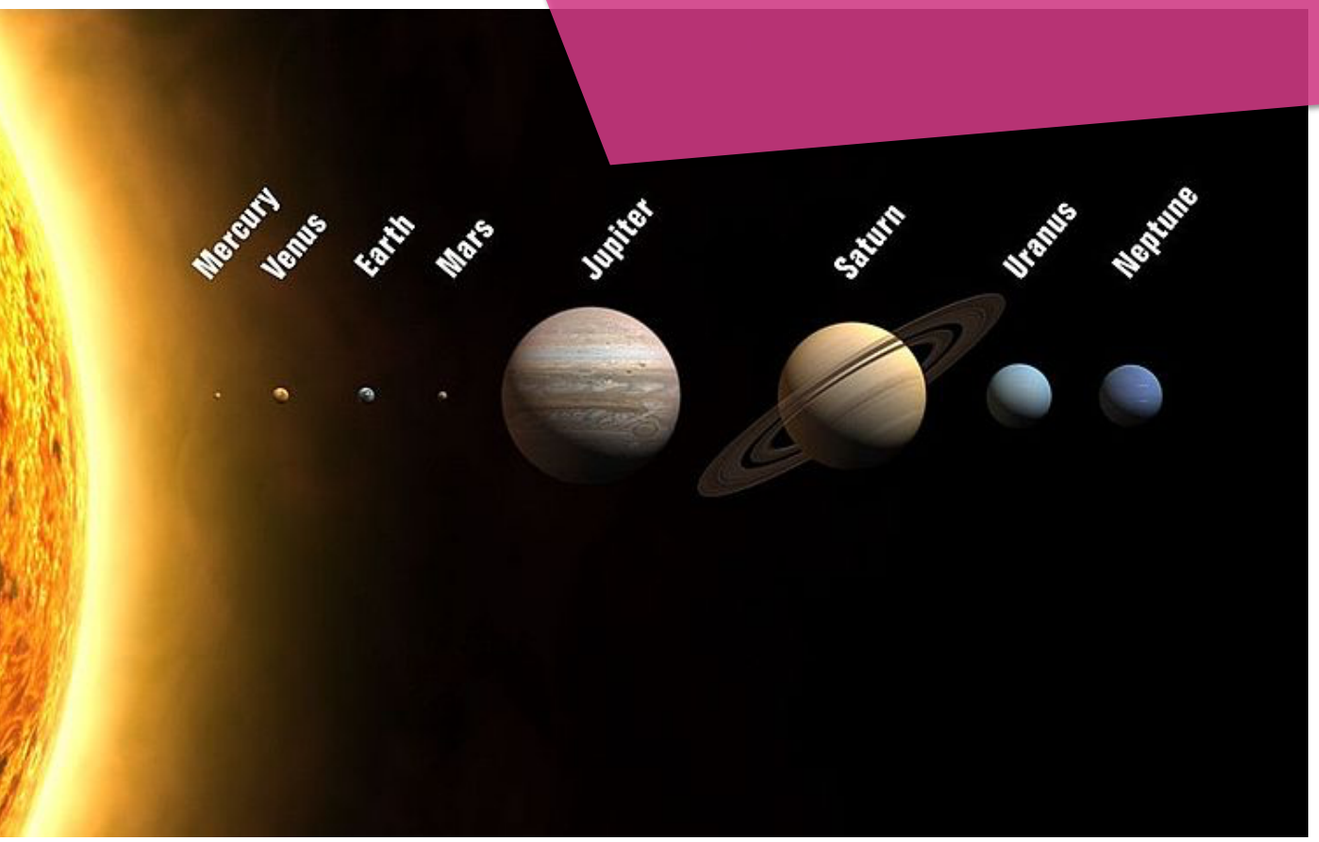
Lightning has been detected on Venus.

Russia's Venera 9 took the first photos of the planet's surface. Several spacecraft that entered Venusian atmosphere were crushed by its extreme pressure. The Magellan probe mapped the surface of Venus with radar as optical photos are difficult, if not impossible, due to the dense clouds (see image left).

Transits of Mercury and Venus

Venus and Mercury are the only two planets in our solar system we can see pass in front of the Sun, because they are closer to the Sun than the earth. When we see a planet pass in front of a Sun or an exoplanet pass in front of a distant star, we call this event a transit.

Factoids



What is the Ecliptic?

The Ecliptic is the orbital plane followed by all the major planets in our solar system.

From our point of view on Earth, it seems like the Sun, Moon and planets cross the sky along the same, general path.

In olden days, people thought this path was special and created 12 pictures made up of the stars along this path. They called these pictures the Zodiac - just another word for zoo, as most of the pictures were of animals. Of course, these days, we call celestial pictures of stars constellations.

What is an AU?

An AU or astronomical unit is the distance from the Sun to the Earth. So the distance from the Sun to the Earth is 1 AU. Mercury and Venus are closer to the Sun, so their distance is less than 1 AU. Neptune is about thirty times the distance from the Sun as the Earth, so it is 30 AUs from the Sun.

One Light year equals 60,000 AUs.

Earth Home Sweet Home

Moons: One.

Distance from Sun: 93 million miles (92,956,021 miles) or 1 AU

Diameter: 7918 miles

Temperature range: 130° below F to 132° above F

Duration of orbit around Sun (Earth year): 365.26 days (365days 6 hours 9minutes)

Duration of Rotation (Earth day): 23 hours 56 minutes

First spacecraft to orbit Earth: Sputnik 1 (Russia, 1957)

Also known as: Terra, Gaia, the big blue marble

Earth

The Moon is our companion as we orbit the Sun

Galileo thought the Moon was covered with seas. He called them mare, the Latin word for seas. We now know this material is lava, created by asteroid and cometary impacts that pierced the crust of the ancient Moon and ejected its hot interior onto the surface.

Earth's molten core provides a magnetic field that protects the planet from harmful solar radiation. Mercury, Venus and Mars do not have this protection. The deflection of solar radiation sometimes results in colorful displays known as auroras or the northern and southern lights.

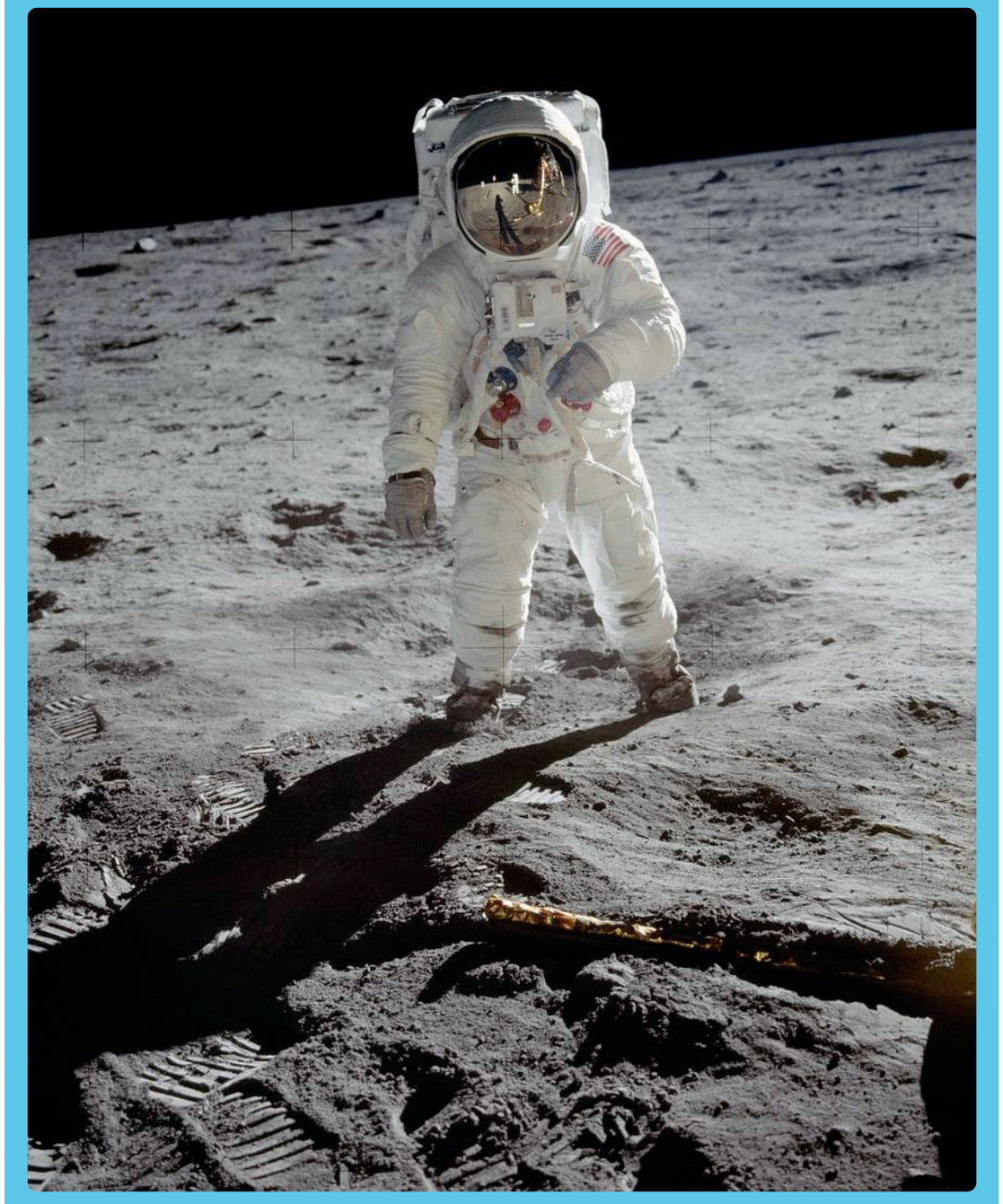
Earth is only planet currently known to harbor life. Some life forms, such as whales, humans, elephants and dolphins, exhibit high order intelligence. One out of every four life forms on Earth is a beetle, and nine out of ten are insects.

Earth's atmosphere is composed mainly of nitrogen and oxygen. Lightning can be observed on Earth as well as wind, rain, snow, and a variety of cloud types and dust storms. Most of the surface features on Earth have been formed by the movement of water and ice, and tectonic plates. Geysers are sometimes found near volcanic vents.

Earth's Moon

The gravity of the Moon affects the ocean tides on Earth and is slowing down the rotation of our planet ever so slightly. The Earth once rotated once every six hours and the Moon has now slowed down our rotation to once every 24 hours. The Earth continues to slow down!

The Moon is about one-sixth the size of Earth. We can only see one face of the Moon due to its rotation. It has mountains, craters (about 40 filled with ice) and molten material called mare. When the Moon passes in a certain position between the Earth and Sun, the Moon blocks the Sun's light and a solar eclipse occurs.



Perhaps the most famous photo in history, Buzz Aldrin standing on the surface of the Moon in July 1969.

Missions to the Moon

The Moon is the only other world in our solar system that has been visited by humans so far (although humans may travel to Mars before much longer).

The Apollo astronauts were the first humans to set foot on the moon. On July 19, 1969, Neil Armstrong took one small step and stood triumphant on the surface of the Moon, fulfilling President Kennedy's challenge to land on the Moon within a decade.

Six Apollo missions and 12 men walked on the surface of the Moon, the last in 1972. Soon, the United States and other countries plan to land and even set up colonies on the Moon.

China plans to send astronauts to the Moon by the year 2022. They are the first country to land a spacecraft, a small rover, on the far side of the Moon.

The United States has begun a new mission called Artemis (named after Apollo's twin sister), which is part of a long range range program called Gateway to Mars. The Gateway space platform will orbit both the Earth and Moon. It will serve as a jumping off point, an interplanetary way station of sorts, to send astronauts on their way to Mars.

Other countries such as India, Russia, Japan, Israel and great Britain all plan to have bases on the Moon someday. It may not be much longer before we see people living on the Moon, much like we now see astronauts living on the International Space Station.

Mars

Mars the Red Planet

Moons: Phobos and Deimos

Distance from Sun: Varies, averaging 142 million miles or between 1.3 and 1.6 AU

Diameter: 4221 miles (about one-half the size of Earth)

Temperature range: 225 below 0° to 90° above F

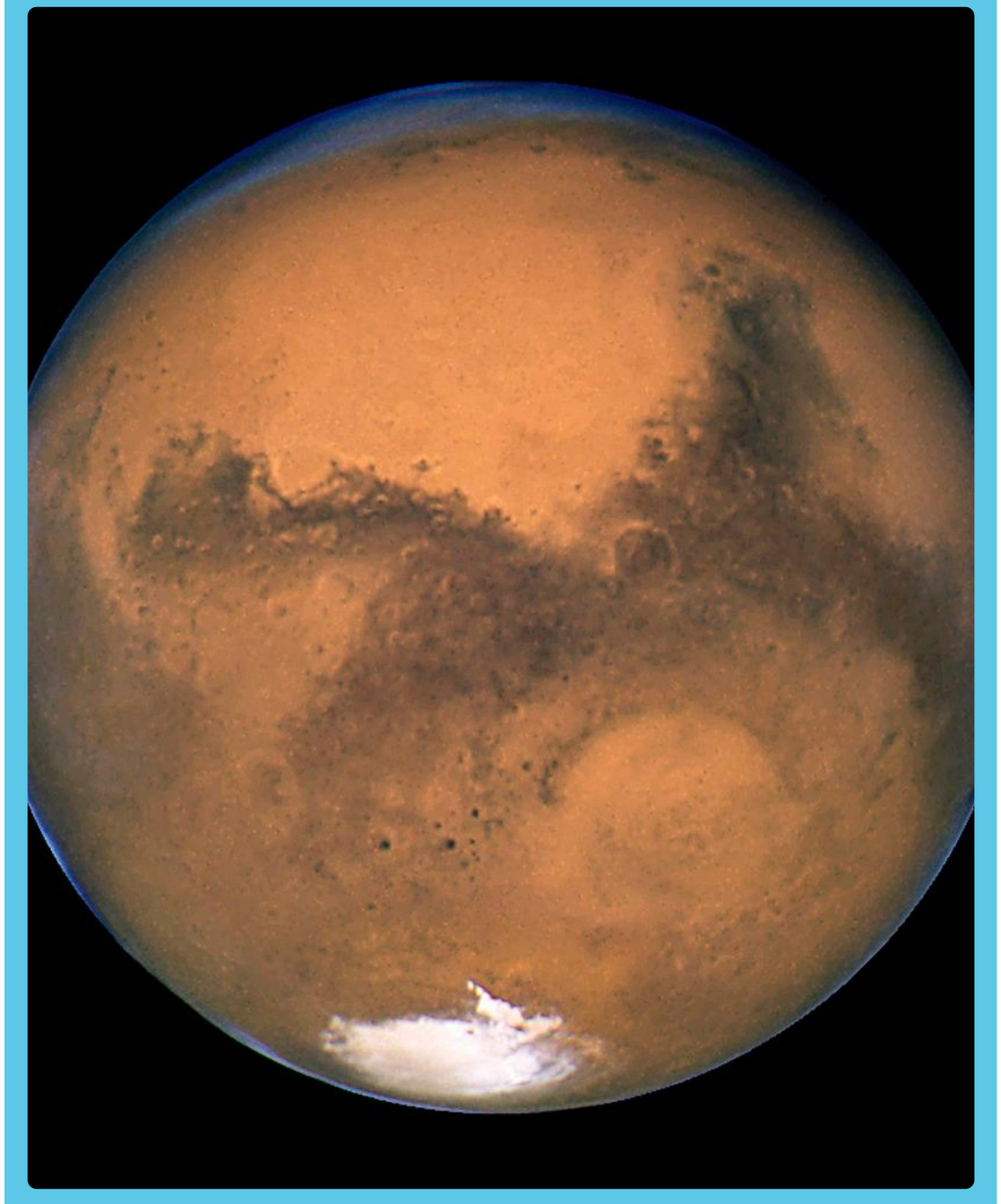
Duration of Orbit (Martian year): 2.14 Earth years (687 days)

Duration of Rotation (Martian day): 1.03 Earth days (24 hours 37minutes), just slightly longer than an Earth day. A Martian day is known as a “Sol.”

Significant spacecrafts: Spirit, Opportunity, Curiosity (rovers), Phoenix, Viking, Pathfinder, Mars Express, Perseverance.

Also known as: Ares, the Roman god of war,
Fire Star" (火星) in Asian cultures

Exploring Mars



Mars is commonly known as the Red Planet. Recently, it was confirmed that liquid water sometimes still flows on the surface. It has two small moons, Phobos and Deimos.

Mars is a rocky planet with plains, impact craters and caves. It was once believed to have canals on its surface, but this was an illusion produced by early telescopes.

Water Ice was discovered underground and tested by the Phoenix spacecraft. The Opportunity, Spirit and Curiosity rovers also discovered evidence that water once flowed on Mars. The poles of Mars have ice caps made up of layers of water ice and dry ice, one to two miles thick during winter.

Sometimes, giant dust storms cover up to half the planet and dust devils and giant tornadoes have been spotted blowing across the surface.

Curiosity has discovered phosphates in the Martian soil. This suggest that crops could be grown in Martian greenhouses.

The Perseverance rover, accompanied by a small helicopter called Ingenuity, is set to launch in July 2020.The rover will seek signs of ancient life, and collect rock and soil samples for possible return to Earth.

Loss of the Magnetic Core

At one time, Mars had a spinning molten core that produced a magnetic field. Together with gravity, this field allowed an atmosphere and liquid water to form on its surface. But at some point, the magnetic field disappeared. The loss of the magnetic field means Mars is now subjected to solar radiation. Gradually, the most of the atmosphere dissipated into space. Water also dissipated into space and some of it flowed under the surface of the planet and froze.

Carl Sagan, with a model of the first Viking spacecraft.

History of NASA's Mars Exploration

In July, NASA will launch its newest Mars rover, Perseverance. But did you know that Perseverance is only latest mission in NASA's long range exploration of Mars? Here's some of the highlights of this program.

After sending several Mariner spacecraft into orbit around Mars in the 1960s, NASA successfully landed Viking 1 on Mars in 1976. It searched for signs of organic compounds that might signal that Mars may have held conditions for life at one time. Although the results were inconclusive, they were intriguing. Viking took some of the first panorama images of the red planet. Viking 2 landed on Mars two months later.

In 2004, NASA landed two major rovers, Spirit and Opportunity. Air bags formed around the rovers during descent and the rovers bounced to a landing. Spirit in fact, bounced over 20 times. Opportunity landed halfway across Mars about 2 weeks later, in a similar manner. The two rovers discovered evidence that water once flowed on the surface of Mars. They studied environmental conditions to see if Mars was conducive to life, and in fact found plants can indeed grow in the Martian soil. They also studied the geological processes that shaped Mars. Both rovers spotted dust devils swirling across the Martian surface.

Although designed to operate for only three months, Spirit traversed the surface for 7 years until getting stuck in the Martian soil. Opportunity traveled for 13 years until a

A “selfie” taken by the Curiosity rover.

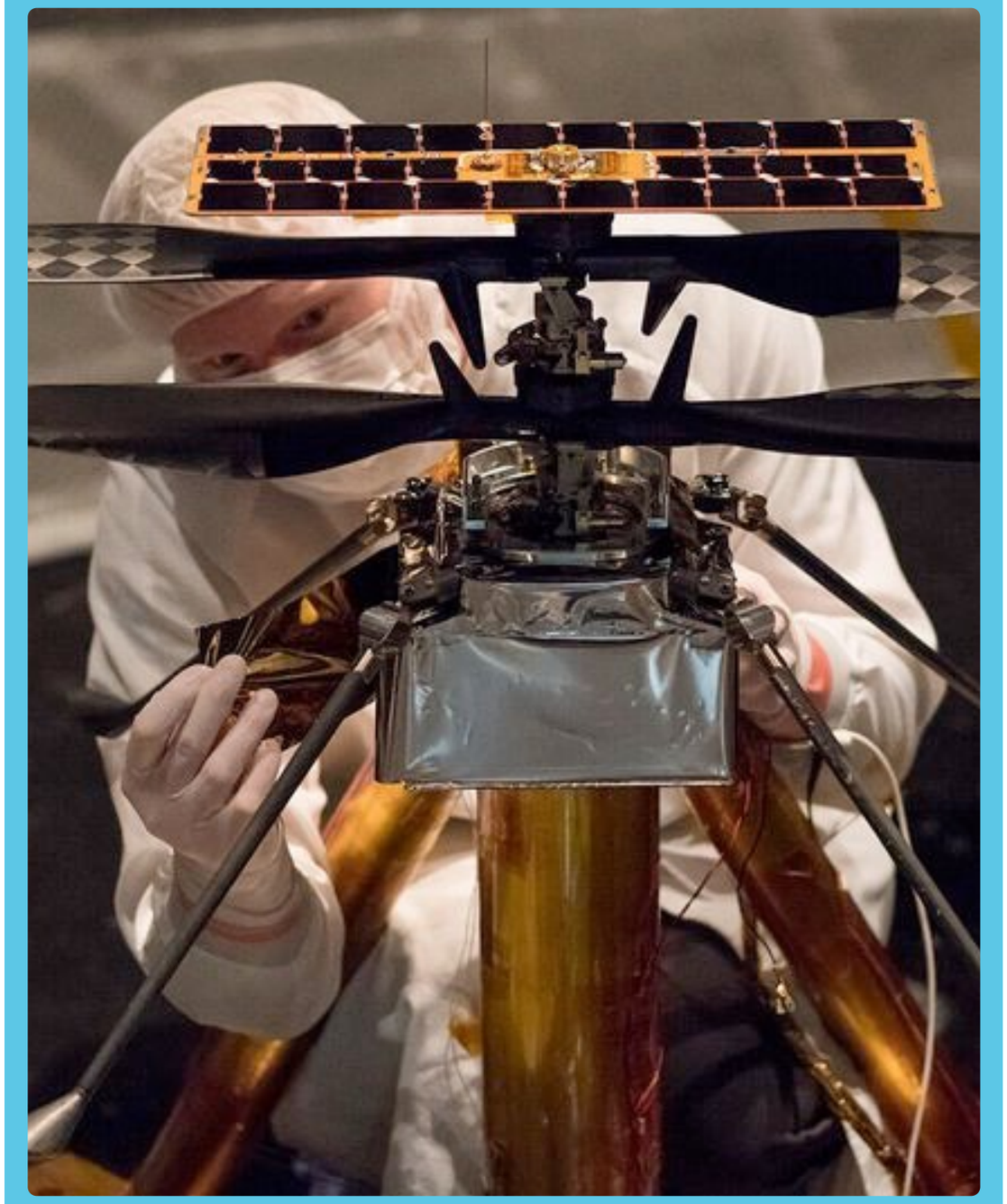
planet-wide dust storm cut off its solar panels from energy-giving sunlight. Opportunity holds the record for traveling farther and operating longer than any other device on Mars. It traveled for 14 years and trekked over 28 miles.

In 2008 , NASA landed a spacecraft called Phoenix near the Martian North Pole. NASA’s goal in all of its Mars’ missions is “To follow the water.” Phoenix had a robotic arm designed to dig into the soil and explore whether ice was buried under the Martian surface. In fact, as the landing rockets blew against the Martian surface, they uncovered a patch of ice - the spacecraft landed on exactly what it was looking for! The robotic arm scooped up some of the ice and tested it. There are different types of ice, but this was water ice, giving strong evidence that there is much water/ice buried beneath the surface—important to future astronauts.

In 2014, Curiosity landed in a manner described as “Seven minutes of terror.” During the last seven minutes of descent, a “sky crane” lowered the rover onto the Martian surface by cables. The mission control scientists and engineers sat on needles and pins until confirmation was sent back that the rover made a perfect landing following its preprogrammed plan. Curiosity landed in the Gale Crater, near Mt. Sharp, which was determined to be an ancient Martian lake bed.

Curiosity is determining the inventory of organic compounds and investigating the building blocks of life in the area. It is studying geological conditions that will reveal the evolution processes of Mars atmosphere. It is in fact, a laboratory on

Mars Helicopter Ingenuity



JPL engineer preparing the Ingenuity helicopter for its launch to Mars. The helicopter will be fitted into the spacecraft below the Perseverance rover.

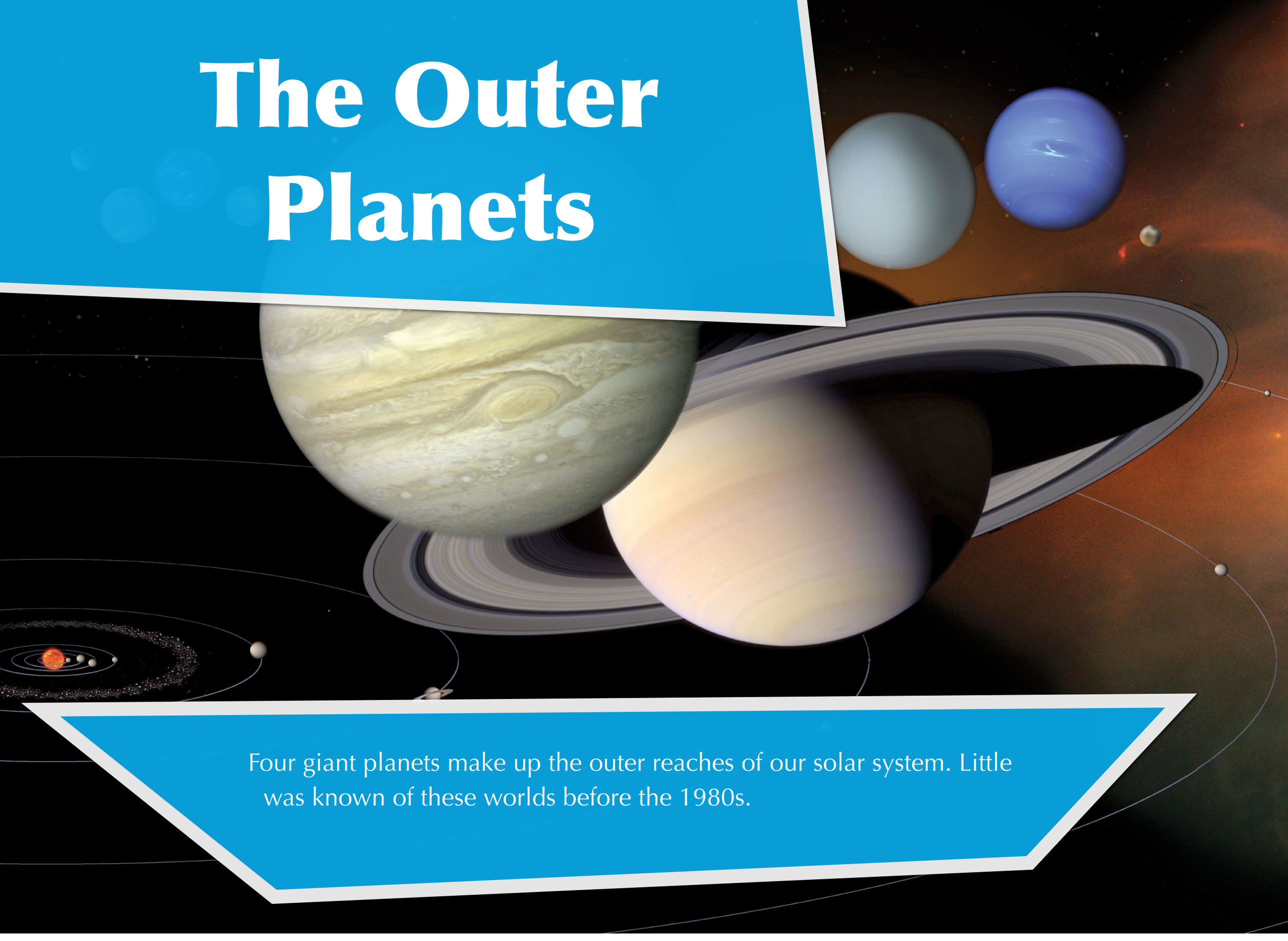
wheel and has 17 cameras mounted on its MiniCooper-sized body. Curiosity is currently slowly making its way up Mt. Sharp.

In 2018, Insight landed on Mars and is studying seismic activity and hopes to drill at least 15 feet under the Martian surface. Its drill, called "the Mole," had been running into difficulties, but now seems to be making progress.

In July, NASA's latest rover, Perseverance, will launch. It will scoop up soil and rocks and cache them in metal containers. A suitcase-sized helicopter, name Ingenuity, will hover over the Martian surface. A later mission will follow up with a mini-rover that will retrieve the samples and return them to its landing craft. This craft will fire the samples into orbit, where they can be captured by an orbiting spacecraft. The orbiter will then aim and fire them to earth, where they can be retrieved and studied in sophisticated laboratories. In this way, we hope to have first hand knowledge of the composition of Mars.

The ultimate goals of NASA's Martian exploration program is to eventually send astronauts to explore and perhaps colonize Mars some day. There are large hurdles to overcome, but each mission has uncovered new pieces of the puzzle we must assemble to make this program a reality. NASA and its major partners, such as JPL and CALTech (to name a few), hopes to be able to send astronauts to Mars during the 2030s. And by the way, if you hear about an astronaut named Sunita "Sunny" Williams, you might want to pay attention. She is training to be the first woman to travel to Mars.

The Outer Planets



Four giant planets make up the outer reaches of our solar system. Little was known of these worlds before the 1980s.

Jupiter

Jupiter the King of the Planets

Moons: 79 moons.

Major Moons: Europa, Callisto, Io and Ganymede (known as the Galilean moons because they were discovered by Galileo).

Distance from Sun: 483,766,653 miles or 5.2 AU

Diameter: 86,881 miles

Temperature range: 234 below 0° F

Duration of Orbit (Jovian year): 11.8 Earth years

Duration of Rotation (Jovian day): 10 Earth Hours

Significant spacecrafts: Magellan, Voyager I and II, Juno

Also known as: Marduk (Babylonian), Jove (sometimes we call things belonging to Jupiter as Jovian), Wood Star (Chinese: 木星)

Jupiter's Great Red Spot and Swirling Clouds

Jupiter's most prominent feature, the Great Red Spot. The white spot just below the Red Spot is about the same size of the Earth.

Jupiter is a gas giant planet, composed mainly of hydrogen and a little helium. There is also the presence of water and ammonia ice. Jupiter may have a solid or liquid core.

Great Red Spot

The most prominent feature of a Jupiter is a giant storm that has been raging for hundreds of years, perhaps longer, called the Great Red Spot. A few years ago, the Red Spot started to shrink, but recently the Juno spacecraft revealed that it has returned to its previous size. Smaller spots, also storms, appear and disappear from time to time.

Other Features

Horizontal cloud bands rotate across the face of Jupiter and sometimes change color. There may be several layers of clouds under the top layer and lightning has been observed. Jupiter has a powerful magnetic field.

Jupiter has a partial ring that is only visible from spacecraft.

Shoemaker-Levy 9 Comet

In 1993, Jupiter was struck by a comet known as S-L9, nicknamed the “String of Pearls.” The S-L9 impact was the first time a cometary impact was observed on a planet in the solar system. In 2009, a new comet impact site was observed.

Significant Moons

Callisto, Ganymede and Europa are covered with ice.

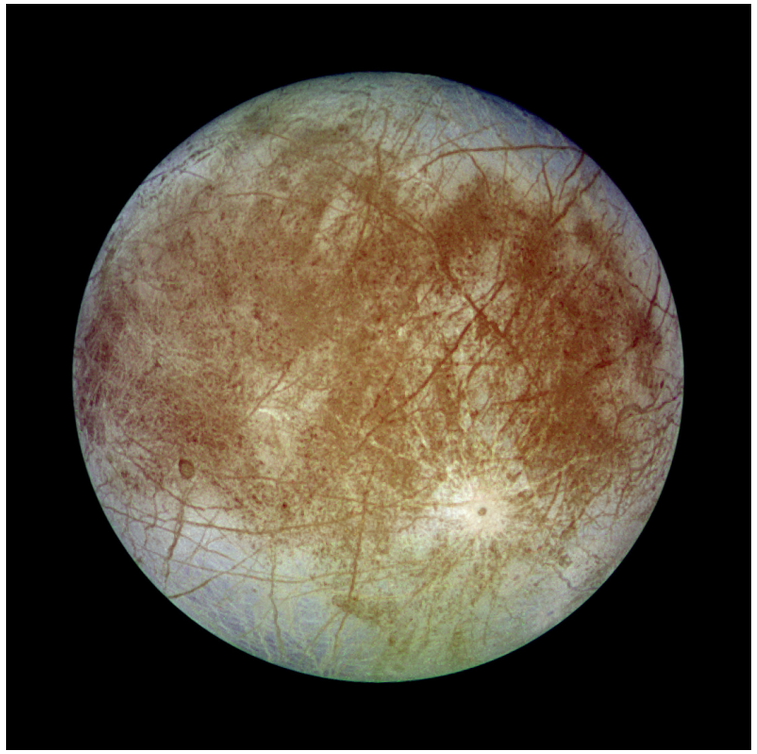
Image of Jupiter taken by Juno

Juno has transmitted amazing close up images of Jupiter, revealing the planet in ways never seen before.

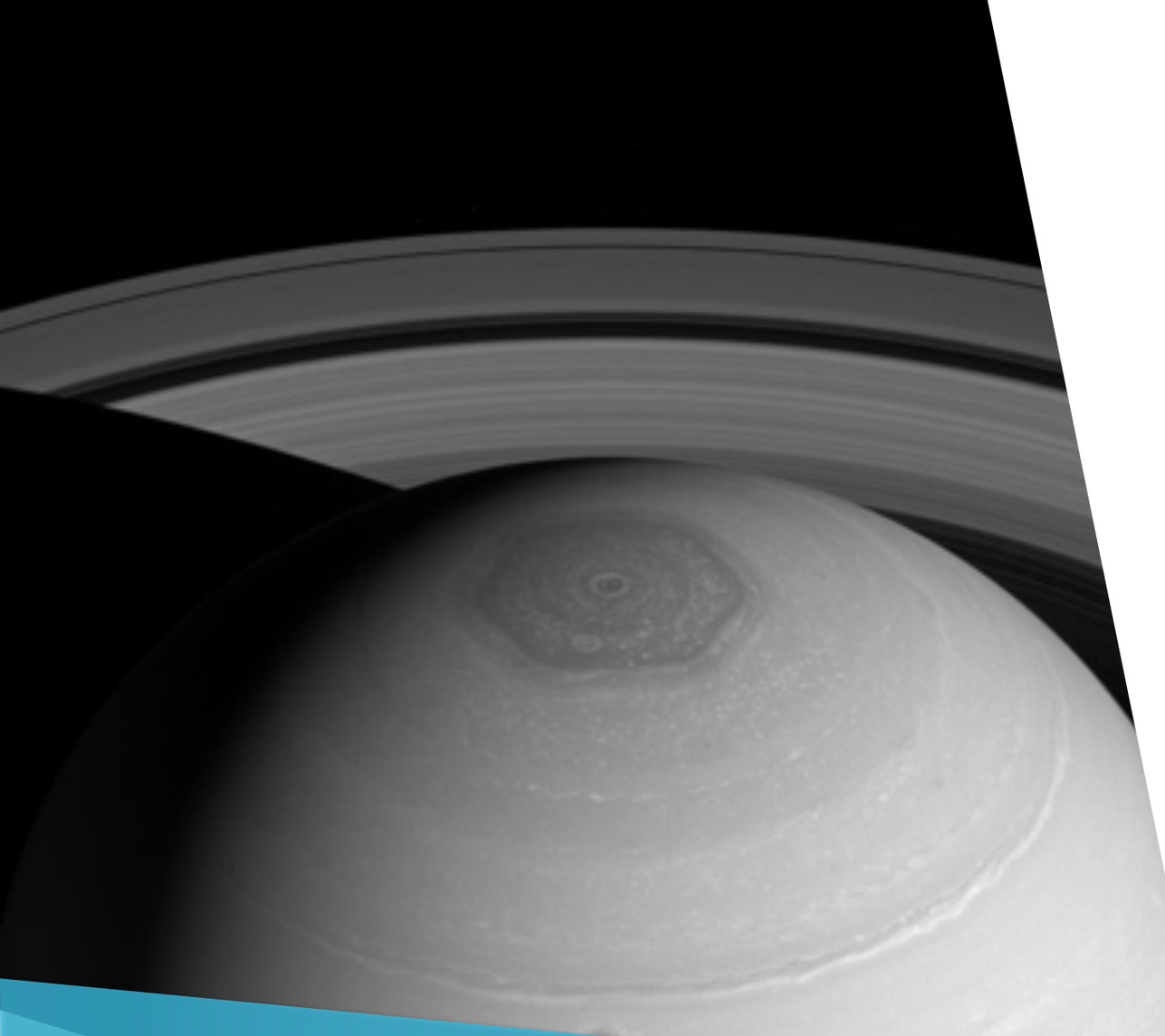
Ganymede is the largest moon in the solar system. Ganymede is now believed to have a huge underground ocean containing more water than all the oceans of the Earth.

Europa may have water geysers and a patch of organic clay on its surface. Europa may also have an underground ocean which might contain life. NASA is planning to launch the Europa Clipper in 2023 to uncover evidence that organic material and possibly life may be present on Europa.

Io is covered with active volcanos that continually recover the surface with yellow and red sulfur.



Evidence suggests Europa has an underground ocean that may harbor life.



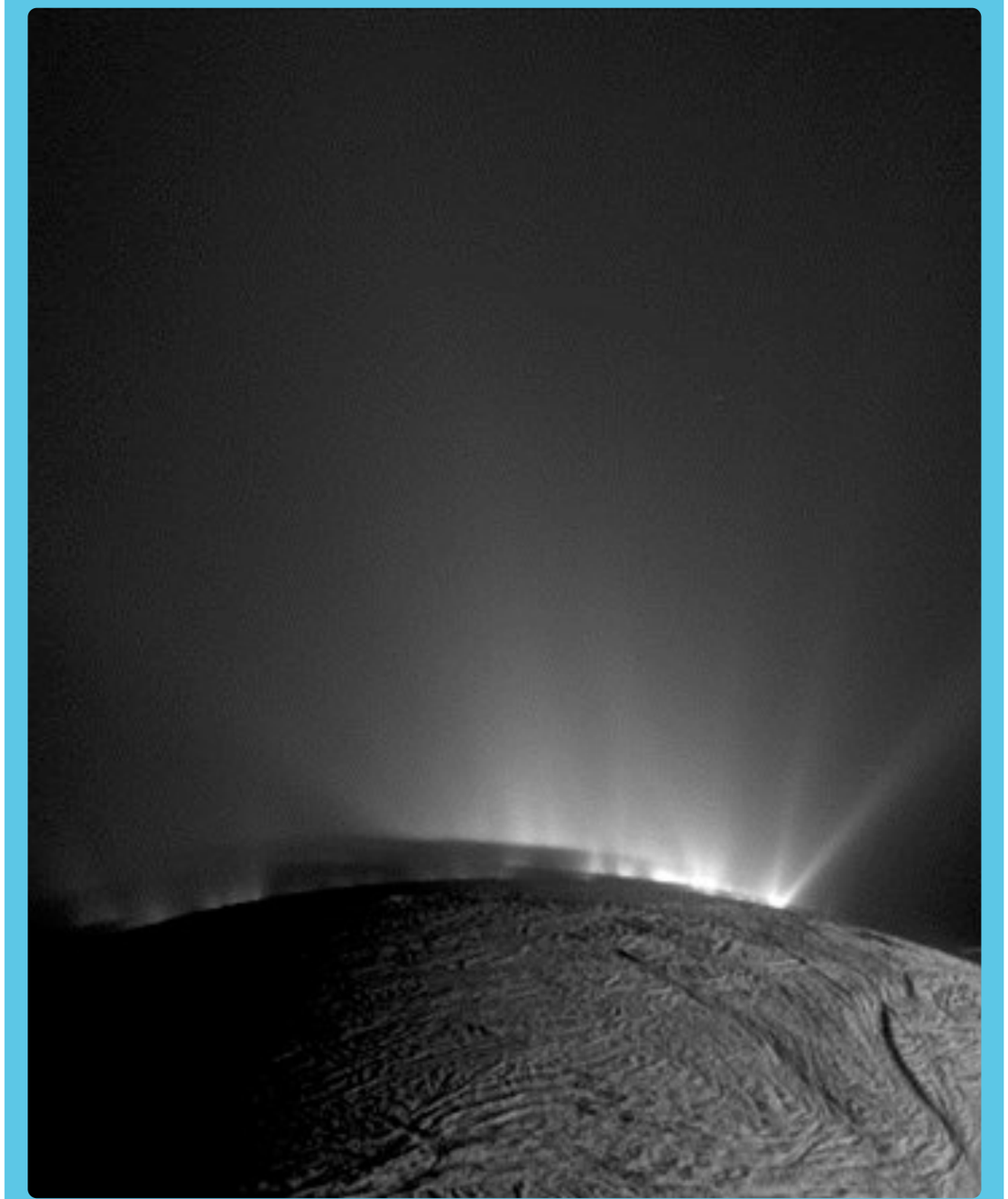
Saturn the Magnificent

Moons: 81 moons, including 8 shepherd moons.
Major moons: Titan and Enceladus
Distance from Sun: 890,703,868 miles or 9.6 AU
Diameter: 74,898 miles
Temperature range: 310 below 0° to 220° below F
Duration of Orbit (Saturnian year): 29.4 Earth years
Duration of Rotation (Saturnian day): 11 Earth Hours
Significant spacecrafts: Pioneer 11, Voyager I and II, Cassini-Huygens. The Huygens probe landed on the surface of Titan.
Also known as: Cronos (Greek), Earth Star (Chinese: 土星), Zuhal (Turkey)

Section 2

Saturn

Enceladus



Geysers erupting on Saturn's moon Enceladus. Evidence suggests Enceladus has an underground ocean and possibly lifeforms.

Saturn is a gas giant planet, composed mainly of hydrogen and a little helium, methane, plus water and ammonia ice.

Rings

The most striking feature of Saturn is its magnificent ring structure. There are 7 main rings (each one of these is made up of several individual strands). These rings are lettered A (the innermost ring) through G (the outermost ring). A large, empty gap in the rings is known as the Cassini division. There are two other significant, but smaller gaps.

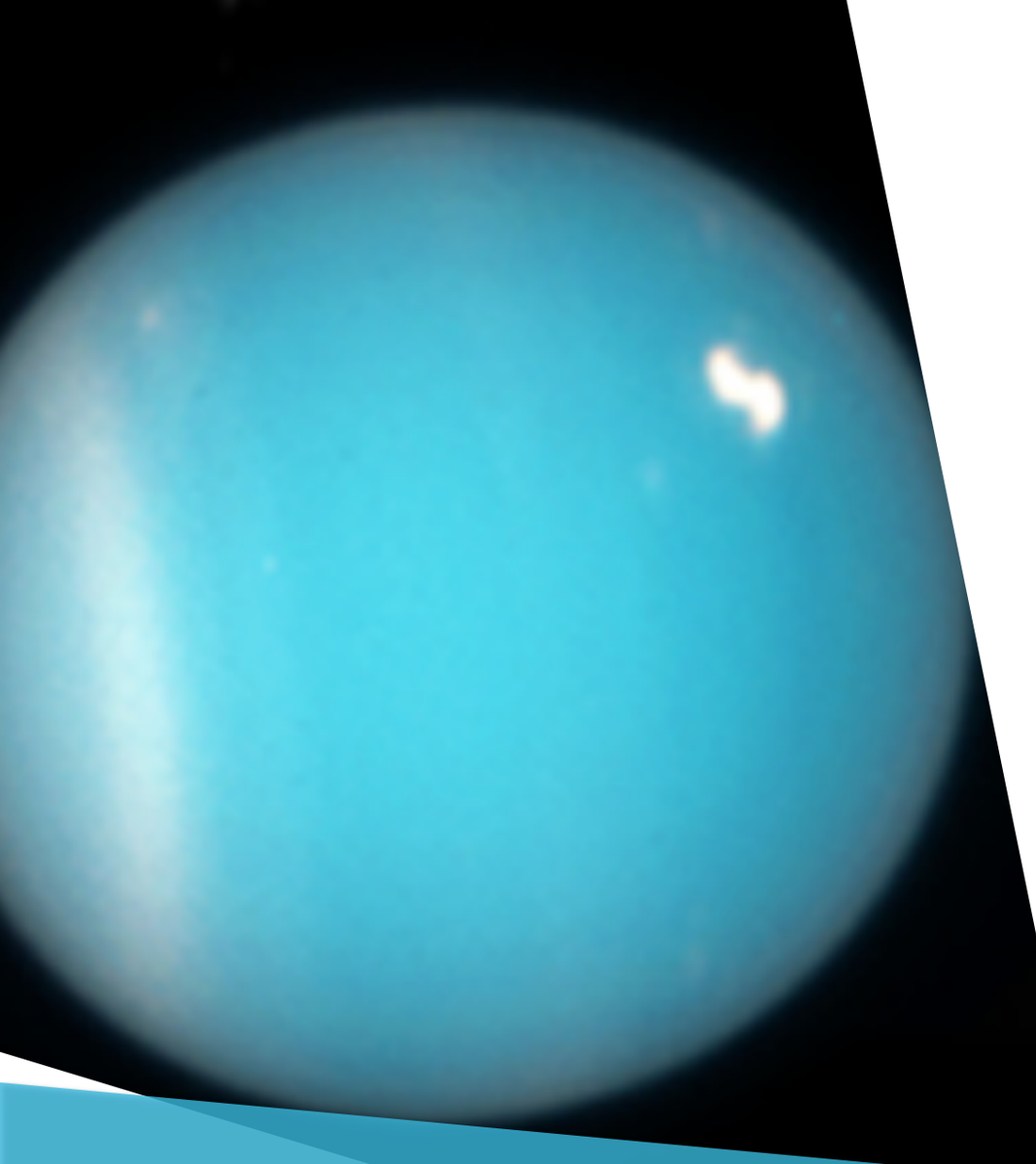
The rings are mainly made up of ice and dust. They may have been created when two or more moons collided, or are just made up of material that was left over from the creation of Saturn. The rings structure is kept intact by the gravity of small moons within the rings, known as shepherd moons. The rings are only about 33 feet thick in some areas.

Storms

Saturn has a large six-sided (hexagonal) cyclone rotating on its North Pole. The very regular geometric phenomenon holds its unusual shape year after year, much like Jupiter's great red spot. It is not known when or how this storm began or why it has six sides.

Significant Moons

Enceladus has water geysers and may have an underground ocean - and possibly even contain life. The ice erupting from its surface replenishes the ice in Saturn's central rings. Titan, Saturn's largest moon, has several large lakes, consisting of liquid methane and ice. Titan also has a thick atmosphere made of methane.



Uranus, formerly known as George

Moons: 27 moons

Important moons: Titania, Oberon, Ariel and Miranda.

Distance from Sun: 1, 787,484,958 miles or 19.2 AU

Diameter: 31,763 miles

Temperature: 371° below 0° F, the coldest planet in the solar system

Duration of Orbit (Uranian year): 84.3 Earth years

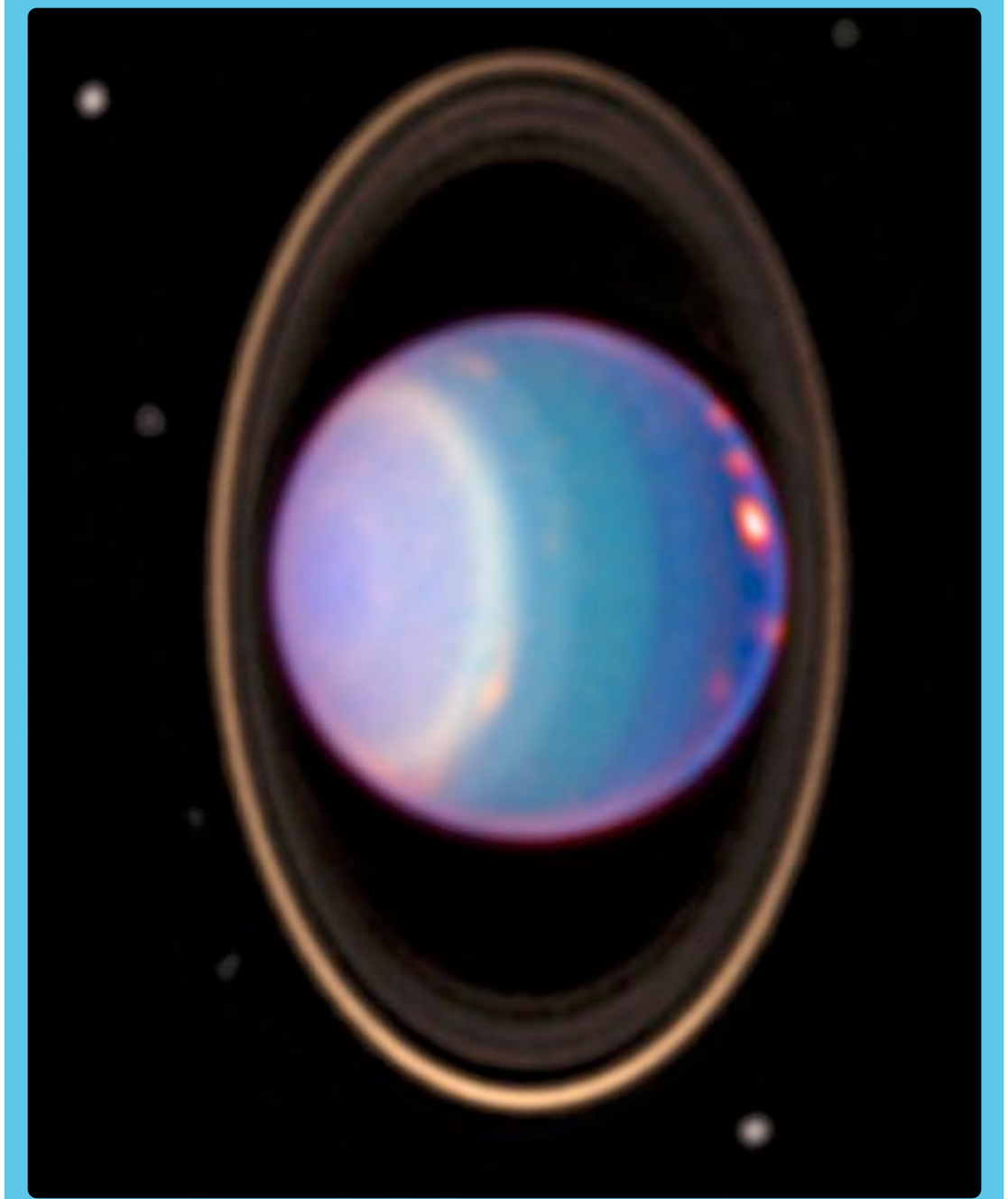
Duration of Rotation (Uranian day): 17 Earth Hours

Significant spacecraft: Voyager II

Also known as: First called George's (or the Georgian) Planet, named after King George III.

Uranus

Uranus



A Hubble Space Telescope infrared image of Uranus and its rings.

Uranus is a gas giant planet, composed mainly of hydrogen, a little helium, methane, plus water and ammonia ice. Uranus is believed to have a rocky core surrounded by ice.

Name

Uranus is the only planet that uses a Greek, rather than a Roman, mythological name. It was not known in ancient times and was discovered after the invention of the telescope. Observed by William Herschel in 1781. Herschel named the planet after King George III of England, calling it George's or the Georgian planet. The name was changed to Uranus, the name of Saturn's father in Greek mythology.

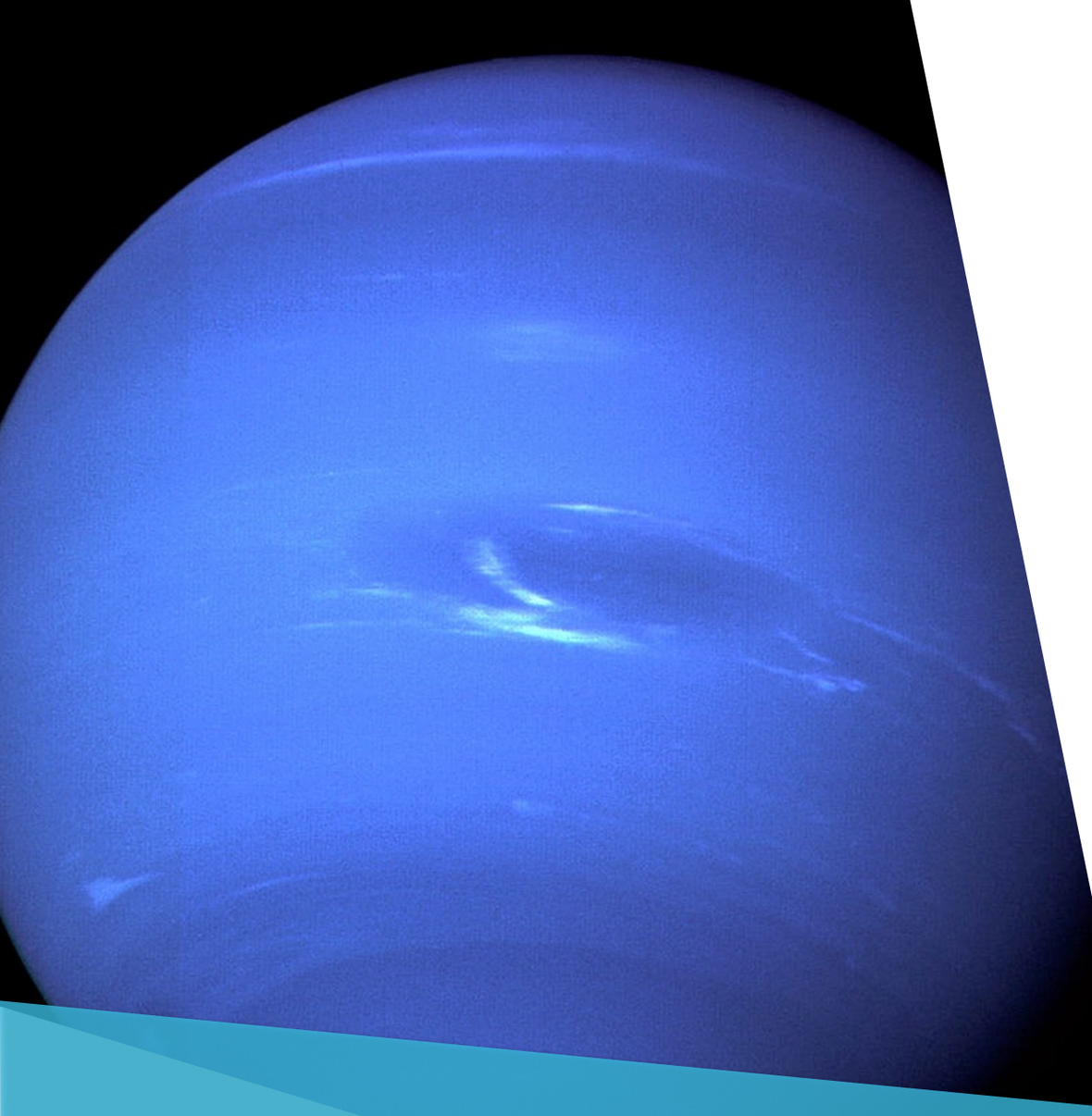
Uranus' moons are named after characters in Shakespeare's plays.

Rings

Uranus has a large ring structure made up of 13 rings. The rings were first spotted and photographed by the Voyager II satellite.

The rings are mainly made of ice and dust. They were probably created when two moons collided. These rings were not created at the same time as the planet. The rings are tilted and Uranus may have been struck by an Earth-sized object that knocked it on its side.

Uranus and Neptune belong to a group of planets known as Neptune Class planets.



Neptune

Neptune Planet of Fierce Winds

Moons: 14 moons. Triton is the largest moon.

Distance from Sun: 2, 798,309,291 miles or 30.1 AU

Diameter: 30,775 miles

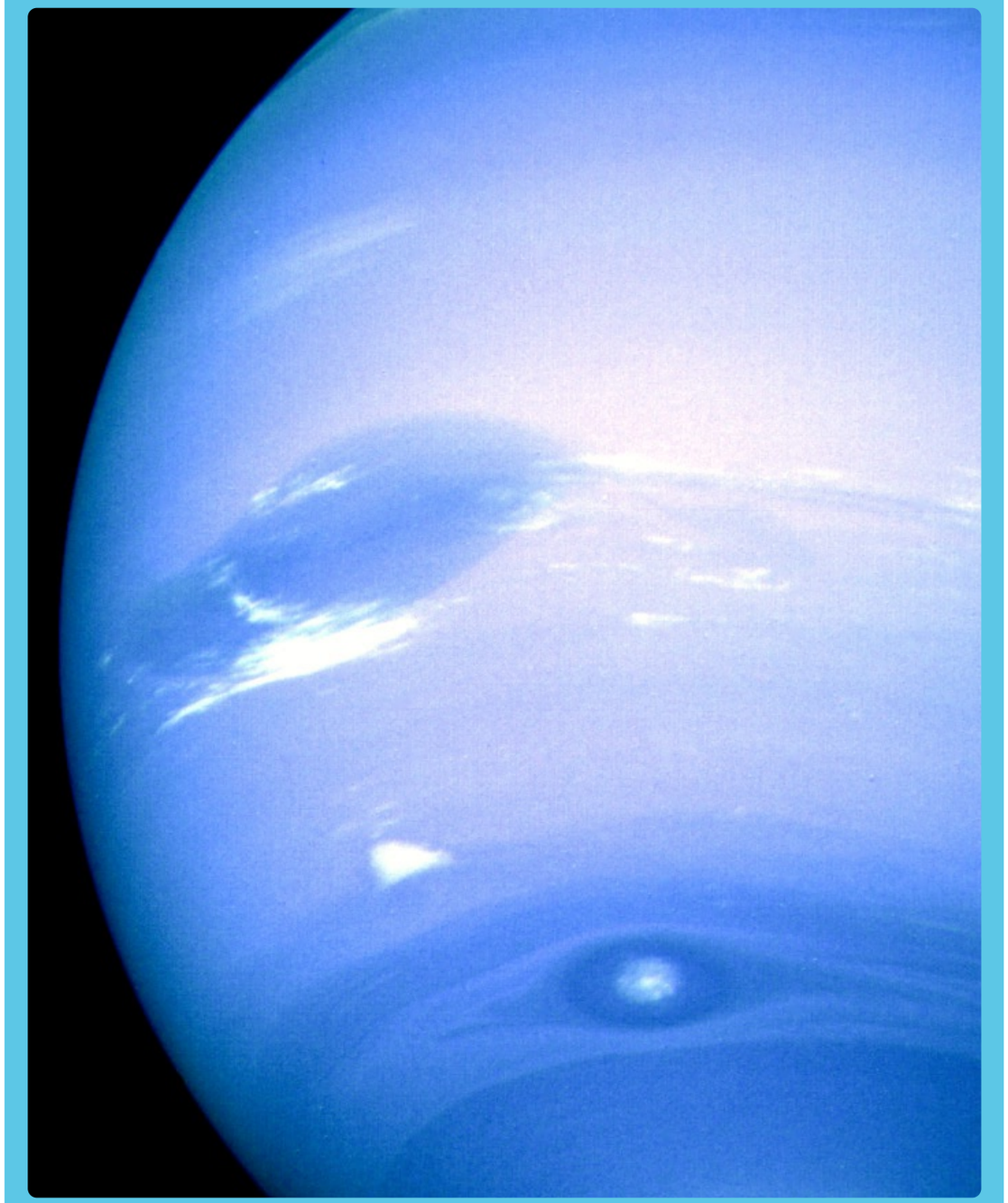
Temperature: 218° below 0° F.

Duration of Orbit (Neptunian year): 164.7 Earth years

Rotation (Neptunian day): 16 Earth Hours

Significant spacecraft: Voyager II.

Neptune's Great Dark Spot



The Dark Spot raged for twenty years with winds of 1000 miles per hour. The white areas are called scooters and are also storms.

Neptune is a giant planet, composed mainly of hydrogen and a little helium, methane, plus water and ammonia ice. Methane absorbs all colors except blue and gives both Uranus and Neptune their characteristic blue color. Neptune, like Uranus, is believed to have a rocky core surrounded by ice.

It was not known in ancient times. Using mathematics, its position was predicted independently by both Urbain Le Verrier and John Couch Adams. It was finally observed in 1846 by Johannn Galle.

Rings

Neptune has a deteriorating ring structure. Some of the rings are not complete circles, but are made up of arcs – similar to Jupiter's rings.

The Great Dark Spot

A large storm, known as the Great Dark Spot, raged on the surface of Neptune for about 20 years before blowing itself out. Winds blew at more than 1000 miles an hour, making it the fastest wind speed ever observed in the solar system. Another dark storm was observed in 2019 by the Hubble Telescope.

Moons

Triton is Neptune's largest moon. Surface markings reveal that it once had geologically active geysers or volcanoes that erupted nitrogen.

Pluto and Beyond

The frozen regions of the Kuiper Belt and the Oort Cloud populate the farthest regions of our solar systems. As the New Horizons spacecraft races deep through the Kuiper Belt, we will no doubt make new discoveries and uncover new mysteries.

Pluto

Pluto Everyone's favorite

Moons: 5 moons: Charon, Hydra, Nix, Styx, Kerberos

Distance from Sun: 3, 649,825,210 miles or 43.1 AU

Diameter: 1,433 miles (three-fourths the size of Earth's moon)

Temperature range : 400° below 0° F.

Orbit (Plutonian year): 248 Earth years

Rotation (Plutonian day): 6.3 Earth days (6 days, 8 hours)

Significant spacecraft: New Horizons

Pluto's atmosphere

New Horizons captured this image of Pluto, backlit by the Sun. The image reveals Pluto's methane and carbon monoxide atmosphere.

Pluto was not known in ancient times. It was discovered by Clyde Tombaugh in 1930. Tombaugh searched photographic images for two years to find the tiny world.

Until New Horizons flew past Pluto in July 2015, very little was known of Pluto's composition and features. Although instruments successfully captured scientific information during the Pluto flyby, data slowly has been making its way back to Mission Control due to slow data transmission rates.

Features

Pluto has a copper red color and a large feature, resembling a heart. This region is made of methane ice, and has been named the Tombaugh Reggio, in honor of the discoverer of Pluto..

Pluto has a rocky surface and has flowing glaciers made of methane ice and a mountain range the size of the Rocky Mountains, made of water ice. Pluto has a thin atmosphere made up of nitrogen, methane, and carbon monoxide. Scientists now suspect that Pluto may have an underground ocean.

Orbit

It is sometimes closer to the Sun than Neptune, but is currently moving farther away again.

All the planets in the solar system follow a path call the ecliptic, the Earth's orbital plane. However, Pluto is tilted to the ecliptic and moves above it and below it at an angle of about 17°.

Pluto and Charon

Pluto and its largest moon, Charon, orbit each other. Another moon, called Nix, is oval shaped and is white, with a red spot at its center.

Planet vs. Dwarf Planet Debate

Pluto is no longer classified as a planet, but as a dwarf planet. When Pluto was discovered, no one knew exactly how big it was. If its true size had been known, it may never have been classified a planet to begin with. But as it was popularly accepted as a planet, there was a huge public outcry when the IAU (International Astronomical Union) changed its classification to a dwarf planet. New Horizons has now accurately measured Pluto, and it is now known to be larger than Eris, confirming it is the largest dwarf planet. However, Pluto is smaller than our Moon.

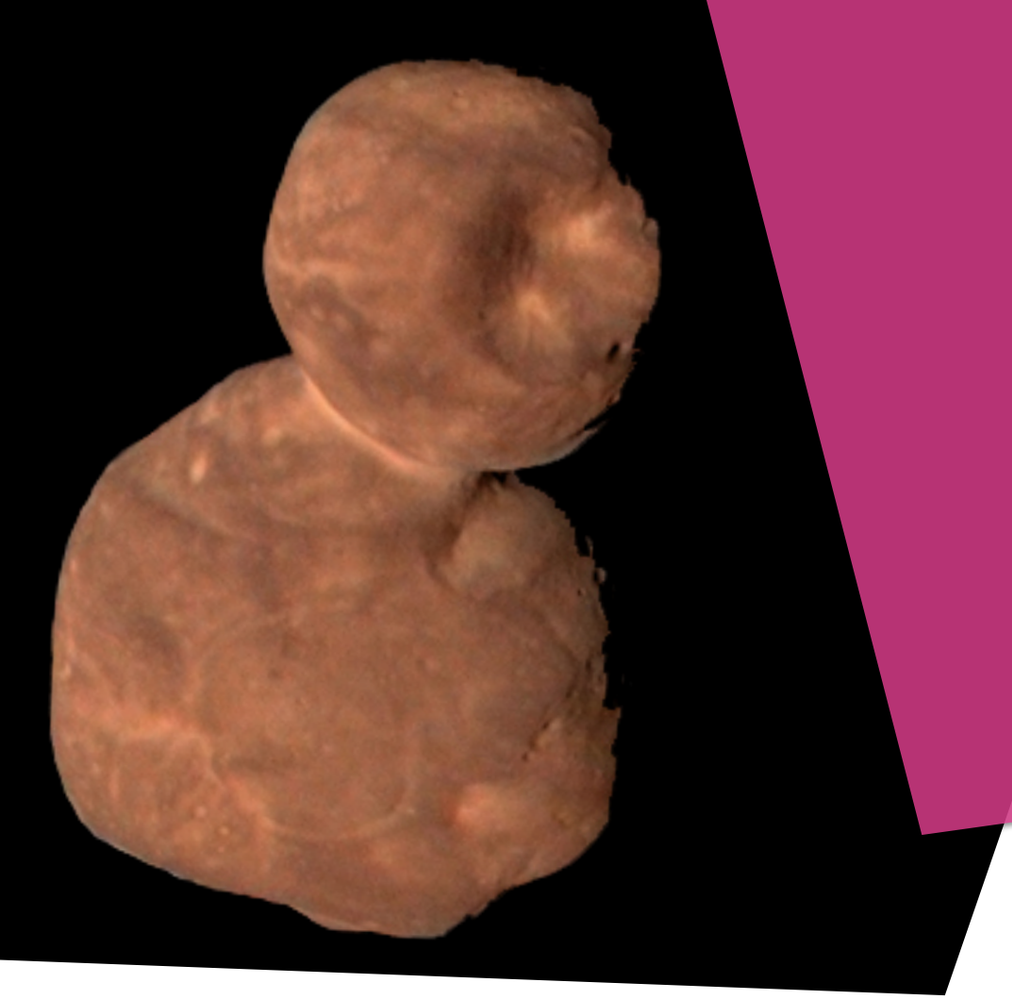
Now that New Horizons has revealed Pluto to be a complex world, the debate over its status has been re-ignited and many petitions have been circulated to restore Pluto to full planet status again.

Moons and a Double Planet System

Nix is white with a red spot in its center. It is oval shaped and tumbles erratically end over end like a football.

Kerberos is the only dark moon. It may have been formed outside of the Plutonian system and later captured by Pluto's gravity. It may have even impacted with Pluto.

Pluto and Charon are tidally locked with each other – this means the same side of Pluto always faces the same side of Charon. However, Charon and Pluto orbit each other and are now considered to be a double (dwarf) planet or binary planetary system.



Kuiper Belt and Oort Cloud

The Kuiper Belt

Out past Neptune lies an icy region of space known as the Kuiper (pronounced coy-per)Belt. The Kuiper Belt is a lot like the asteroid belt, only 20 times wider and covering a region of 30 to 50 AUs beyond Neptune. Objects in the Belt are made up of ice and rock. Ice in this region is made of water, methane and ammonia. Pluto is the first member of the Kuiper Belt, followed by the other dwarf planets Eris, Makemake and Haumea. Between 40 and 200 frozen worlds may inhabit the Belt. Not much is known about this distant regions of our solar system. In 2019, the New Horizon spacecraft visited a small snowman-shaped world designated Arrokath (see image above), in the Kuiper Belt.

The Oort Cloud spherically surrounds the edges of the solar system with millions of ice particles. It is believed that this is where many comets come from. Hale-Bopp is perhaps the most famous comet to have that originated in the Cloud. It is speculated that when large objects such as planets and stars pass nearby our solar system, their gravity bumps comets out of the Oort Cloud, sending them careening toward our Sun. We have not yet launched a spacecraft to the Oort Cloud. In fact, we don't have a spacecraft that could reach the Oort cloud for many human lifetimes.The Oort Cloud may begin an incredibly distant 2000 AUs from the Sun and may extend out to 100,000 AUs (this is half the distance to the nearest star, Proxima Centauri).

My Very Eager Mother

There's a simple phrase to help you remember the name and the order of the planets in our solar system:

My very eager mother just served us nine pizzas.

My (Mercury) very (Venus) eager (Earth) mother (Mars) just (Jupiter) served (Saturn) us (Uranus) nine (Neptune) pizzas (Pluto). The position of each word is the order of the planets from the closest to the farthest from the Sun.

At least that's how the phrase used to read until Pluto was no longer considered a planet. So we have to come up with a new phrase. Here's some other suggestions:

My very eager mother just served us nachos. Or how about:

My very eager mother just served us noodles. Or even:

My very eager mother just served us nothing.

We personally like nachos, but you can make up your own phrase, using all different words, if you'd like. Or you can keep the original phrase – a lot of folks still feel Pluto is important enough to be rub shoulders with the big guys!

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