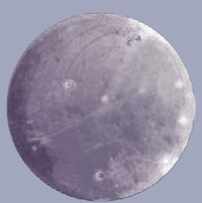
MERCURY

The closest planet to the Sun is Mercury. Like the other inner planets—Venus, Earth, and Mars—it is made of rock and metal. Since Mercury is closer to the Sun than Earth, it is a much hotter and harsher place than our planet.

It is difficult to spot Mercury in the sky. Seen from Earth, it is always close to the Sun and hidden by the glare. On just a few days a year, it is possible to spot the little planet for a few minutes when the Sun is setting or rising.



SIZE: 3,031 miles across (0.4 times the size of Earth)

WEIGHT: 0.06 Earths

DAY: 176 Earth days

YEAR: 88 Earth days

DISTANCE FROM THE SUN: 0.4 AU

SURFACE TEMPERATURE: -274 °F to 788 °F

ATMOSPHERE: None

MOONS: 0

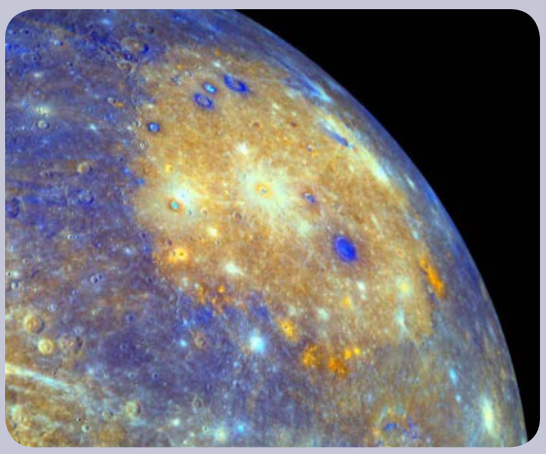
SCALE

Mercury is covered in craters made by being hit by millions of **meteorites**.

Eminescu Crater

CALORIS BASIN

The largest crater on Mercury, called the Caloris Basin, is 808 miles across. It formed when an asteroid hit Mercury about 3.9 billion years ago. The force from this impact sent a shockwave right through Mercury, which made the rock on the far side of the planet crack.



This photo taken by the *Messenger* spacecraft in 2008 uses bright colors to show different materials. The Caloris Basin is shown in orange.

Sander Crater

Munch Crater

Poe Crater

Basho Crater

Neruda Crater

Craters on Mercury are named after artists and writers. These craters remember painter Edvard Munch, photographer August Sander, and author Edgar Allan Poe.

SPEEDY PLANET

Mercury is named after the Roman god whose job was to race around carrying messages. Mercury also travels fast, whizzing around the Sun in 88 Earth days. A rocket traveling as fast as Mercury would cross the Atlantic Ocean in 1 minute! But Mercury spins slowly on its **axis**, only once every 58 Earth days. If you were standing on Mercury, it would take 176 Earth days for the Sun to rise, set, and rise again!

Mercury was the Roman god known for his speediness—just like the planet that took his name.

Some craters are surrounded by "rays" like the spokes of a wheel. These were created when meteorites smashed rocks into dust, spraying it out in all directions.

VENUS

About 100 years ago, many people believed that aliens called Venusians lived on Venus. They thought Venus was a paradise world!

Until recently, no one knew much about Venus. Even seen through telescopes, Venus is covered in yellow-white clouds. The clouds reflect sunlight, making Venus the brightest natural object in the night sky. Venus is seen before sunrise and after sunset, when it is called the Morning or Evening Star, even though it's a planet!

SIZE: 7,520 miles across (0.95 times the size of Earth)

WEIGHT: 0.8 Earths

DAY: 243 Earth days

YEAR: 224 Earth days

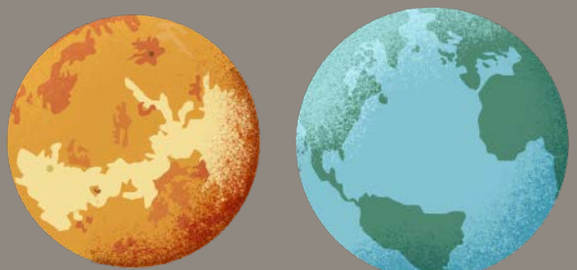
DISTANCE FROM THE SUN: 0.7 AU

SURFACE TEMPERATURE: 860 °F

ATMOSPHERE: Carbon dioxide, nitrogen

MOONS: 0

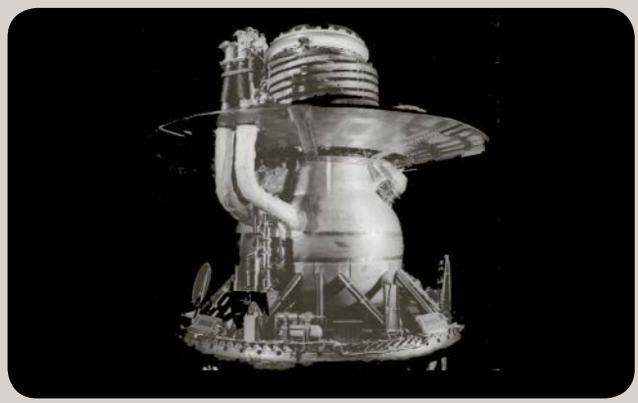
SCALE



Venus Earth

INTO THE UNKNOWN

In 1965, Russian astronomers sent *Venera 3*, an unmanned spacecraft, or 'space probe', to find out what Venus was like. *Venera 3* dropped into Venus's clouds and was never heard from again. The Russians kept sending probes. A few reached the surface but quickly broke. Finally, in 1975, *Venera 9* made it down in one piece and sent back a picture of Venus's rocky surface. In 1990–94, NASA's *Magellan* probe created maps of Venus with radar, which uses **radio waves** to bounce off the surface and build up a picture.



The *Venera 13* probe launched in 1981. It was built to be very strong to survive on Venus's surface.

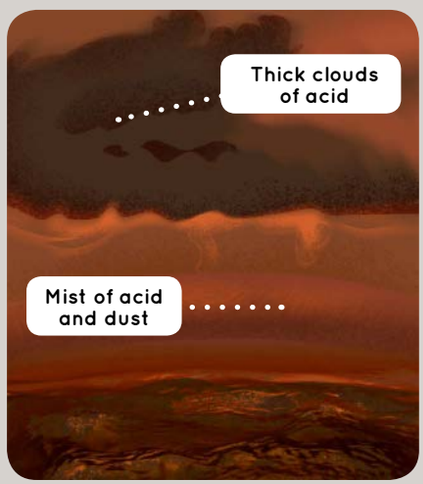
The volcano Sapas Mons is 250 miles wide. Like volcanoes on Earth, its slopes were built up as super-hot lava flows hardened into rock.

Venus's Atla Regio region has six large volcanoes. The largest is Maat Mons, which is 5 miles tall.

The Sapas Mons volcano has two craters. Thanks to the *Magellan* probe, we have a good idea what they look like.

NOT A PARADISE!

Venera 9 found that Venus is the hottest planet in the Solar System. The thick, heavy atmosphere traps the Sun's heat, making it hotter than an oven! When it rains on Venus, the raindrops are pure **acid**.



The atmosphere on Venus would be deadly to humans.

MARS

Ancient people named this planet after the Roman god of war. Mars is the planet in the Solar System most similar to Earth. However, it is dry and cold, so living things cannot exist there.

Mars looks red from Earth because its rocky surface is rich with iron, which turns rusty and red. Mars's poles are covered in ice, made of frozen water and carbon dioxide. Some astronomers think that, long ago, Mars was warmer and may have been covered in seas.

SIZE: 4,220 miles across (0.5 times the size of Earth)

WEIGHT: 0.15 Earths

DAY: 24.5 Earth hours

YEAR: 687 Earth days

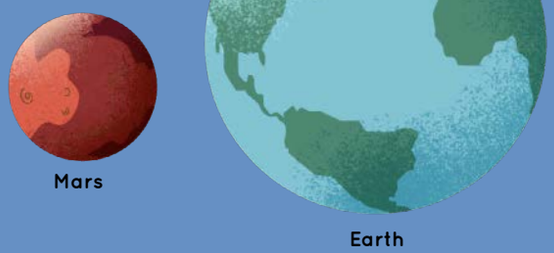
DISTANCE FROM THE SUN: 1.5 AU

SURFACE TEMPERATURE: -193 °F to 68 °F

ATMOSPHERE: Carbon dioxide

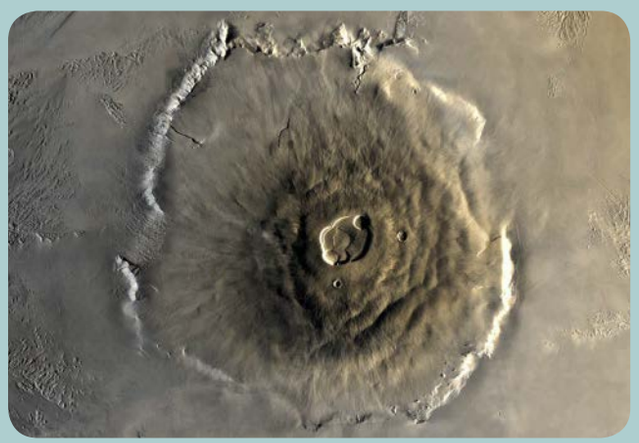
MOONS: 2

SCALE



BIGGEST VOLCANO

Mars has the largest volcano (which is also the largest mountain) in the Solar System. It is called Olympus Mons and is 16.8 miles tall (nearly three times bigger than Earth's highest mountain, Mount Everest). The volcano last erupted around 25 million years ago.



This overhead photo of Olympus Mons was taken by NASA's *Viking 1* space probe in 1978.

If simple life once existed on Mars, it would have left chemicals in the rocks. *Curiosity* has drills, brushes for collecting dust, and lasers for blasting rocks apart to test them.

MARTIAN MOONS

Mars has two small moons, named Phobos and Deimos. These are nothing like Earth's Moon: they are only about as wide as a city and look like giant boulders covered in craters. Astronomers think the moons were once asteroids that came too close to Mars and were pulled into orbit by the planet's gravity. The moons' names mean "Fear" and "Terror," who were the children of the Greek god of war, named Ares.

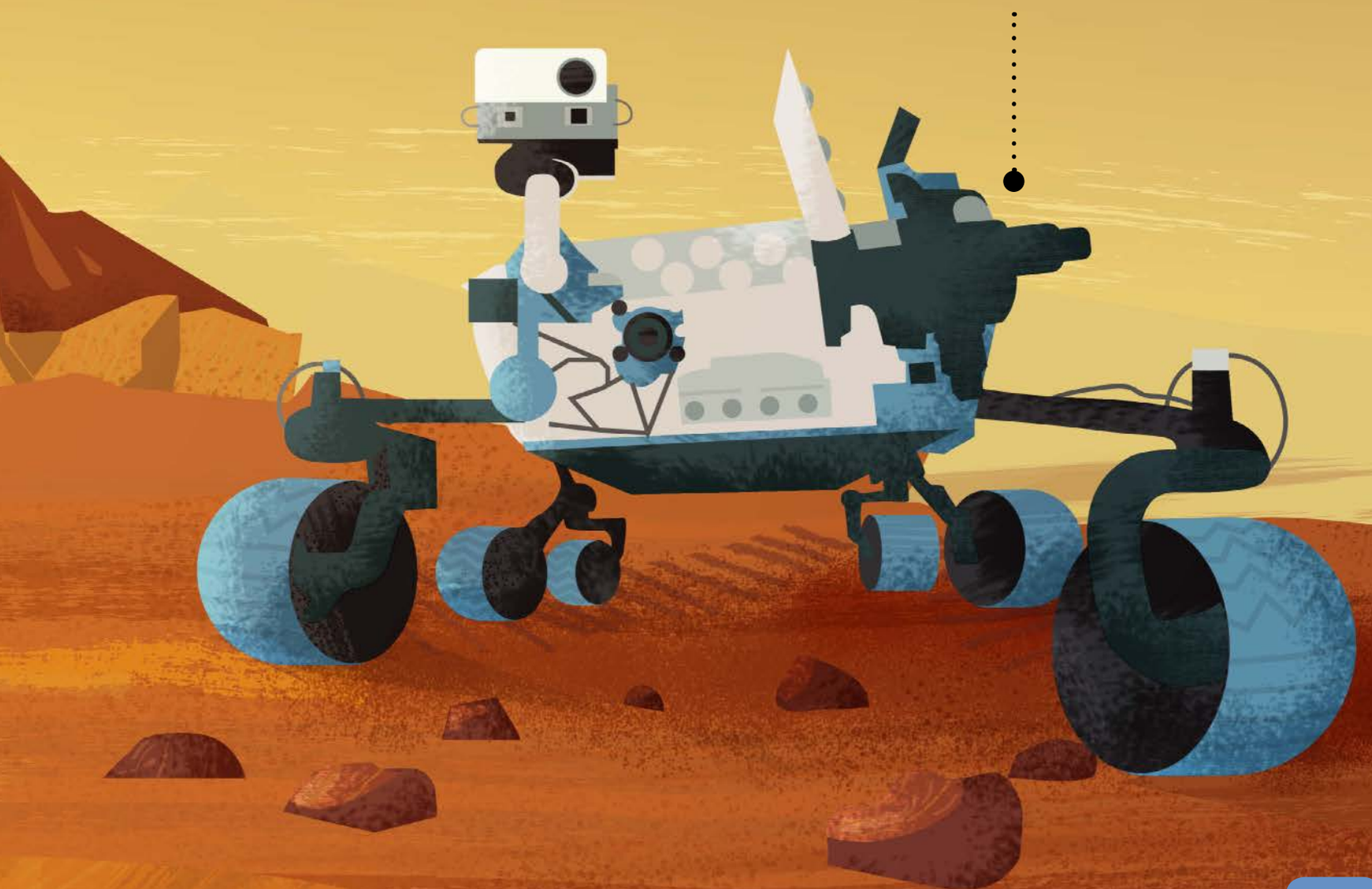
Phobos

Deimos

CURIOSITY

Since 2012, NASA's *Curiosity* rover has been rolling over Mars's surface. The rover's main job is to look for traces of water and signs of alien life. Although there is probably no life on Mars today, astronomers wonder if that was always the case.

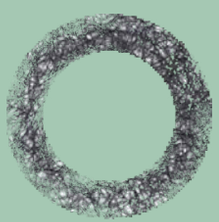
Curiosity receives instructions from Earth using radio waves. However, if a rock or a hole blocks the rover's way, it knows how to get out of trouble on its own.



THE ASTEROID BELT

The Asteroid Belt is a ring of rocks that orbit the Sun in a large gap between the orbits of Mars and Jupiter. Astronomers have counted 50,000 large rocks that range from car-sized to country-sized, but there are probably millions of smaller rocks as well. Asteroid means "star-like."

Asteroids are made of metals and rock. Many of the metals are rare on Earth. We use them to make batteries and computer microchips. Companies are figuring out if it is possible to send mining spacecraft to these asteroids.



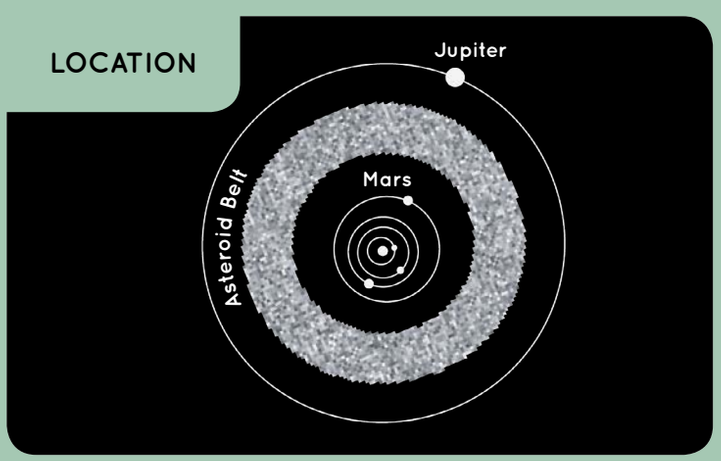
LARGEST ASTEROID: Ceres (590 miles across)

WEIGHT OF ALL ROCKS IN THE BELT: 0.04 Earth Moons

AVERAGE DISTANCE FROM THE SUN: 2.2–3.2 AU

AVERAGE SPEED OF ORBIT: 15 miles per second

MOONS: 143 asteroids have their own moons



DANGER TO EARTH

Thousands of asteroids orbit outside the main Asteroid Belt. Some of them come close to Earth. Asteroids do not follow simple orbits: the gravity of big planets makes the rocks swerve and loop through space. Astronomers watch the "Near-Earth Asteroids" to check if one is going to hit us. If needed, we could send spacecraft to knock the asteroid out of its collision course.

In 2013, a small Near-Earth Asteroid entered Earth's atmosphere above Chelyabinsk, Russia.

The first asteroid to be found was Ceres, in 1801, and it is also the biggest. If Ceres landed on Earth it would cover Spain. Ceres is so large that astronomers call it a **dwarf planet** (see page 32). About half the weight of the Asteroid Belt is contained in the four largest asteroids: Ceres, Vesta, Pallas, and Hygiea.

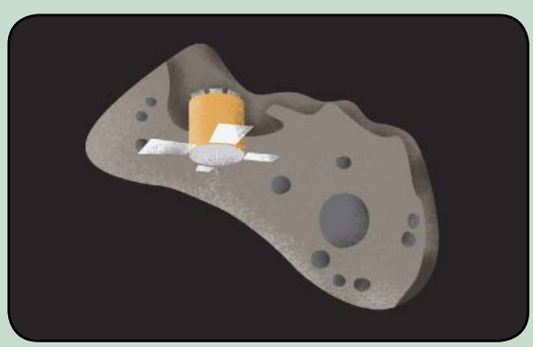
Ceres

Pallas

Vesta

ASTEROID LANDER

In 2001, a space probe called *NEAR-Shoemaker* landed on a Near-Earth Asteroid named Eros. Eros is shaped like a 10-mile-long peanut. The gravity of Eros does not pull to the middle of the asteroid, but pulls toward the larger, heavier ends. That means that, in some places on Eros, things will fall uphill!



Eros was the first asteroid to be landed on.

JUPITER

Jupiter is the biggest and heaviest planet in the Solar System. It is a gas giant. Much of it is made of liquid and thick, foggy gases.

When the Sun was young, it was surrounded by dust and gases. The dust was heavier, so it was pulled nearer to the Sun, forming the inner, rocky planets: Mercury, Venus, Earth, and Mars. The gas farther away from the Sun formed the giant, gassy outer planets: Jupiter, Saturn, Uranus, and Neptune.

SIZE: 88,846 miles across (11 times the size of Earth)

WEIGHT: 318 Earths

DAY: 10 Earth hours

YEAR: 12 Earth years

DISTANCE FROM THE SUN: 5 AU

SURFACE TEMPERATURE: -148 °F

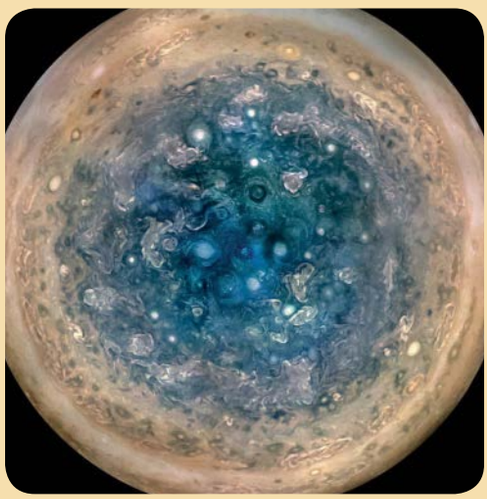
ATMOSPHERE: Hydrogen, helium, methane

MOONS: 69, plus a faint ring system

SCALE

JUNO TO JUPITER

NASA's *Juno* space probe went into orbit around Jupiter in 2016. *Juno*'s mission is to search for clues about the planet's core and to study its atmosphere and winds, which can reach up to 384 miles per hour.



In 2017, *Juno* took this photo of storms around Jupiter's South Pole.

Jupiter has layers of liquid and gassy hydrogen and helium, around a core of rock and ice.

Jupiter's second biggest moon, Callisto, has more craters for its size than any object in the Solar System.

Jupiter's largest moon, Ganymede, is also the largest moon in the Solar System.

The third largest moon, Io, is the most volcanically active place in the Solar System.

The fourth biggest moon, Europa, has a hidden ocean of water, covered in ice. Could this ocean be home to alien life?

Jupiter's clouds tangle into vast storms. The largest, called the Great Red Spot, has been raging since at least 1665.

SATURN

This is the second largest planet in the Solar System. Like Jupiter, it is a gas giant. All the giant planets have a ring system, but Saturn has the largest and brightest.

Like the other giant planets, Saturn is made mostly from hydrogen and helium, which are the lightest materials in the Universe. Helium is the gas in party balloons. Saturn is the most lightweight planet. If it were possible to put Saturn in a giant bucket of water, it would float.

SIZE: 74,898 miles across (9.5 times the size of Earth)

WEIGHT: 95 Earths

DAY: 10.5 Earth hours

YEAR: 29 Earth years

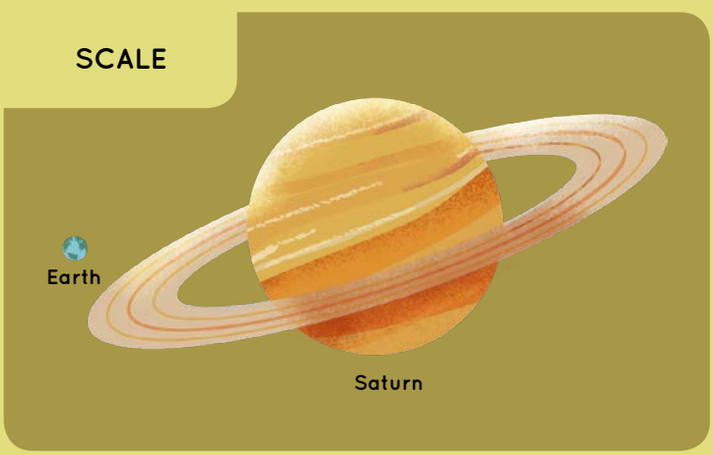
DISTANCE FROM THE SUN: 9.5 AU

SURFACE TEMPERATURE: -220 °F

ATMOSPHERE: Hydrogen, helium, methane

MOONS: 62, plus a ring system

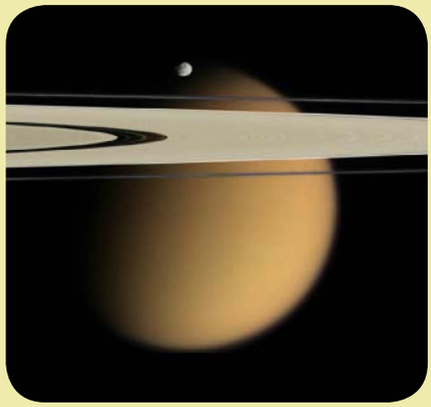
SCALE



Saturn's main rings stretch from 4,000 to 50,000 miles away from Saturn's **equator**. They are made of billions of pieces of ice that range from tiny specks to chunks as big as a house. Although Saturn's rings are massively wide, they are only about 30 feet thick.

TITAN

Saturn's largest moon is Titan. Like Jupiter's moon Ganymede, it is larger than Mercury. It is the only moon in the Solar System with a thick atmosphere, which forms orange clouds. In 2004, a landing craft named *Huygens* was dropped onto Titan by the *Cassini* probe. It found that the moon was covered in lakes and rivers, but instead of water, they were filled with gasoline-like liquids!

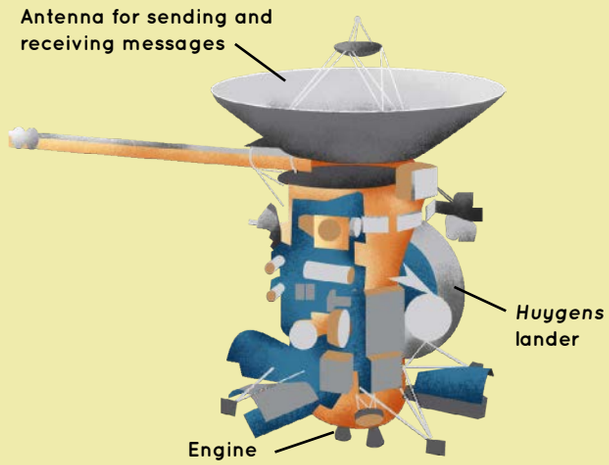


This photograph taken by *Cassini* shows Titan behind Saturn's rings and the smaller moon Epimetheus.

Saturn is not a perfect ball shape. It is flattened at the poles and bulges at the equator.

THE CASSINI MISSION

The *Cassini* space probe spent 13 years studying Saturn. It was named after Italian astronomer Giovanni Cassini, who correctly suggested in 1675 that Saturn's "ring" was actually several rings, with gaps between them. In 2017, *Cassini* made one final mission, flying straight into Saturn's atmosphere. The spacecraft sent back information about the chemicals in the clouds before it was ripped apart.

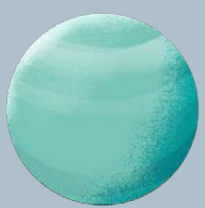


***Cassini* went into orbit around Saturn in 2004.**

URANUS

Uranus can just be spotted in the night sky without a telescope, but it is so dim that it was mistaken for a star until 1781.

Uranus is an ice giant, like the next planet in the Solar System, Neptune. They are both made of the same kind of material as Jupiter and Saturn, but they are much farther from the Sun and much colder. Instead of being giant balls of gas, the outer two planets are giant balls of ice, liquid, and extremely cold gas.



SIZE: 31,763 miles across (4 times the size of Earth)

WEIGHT: 15 Earths

DAY: 17 Earth hours and 14 minutes

YEAR: 84 Earth years

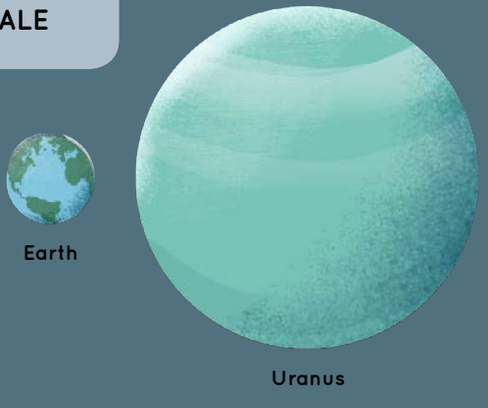
DISTANCE FROM THE SUN: 19 AU

SURFACE TEMPERATURE: -328 °F

ATMOSPHERE: Hydrogen, helium, methane

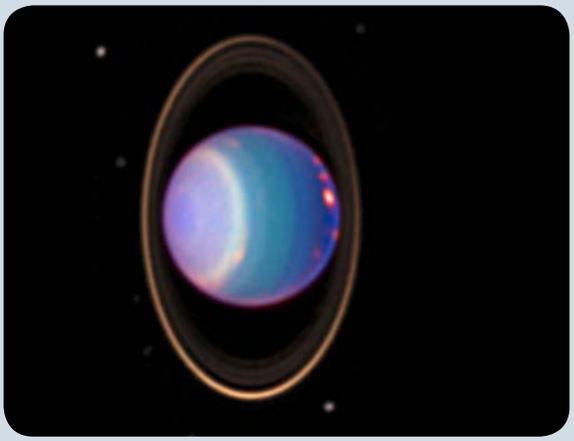
MOONS: 27, plus a ring system

SCALE



BIG RINGS

Little was known about Uranus until the 1980s, when the *Voyager 2* probe flew by. It revealed the huge size of Uranus's rings: the outer ring, number 13, stretches 61,000 miles from the planet. The rings are made mostly of ice, coated with grime.



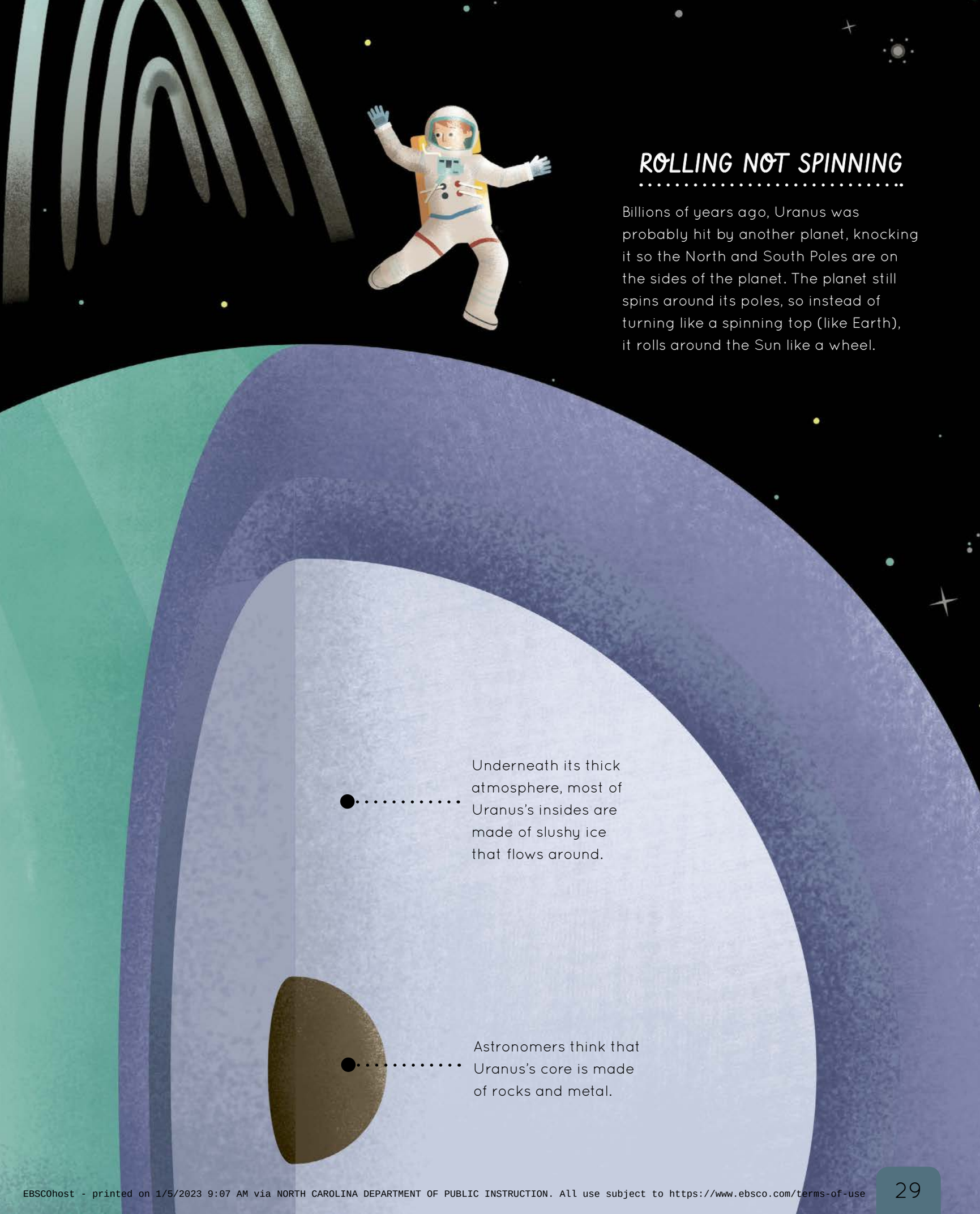
The *Hubble Space Telescope* took this photo of Uranus, its rings, and some of its moons.

White clouds can be seen in Uranus's atmosphere.

IT'S A PLANET!

The discovery of Uranus made Herschel famous.

In 1781, Uranus became the first planet to be discovered with a telescope. Using a telescope he built himself, the astonomer William Herschel noticed the distant "star" was actually orbiting the Sun like a planet.



ROLLING NOT SPINNING

Billions of years ago, Uranus was probably hit by another planet, knocking it so the North and South Poles are on the sides of the planet. The planet still spins around its poles, so instead of turning like a spinning top (like Earth), it rolls around the Sun like a wheel.

Underneath its thick atmosphere, most of Uranus's insides are made of slushy ice that flows around.

Astronomers think that Uranus's core is made of rocks and metal.

NEPTUNE

Neptune has a deep blue color as if it is covered in water, so its discoverers named it after the Roman god of the sea. In fact, Neptune is an ice giant, made mostly of slushy ice. Like Uranus, it probably has a core of rock.

Neptune has the wildest weather in the Solar System. The planet's winds blow at 1,250 miles per hour, 20 times faster than a hurricane on Earth. White clouds called scooters are blown right around the planet.

SIZE: 30,775 miles across (3.8 times the size of Earth)

WEIGHT: 17 Earths

DAY: 16 Earth hours

YEAR: 165 Earth years

DISTANCE FROM THE SUN: 30 AU

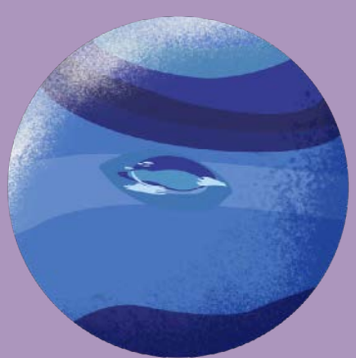
SURFACE TEMPERATURE: -328 °F

ATMOSPHERE: Hydrogen, helium, methane

MOONS: 14, plus a faint ring system

SCALE

Earth



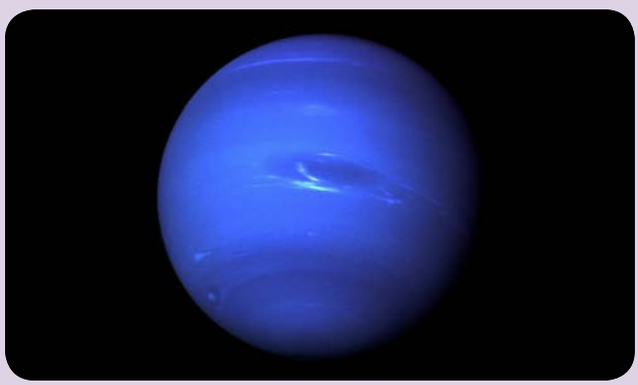
Neptune

WHY THE WOBBLE?

After figuring out Uranus's path around the Sun, astronomers saw that it wobbles a little. This showed that another, more distant planet was pulling on it. This realization led to the discovery of Neptune in 1846.

GREAT DARK SPOT

Voyager 2 passed Neptune in 1989, capturing images of a 8,000-mile storm that was soon named the Great Dark Spot. Five years later, when the *Hubble Telescope* photographed Neptune, the storm had disappeared, but a new, huge storm had appeared.



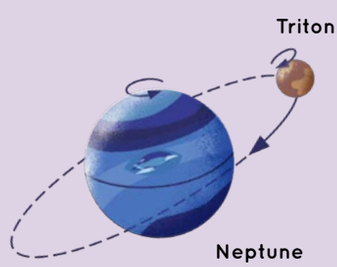
***Voyager 2* took this photo of Neptune when it passed 4 million miles from the planet. The Great Dark Spot can be seen at the center.**

Neptune's clouds look a bit like Earth's clouds, but they are made of methane ice crystals rather than water.

Neptune has at least five rings. They are made of icy boulders, darkened by a coating of grime.

WRONG WAY, TRITON!

Neptune's largest moon is Triton. All other moons in the Solar System orbit their planet in the same direction as the planet spins. But Triton orbits Neptune in the opposite direction. That suggests that Triton comes from the outer Solar System and was captured by Neptune's gravity, becoming its moon.



Triton spins in the opposite direction from Neptune.

PLUTO

In 1930, Clyde Tombaugh discovered Pluto. It was thought that Pluto was bigger than Earth, so it was named the ninth planet in the Solar System. Pluto is so far away it took years to figure out that it is actually smaller than our Moon. In 2006, astronomers decided Pluto should be described as a dwarf planet.

Pluto is the largest object in the Kuiper Belt, a distant region of the Solar System where icy objects swing around the Sun.

SIZE: 1,413 miles across (0.18 times the size of Earth)

WEIGHT: 0.002 Earths

DAY: 6 Earth days

YEAR: 248 Earth years

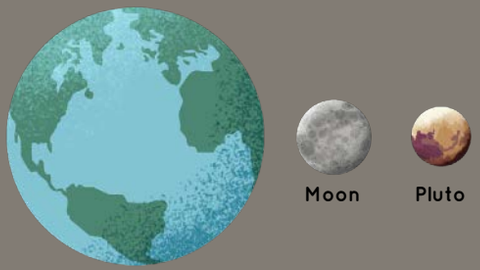
DISTANCE FROM THE SUN: 39 AU

SURFACE TEMPERATURE: -380 °F

ATMOSPHERE: Nitrogen, methane, carbon monoxide

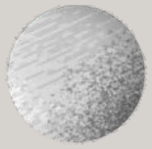
MOONS: 5

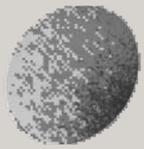
SCALE



WHAT IS A DWARF PLANET?

A dwarf planet is an object that orbits the Sun. (Unlike a moon, which orbits a planet.) A dwarf planet is large enough for the pull of its own gravity to crush it into a ball-like planet shape. However, unlike a true planet, a dwarf planet's gravity is not strong enough to clear its orbit, so its path is crossed by other objects. At the time of writing, astronomers agree there are five other dwarf planets in our Solar System: Ceres, in the Asteroid Belt (see page 23); and Eris, Haumea, Makemake, and Sedna, which are ice balls orbiting far beyond Neptune. Astronomers are likely to find more dwarf planets in the future.


Eris


Haumea


Makemake


Sedna


Styx

Hydra

The dwarf planet Pluto is named after the Greek and Roman god of the dead, Pluto.

NEW HORIZONS

In 2006, the *New Horizons* space probe was sent to study Pluto. It took more than nine years to get there, arriving during Pluto's long summer. (In the winter, it gets so cold that Pluto's atmosphere freezes solid.) The probe saw that Pluto's surface is made mostly of frozen nitrogen.

In this image taken by *New Horizons*, the large pale area on Pluto's surface is an ice sheet named Tombaugh Regio.

Pluto

Charon

Nix

Kerberos

PLUTO'S MOONS

The largest of Pluto's moons, Charon, is named after the boatman who brings the dead to the underworld in Greek myths. The moon orbits so close that Charon and Pluto swing around each other. The other moons are also named after creatures and places in the Greek underworld.