KS3 Bitesize

Astronomy and space science

The solar system contains planets, their satellites, asteroids and comets. The planets orbit the Sun and take different amounts of time to do this.

We have night and day on Earth because the Earth spins on its axis. The tilt of the Earth's axis causes the seasons to change as we orbit the Sun in one Earth year.

Introduction

This Revision Bite covers:

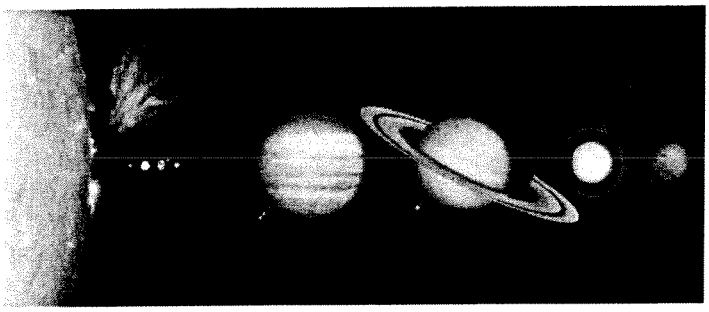
- **The solar system**
- **Gravitational forces**
- **Days and nights**
- **Years and seasons**
- **The Moon**
- **Artificial satellites and space probes**

The solar system

The universe contains over 100 billion galaxies. A galaxy is a group of billions of stars. Our own galaxy is called the Milky Way, and it contains about 300 billion stars (300,000,000,000) and one of these is our Sun.

Planets and other objects go round the Sun, and these make up the **solar system**, with the Sun at the centre. The solar system contains different types of objects including:

- a star - the Sun
- planets, which go around the Sun
- satellites, which go around planets
- smaller objects such as asteroids and comets



The planets in order from the Sun

Mercury to Neptune

There are **eight** planets in the solar system. Starting with Mercury, which is the closest to the Sun, the planets are:

- Mercury
- Venus
- Earth
- Mars
- Jupiter
- Saturn
- Uranus
- Neptune

If you can't remember the correct order, try this sentence, or make one up of your own:

My **V**ery **E**asy **M**ethod **J**ust **S**peeds **U**p **N**aming

Pluto and the dwarf planets

Scientists have discovered other objects orbiting the Sun. These include **comets**, **asteroids** and **dwarf planets**, like Pluto and Eris.

Pluto used to be considered the ninth planet in our solar system. But in 2006 scientists renamed it as a dwarf planet. So now we have 8 planets in the solar system.

Heliocentric model

People used to think that the Earth was at the centre of the universe, with everything going around it. We now know that this is not correct. Scientific observations and space exploration show that the Sun is at the centre of our solar system. The Earth and other planets go around it. We say that the planets are in orbit around the Sun.

This model is called the **heliocentric model**. (Helios is the ancient Greek word for Sun.)

Gravitational forces

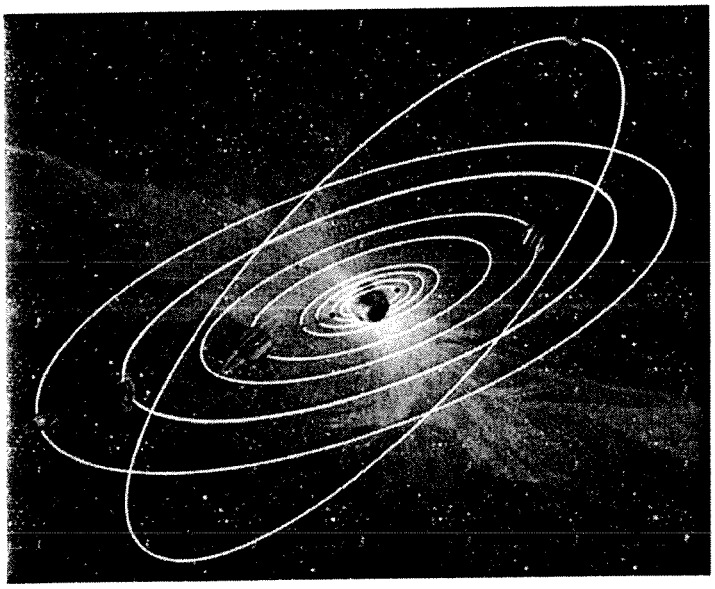
All objects are attracted towards each other by a force called **gravity**. Gravity only becomes noticeable when there is a really massive object like a star, planet or moon. You can find out more about gravity in the Revision Bite called **Forces**.

Gravity and the solar system

Gravitational forces between the Sun and planets keep the planets in **orbit** around the Sun. Without these forces, the planets would fly off into deep space.

Their orbits are slightly squashed circles called **ellipses**. Diagrams often show the orbits as very squashed, but this is just to get a sense of perspective and to fit the diagrams onto the page.

The planets furthest out are also the coldest because they receive the least heat energy from the Sun.

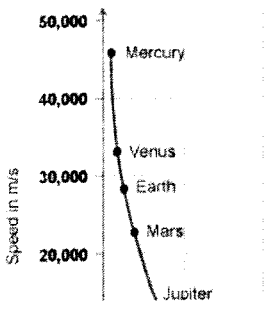


Orbit times and speeds

Planets that are **further** from the Sun:

- move more slowly
- take more time to complete an orbit

For example, Mercury, the closest planet to the Sun, takes just 88 Earth days to complete an orbit. But Neptune, the furthest out, takes 164 Earth years to complete an orbit.



Star trails made by leaving the camera shutter open during the night

Years and seasons

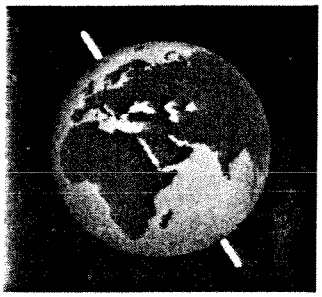
Years

A planet's year is the time it takes to make **one complete orbit** around the Sun. The Earth goes once round the Sun in one Earth year. That's 365 Earth days.

We've seen already that different planets take different lengths of time to orbit the Sun. That means their years are different lengths. Mercury has a year of just 88 Earth days, and Neptune has a year of 164 Earth years.

Seasons

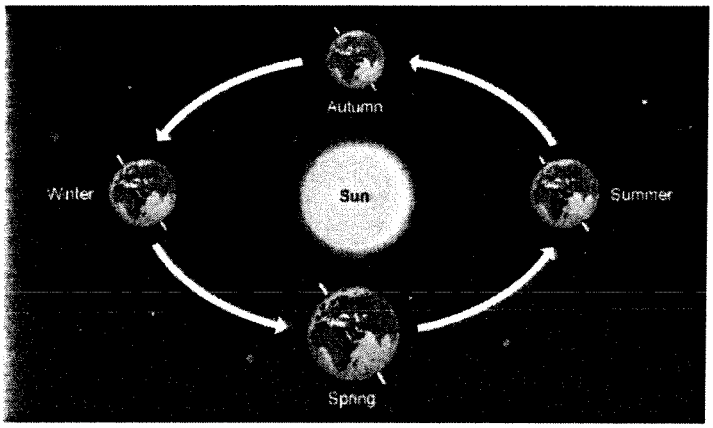
The Earth's axis is the imaginary line through the centre of the Earth between the South and North poles. This axis is **tilted** slightly compared to the way the Earth orbits the Sun.



We get different seasons (winter, spring, summer and autumn) because the Earth is tilted. This is how it works:

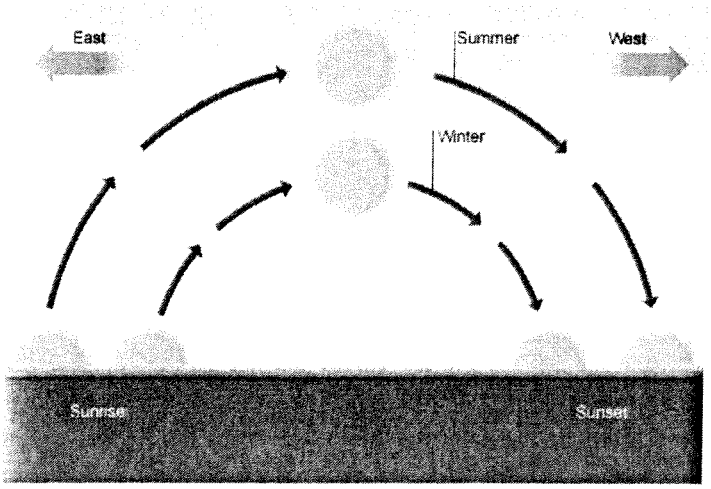
When the northern hemisphere is tilted towards the Sun it is summer in the UK.

When the northern hemisphere is tilted away from the Sun it is winter in the UK.



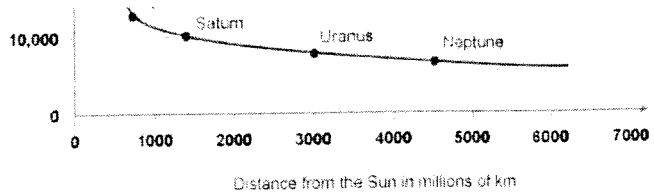
When it is summer in the northern hemisphere, it is winter in the southern hemisphere.

Because of the tilt of the Earth's axis the Sun moves higher in the sky in summer, when we tilt towards it, than in winter.



The Moon

The Moon orbits the Earth, so it is called a **satellite** of Earth. The Moon is a **natural satellite**. No-one built it or launched it into space.



The graph shows the distances of the planets from the Sun and the time it takes them to orbit once around it. The shape of the curve shows that the further out a planet is the longer it takes to orbit the Sun.

Days and nights

The planets **spin** as they orbit the Sun. It takes the Earth 24 hours to make one complete turn on its axis, so an Earth day is 24 hours long.

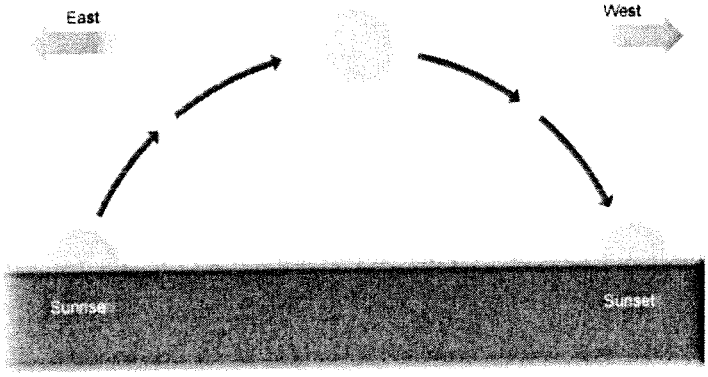
Different planets take different amounts of time to make one complete turn, so they have different lengths of day.

Day and night

The Sun lights up one half of the Earth, and the other half is in shadow. As the Earth spins we move from shadow to light and back to shadow and so on. It is daytime in the UK when our part of the planet is in the lit by the Sun. And it is night-time in the UK when our part of the planet is facing away from the Sun.

Path of the Sun

During the day, the Sun appears to move through the sky. Remember that this happens because the Earth is spinning on its axis. In the UK if we look south and follow the path of Sun in the sky during the day, it looks like this:



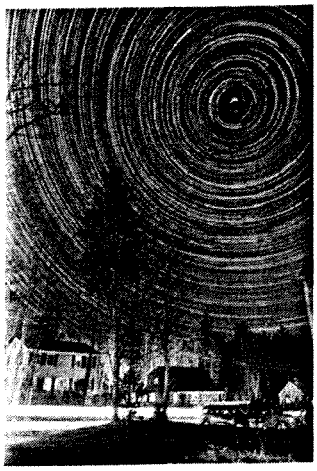
The sun rises in the east and sets in the west

The Sun appears to move from **east to west**. That's because the Earth is spinning towards to the east, so we see the Sun first appear there at the start of the day. The Sun 'rises' in the east and 'sets' in the west.

One way to remember which way the Earth turns is to remember "**w.e. spin**", which means the Earth spins from west to east.

Nights

During the night, we cannot see the Sun. But the Earth is still spinning on its axis. This means that the stars appear to move from east to west in the sky, just as the Sun does in the day.



Gravitational forces between the Moon and the Earth keep the Moon in orbit. The Moon does not produce light. But it does **reflect** light from the Sun, which is how we are able to see it from Earth. (Only stars produce light and they are called luminous for that reason.)

Phases of the Moon

It takes the Moon 28 days to make a complete orbit of the Earth. As it orbits, we see the Moon lit from different angles. This is why we see **phases** of the Moon.

Sometimes the Moon looks like a full circle. That is called a 'full Moon'. At other times we see a crescent shaped Moon, because we can only see the edge of the part that is lit by the Sun.

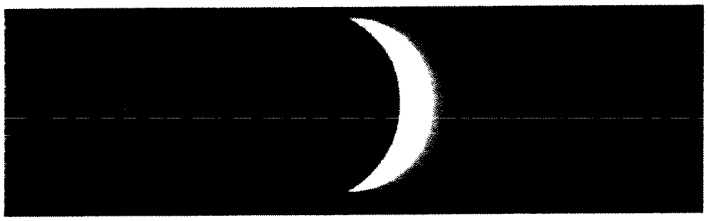
Remember that we can only see the part of the Moon that reflects the Sun's light. How much of that we can see depends upon the position of the Moon in its orbit.

This slideshow shows the phases of the Moon, as seen from the Earth.

Phases of the moon

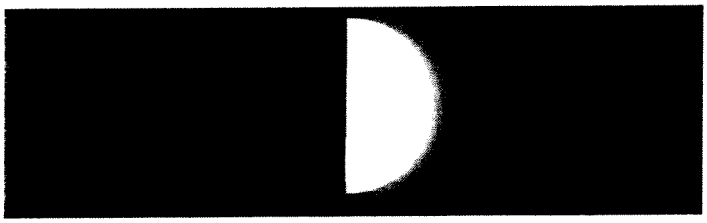
New moon

Phases of the moon



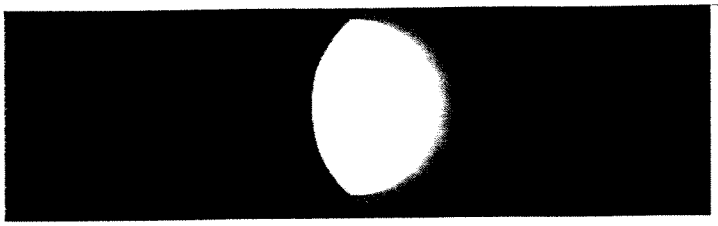
Waxing crescent

Phases of the moon



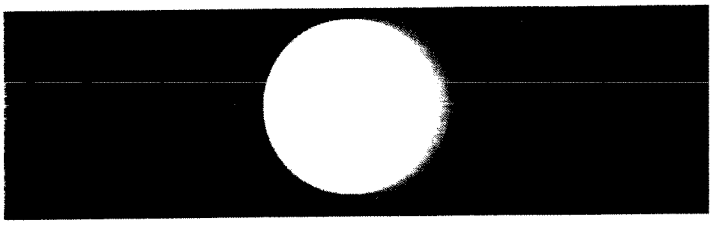
First quarter

Phases of the moon



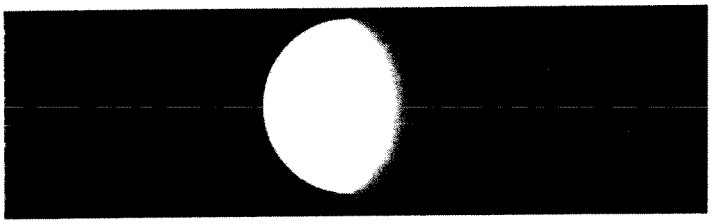
Waxing gibbous

Phases of the moon



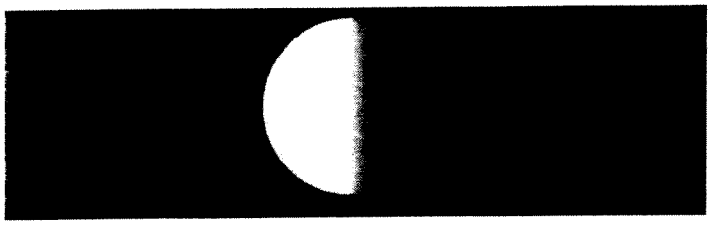
Full moon

Phases of the moon



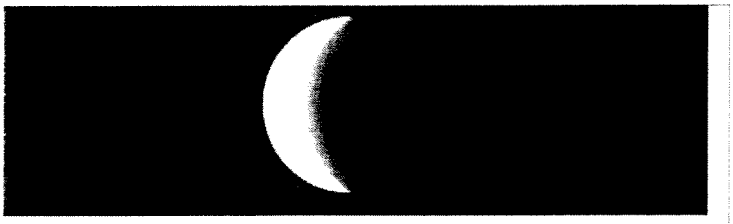
Waning gibbous

Phases of the moon



Second quarter

Phases of the moon



Waning crescent

Eclipse of the Moon

A common mistake is to think that the phases of the Moon happen because the Earth gets in the way, and casts its shadow onto the Moon. That is not how the phases are caused.

However sometimes it does happen that the Earth's shadow falls on the Moon. Then we get an **eclipse** of the Moon. The whole Moon goes from full, to dark, and back again to full, in the course of a few hours.

Satellites

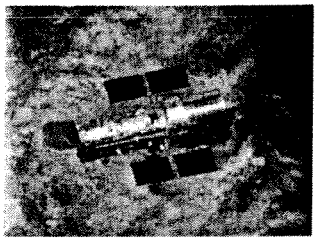
Artificial satellites

Artificial satellites are built by people and launched by rockets into space, where they orbit around the Earth. These are some of the things that artificial satellites are used for:

- communications, including broadcasting television programmes and relaying telephone calls
- Global Positioning System (GPS) and Galileo satellites for navigation
- collecting information to help with weather forecasts
- scientific surveys of the Earth's surface
- map making
- spying

Space telescopes

Some satellites are used to collect information about the planets and stars. The **Hubble Space Telescope** can see further into space than telescopes based on the ground. Its view is not blocked by clouds and it doesn't have to wait for night-time. However, it is difficult and expensive to launch and maintain. If anything goes wrong, only astronauts can fix it.



Hubble Space Telescope - image courtesy of NASA

Space probes

Space probes **do not** orbit the Earth. Instead, they travel to other planets to collect scientific information. Some space probes go into orbit around other planets, some land on them, and some even journey out of the solar system.

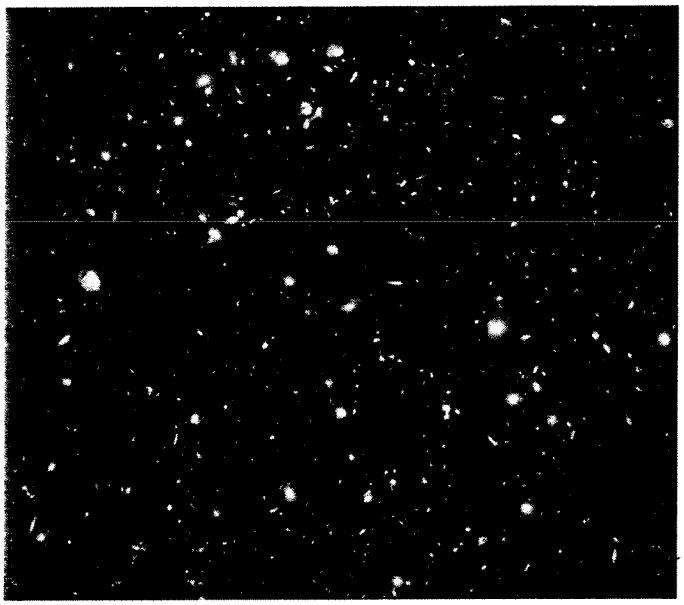
Space exploration

People have flown to the Moon and landed on it. But so far that is the furthest people have travelled from Earth. It takes years to travel to other planets, like Mars, and people have not done this yet.

More from Astronomy and space science

Across the Universe

By Gabrielle Sierra



Our universe is an amazing place. Since prehistoric days, inquisitive minds have been wondering about the celestial objects that surround our planet, and today scientists and astronauts continue that exploration.

This study of celestial objects - such as the planets, stars, and moons - is called Astronomy. An astronomer examines our galaxy and keeps records. Astronomy is one of the oldest sciences, examining the physics, chemistry, mathematics, and evolution of objects and phenomena that exist outside of the Earth's atmosphere.

The movements of the sun, the Earth, and stars are tracked, recorded, and continuously observed by scientists. Giant telescopes and various space missions allow us to keep track of what is going on in our galaxy, and to monitor the progress made by stars and planets as they

move or change. Records are kept to allow us to know when it will be a full moon or a solar eclipse, and models allow us to examine planets and stars in the galaxy.

The Earth is the third planet from the sun, and the fifth-largest of the eight planets in our solar system. The solar system was formed over 4 billion years ago. Our solar system consists of the sun, Earth, as well as Uranus, Neptune, Saturn, Mars, Jupiter, Mercury, and Venus. Each planet moves in an orbit called an ecliptic plane.

An orbit is the curved path an object makes around a point in space. Orbits keep the planets from flying off in a straight line. Gravity is what keeps objects in orbit.

Each of the planets in our solar system is very different. Earth is a terrestrial planet, which means that it is a rocky body, as opposed to Jupiter, which is a gas giant. A gas giant is a planet that is not primarily composed of solid matter. Saturn, Uranus and Neptune are also gas giants. Other terrestrial planets, aside from Earth, are Venus, Mercury, and Mars. Jupiter is the largest planet in our solar system.

The solar system is also made up from other objects including asteroid belts, moons, and dwarf planets like Pluto.

On a clear night we are able to see the moon. The moon is in synchronous rotation with Earth. This means that we always see the same side of the moon. It is the brightest object in the sky after the sun and is thought to have formed nearly 4.5 billion years ago, shortly after the Earth.

On a clear night we are also able to see stars. A star is not actually solid, but a sphere of plasma held together by its own gravity. We can see stars at night due to a process called thermonuclear fusion. This process changes hydrogen into helium at the core of a star, releasing energy that radiates out into outer space. That is why we can see stars so brightly in the night sky. Some stars appear brighter than others, and that is because brighter stars are closer to the Earth.

Most of the stars we see in the sky are outlined on a map called the celestial sphere. Groupings of stars are also mapped out on the celestial sphere. These are called constellations.

Constellations are groups of stars that are internationally defined and form patterns that we can see on Earth. As of 2013 there are eighty-eight constellations recognized by the International Astronomical Union.

The International Astronomical Union is a group of astronomers that acts as the authority on celestial bodies. The main objective of this group is to regulate interactions and research between various countries, keeping international relations friendly and universal. It is in this way that astronomers in Italy have the same names for stars as those in America.

The history of constellations can be traced all the way back to Old Babylonian astronomy in the Middle Bronze Age. Some of the most famous constellations are the zodiac constellations. These are Leo, Virgo, Aries, Taurus, Gemini, Cancer, Libra, Scorpio, Sagittarius, Capricorn, Aquarius, and Pisces. The zodiacal signs are different from the constellations because the groupings of stars drift, changing the shapes.

Other well-known constellations include the Big Dipper and the Little Dipper, which both form a shape that resembles a pot or "dipper."

Orion's Belt is another set of stars that we can easily recognize in the sky. These three stars rest in a straight line, right across the constellation of Orion. In this way they look like a belt. They are most visible during the winter months.

The nearest star to Earth is the sun. The sun provides the Earth with energy. Without the sun we would not be able to survive on this planet.

The North Star is one of the best known amongst the stars that stand on their own. It is very prominent in the sky and is aligned to the north celestial pole. The North Star is also known as Polaris. Polaris is approximately aligned with the Earth's axis of rotation, and therefore appears directly overhead when viewed from the North Pole.

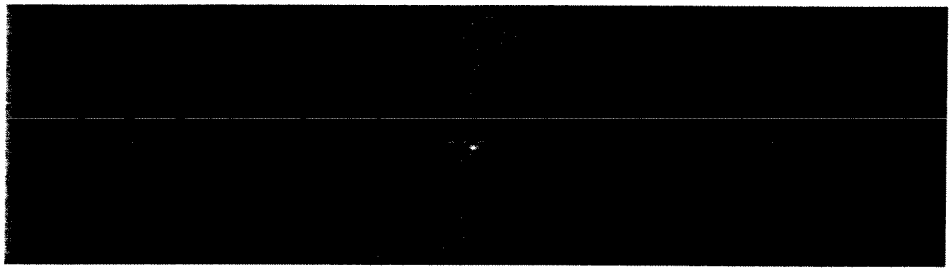
The Earth's axis of rotation is the path our planet takes as it moves around the sun. The Earth rotates around its own axis 365.26 times per each orbit around the sun, which gives us 365 days in each year. In turn, the moon orbits the earth, affecting the ocean tides, and slowing the Earth's rotation with its gravity.

The Earth and its solar system are part of a bigger area of space called the Milky Way galaxy. The Milky Way is a galaxy named this way because it appears in the sky as a "Milky" glowing band. In 1610 Galileo Galilei used his telescope and discovered that the Milky Way galaxy was actually made up of many individual stars.

Scientists believe that the Milky Way galaxy may contain hundreds and thousands of planets, but they have not been able to discover them all yet. Just as the moon, the Earth, and the sun are constantly moving, the galaxy is also moving.

The future of our planet is very much tied to the future of the sun. As the sun evolves so does the planet as well as the plants and animals that can live here. By using models we are able to examine what will happen to the sun and the Earth over the next billion years.

Earth: Read More

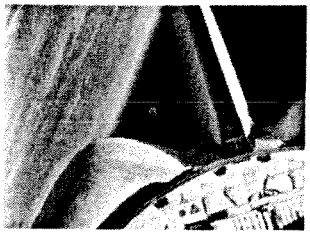


Earth at a a distance of more than 4 billion miles

Editor's Note: *This page provides a brief overview of our home planet. For a comprehensive look at the Earth, visit NASA's Earth Science Division.*

Earth, our home planet, is the only planet in our solar system known to harbor life: life that is incredibly diverse. All the things we need to survive exist under a thin layer of atmosphere that separates us from the cold, airless void of space.

Earth is made up of complex, interactive systems that create a constantly changing world that we are striving to understand. From the vantage point of space we are able to observe our planet globally, using sensitive instruments to understand the delicate balance among its oceans, air, land and life. Satellite observations help study and predict weather, drought, pollution, climate change and many other phenomena that affect the environment, economy and society.



Earth and its moon from the space shuttle

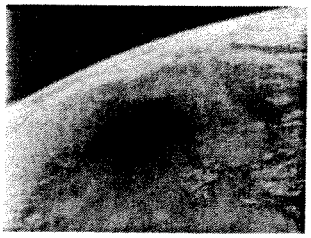
Earth is the third planet from the sun and the fifth largest in our solar system. Earth's diameter is just a few hundred kilometers larger than that of Venus.

The four seasons are a result of Earth's axis of rotation being tilted 23.45 degrees with respect to the plane of Earth's orbit around the sun. During part of the year, the northern hemisphere is tilted toward the sun and the southern hemisphere is tilted away, producing summer in the north and winter in the south. Six months later, the situation is reversed. During March and September, when spring and fall begin in the northern hemisphere, both hemispheres receive roughly equal amounts of solar illumination.

Earth and it's moon as seen by a departing spacecraft.

Earth's global ocean, which covers nearly 70 percent of the planet's surface, has an average depth of about 4 km (2.5 miles). Fresh water exists in the liquid phase only within a narrow temperature span: 32 to 212 degrees Fahrenheit (0 to 100 degrees Celsius). This span is especially narrow when contrasted with the full range of temperatures found within the solar system. The presence and distribution of water vapor in the atmosphere is responsible for much of Earth's weather.

We are enveloped by an atmosphere that consists of 78 percent nitrogen, 21 percent oxygen and 1 percent other ingredients. The atmosphere affects Earth's long-term climate and short-term local weather, shields us from much of the harmful radiation coming from the sun and protects us from meteors as well: most of which burn up before they can strike the surface as meteorites. Earth-orbiting satellites have revealed that the upper atmosphere actually swells by day and contracts by night due to solar heating during the day and cooling at night.



Here is what the Earth looks like during a solar eclipse.

Our planet's rapid rotation and molten nickel-iron core give rise to a magnetic field, which the solar wind distorts into a teardrop shape in space. (The solar wind is a stream of charged particles continuously ejected from the sun.) The Earth's magnetic field does not fade off into space, but has definite boundaries. When charged particles from the solar wind become trapped in Earth's magnetic field, they collide with air molecules above our planet's magnetic poles. These air molecules then begin to glow, and are known as the aurorae -- the northern and southern lights.

Earth's lithosphere, which includes the crust (both continental and oceanic) and the upper mantle, is divided into huge plates that are constantly moving. For example, the North American plate moves west over the Pacific Ocean basin, roughly at a rate equal to the growth of our fingernails. Earthquakes result when plates

grind past one another, ride up over one another, collide to make mountains, or split and separate. The theory of motion of the large plates of the lithosphere is known as plate tectonics. Developed within the last 40 years, this explanation has unified the results of centuries of study of our planet.

How Earth Got its Name
The name Earth is at least 1,000 years old. All of the planets, except for Earth, were named after Greek and Roman gods and goddesses. However, the name Earth is an English/German word, which simply means the ground: *eor(th)e* and *ertha* (Old English) and *erde* (German).

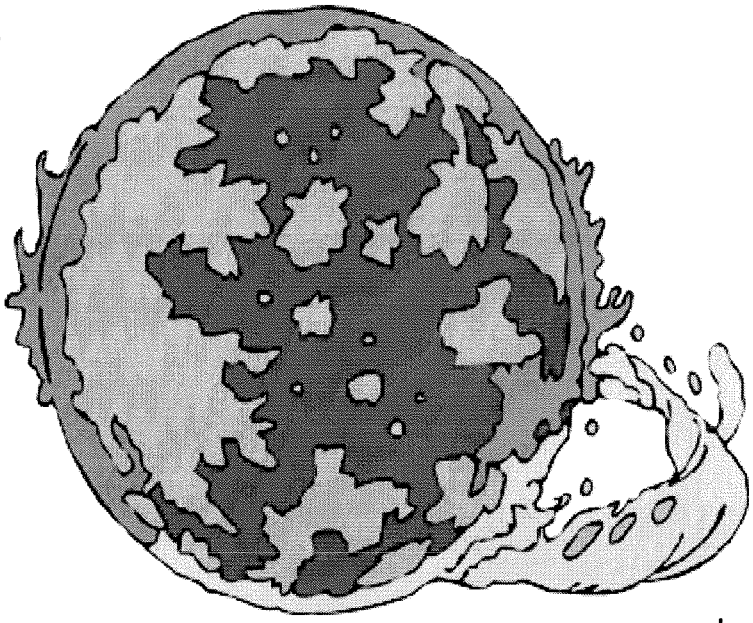
Significant Dates

- **1960:** NASA launches the Television Infrared Observation Satellite (TIROS), the first weather satellite.
- **1972:** The Earth Resources Technology Satellite 1 (renamed Landsat 1) is launched, the first in a series of Earth-imaging satellites that continues today.
- **1987:** NASA's Airborne Antarctic Ozone Experiment helps determine the cause of the Antarctic ozone hole.
- **1992:** TOPEX/Poseidon, a U.S.-France mission, begins measuring sea-surface height. Jason 1 continues these measurements in 2001.
- **1997:** TOPEX/Poseidon captures the evolution of El Nino (cold ocean water in the equatorial Pacific Ocean) and La Nina (warm ocean water in the equatorial Pacific Ocean).
- **1997:** The U.S.-Japan Tropical Rainfall Measuring Mission is launched to provide 3-D maps of storm structure.
- **1999:** Quick Scatterometer (QuikScat) launches in June to measure ocean surface wind velocity; in December the Active Cavity Irradiance Monitor Satellite launches to monitor the total amount of the sun's energy reaching Earth.
- **1999-2006:** A series of satellites are launched to provide global observations of the Earth system -- simultaneously studying land, oceans, atmosphere, water cycles, gravity, clouds and aerosols.
- **2006:** The Antarctic ozone hole was the largest yet observed.
- **2007:** Arctic sea ice reaches the all-time minimum since satellite records began.
- **2008:** The third U.S.-France mission to measure sea-level height, Ocean Surface Topography Mission/Jason 2, is launched, doubling global data coverage.
- **2009:** NASA and Japan release the most accurate topographic map of Earth.

Name: _____

The Sun

by **Cynthia Sherwood**



You may have heard people use the term "solar energy." They're probably talking about the technology that powers a house or heats a swimming pool. But there's only one place that you can find true "solar energy"—the sun!

Without the sun, there wouldn't be life on earth. The sun provides us with both light and heat. It's at the very center of our solar system, with all eight planets revolving around it. The planets' moons, thousands of asteroids, and trillions of comets also revolve around the sun.

From earth, we see the sun as a bright yellow dot in the sky that's sometimes hidden by clouds. But the sun is actually a glowing ball of fiery gas. The part of the sun that we see has a temperature of 10-thousand degrees Fahrenheit (5,600 degrees Celsius). Inside the sun, at its core, the temperature is 27-million degrees (15-million Celsius).

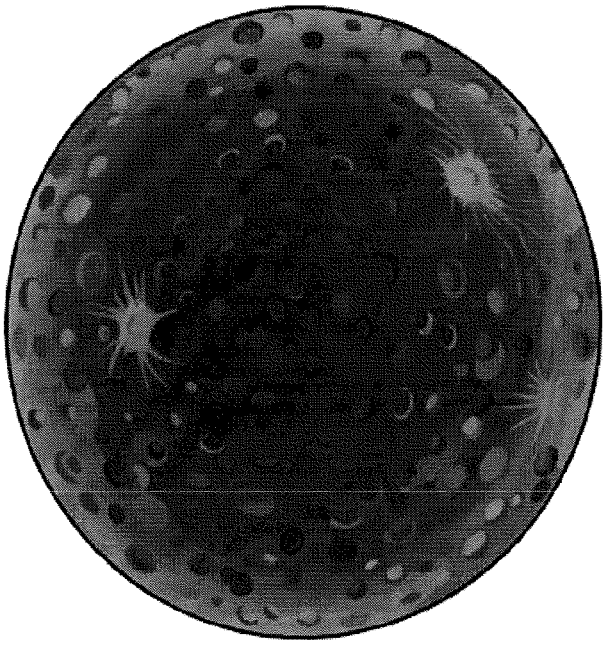
The core is where the sun's incredible energy is created. The temperature is so extreme that nuclear reactions take place and energy travels to the surface of the sun. That energy is then released as light and heat. It takes a million years for energy produced in the sun's core to reach its surface.

Besides being hotter than we can even imagine, the sun is amazingly big. You could fit more than a million Earths inside the sun! But believe it or not, the sun isn't anywhere close to being the biggest object in the universe. The sun is actually a star, just like the others you see at night. It's about average in size when compared to other stars. But to us here on earth, there's nothing average about the sun!

Name: _____

Mercury

by **Cynthia Sherwood**



Mercury is the planet nearest the sun. It's so close that if you were standing on Mercury, the sun would appear two and a half times bigger than what it looks like from here on Earth.

Even the best sunscreen wouldn't be enough on Mercury. The sun's rays are about seven times stronger than on Earth. Mercury is dry, very hot, and practically airless. Mercury is also the smallest planet in our solar system. Because it's often blocked by the glare of the sun, Mercury can be hard to see without a telescope.

Mercury is named after a Roman god who was a messenger known for his speed. As a planet, Mercury moves around the sun faster than any other. It revolves around the sun about once every 88 Earth days.

Did you know....

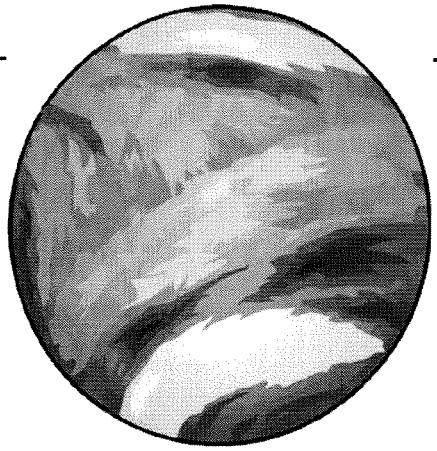
Even though Mercury is the closest planet to the sun, it is ***not*** the hottest planet!

Venus, the second planet from the sun, has hotter temperatures than Mercury. This is because Venus has a thick layer of clouds that trap in heat like a blanket.

Mercury is made up of rock with iron at its core. Its surface looks a lot like our moon, with many craters. Radar images from Earth show that craters at Mercury's north and south poles may contain frozen water, or ice. Scientists couldn't believe it at first. Parts of Mercury reach 800 degrees Fahrenheit (460 degrees Celsius), so they definitely didn't expect to find ice! But it turns out the poles of Mercury are always in the shade of the sun, so they remain extremely cold.

By the way, you'd never be able to enjoy a blue sky on Mercury. Because there's no atmosphere, the sky always appears black. You might even see stars—during the daytime!

Name: _____



Venus

by **Cynthia Sherwood**

Did you know that Earth has a twin? It's Venus, the second planet from the sun. Venus is the planet that comes closest to Earth, even though it's still very far away—about 24 million miles (about 39 million kilometers). Venus is almost the same size as Earth and is made up of similar material, so that's why scientists call it Earth's twin.

Venus is Earth's opposite in other ways. Because it's much closer to the sun than Earth, Venus is extremely hot on its surface—about 870 degrees Fahrenheit (400 degrees Celsius). That's hotter than any other planet. It's even hotter than most ovens! Venus is also very dry. Scientists think Venus used to have a lot of water, just like Earth, but it all boiled away from the heat. Much of Venus is now covered by volcanoes. It has the most of any planet and some are huge—up to 150 miles (241 kilometers) long.

Although astronauts have never landed on Venus, several spacecraft without people on board have visited. Those spacecrafts have taken very detailed pictures of Venus. The most famous one was named "Magellan" and it orbited Venus for four years, ending in 1994. Using radar, Magellan made detailed maps of almost all of Venus's surface.

When you look into the night sky, you can often spot Venus. That's because it's the brightest thing you can see, except for the sun and moon. Venus is sometimes called the "Morning Star" or "Evening Star" because it appears brightest shortly before sunrise and shortly after sunset.

Venus is unique among our solar system's planets in one unusual way. It's the only planet to rotate clockwise on its axis, in the same direction that you'd see the hands of a clock move. All the other planets turn in the opposite direction, known as "counter-clockwise."

Did You Know...

Venus was named for the Roman goddess of love and beauty.

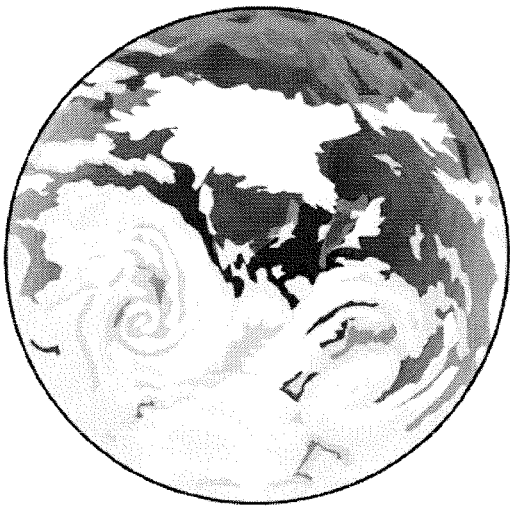
Venus is known as the "cloudy planet." The clouds on Venus aren't made from water like Earth clouds, they're made of a poison called "sulfuric acid."

Venus and Mercury are the only planets without moons.

Name: _____

Earth

by **Cynthia Sherwood**



Earth is the "just right" planet. It's not too close to the sun and it's not too far away. That means Earth doesn't get too hot or too cold, unlike all the other planets. Because of its comfortable temperatures, Earth is the only place in the entire universe where we know that life exists. That makes Earth very special!

Earth is unique in another way too. Living creatures must have water to survive. Since water covers about seventy percent of Earth's surface, our planet is an ideal place to support life in many different forms. The rest of Earth's surface is made up of seven land masses called *continents.*

Scientists say Earth is about four-and-a-half billion years old. Fossils show microscopic life first appeared about a billion years later. Evidence of the first human beings came much later—only about 200-hundred-thousand years ago. That's many millions of years after the dinosaurs became extinct.

Earth is the fifth largest planet and the third planet from the sun, which is about 93 million miles away. It takes one year for Earth to travel completely around the sun. Earth also spins around like a top, going about a thousand miles an hour. You'd think we'd all need seat belts! Earth rotates around like this once every twenty-four hours, and that's what gives us night and day.

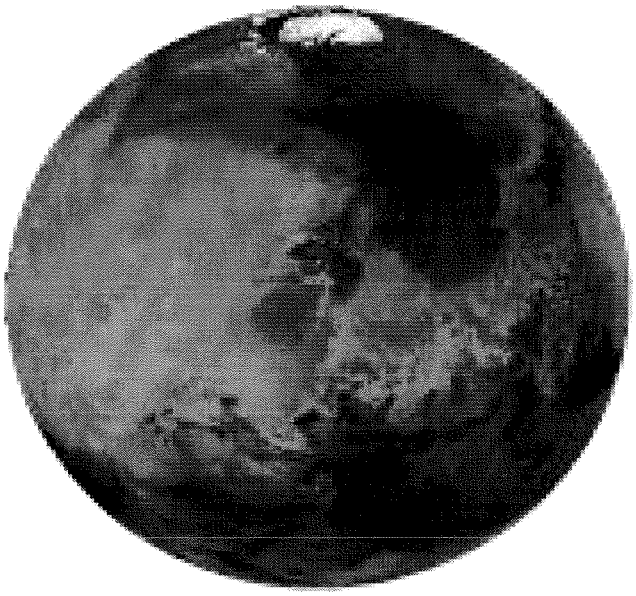
Earth is divided into several layers: the top part is called the *crust*, the part below that is called the *mantle*, and the part in the center is called the *core*. The core is solid and is probably made up of iron. Temperatures at the center of the core may be even hotter than the surface of the sun!

Scientists who study Earth are called *geologists.* Astronauts can also study Earth from space, adding to what we know about our unique and beautiful blue and green planet. Don't you feel lucky to live on the "just right" planet?

Name: _____

Mars

by **Cynthia Sherwood**

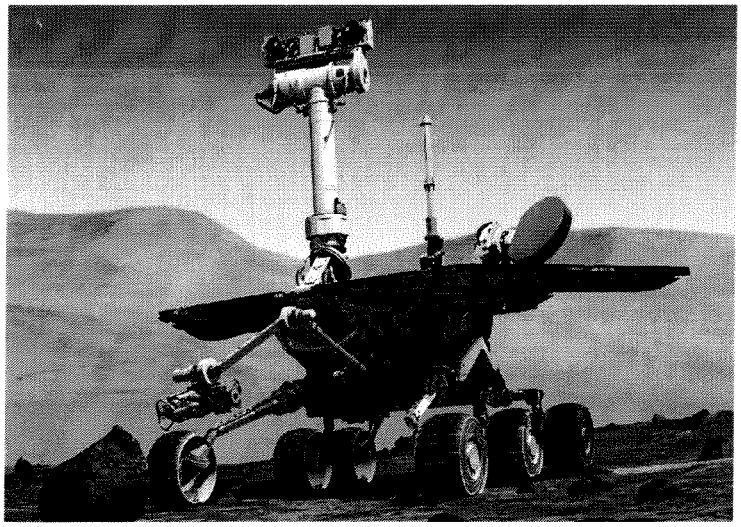


The "Red Planet"—Mars—is the fourth planet from the sun and one of Earth's next door neighbors. Mars was named after the Roman God of war because its reddish-orange color looks a little like blood. The special color actually comes from rust and other minerals in its soil.

The surface of Mars includes many amazing features. There's a canyon that's much deeper and longer than the Grand Canyon in Arizona. There's also a volcano that's the largest in our solar system. "Olympus Mons" volcano is fourteen miles tall. That's three times higher than Mount Everest! The base of Olympus Mons is about the size of the state of Missouri.

Scientists say there's strong evidence that water once flowed over the surface of Mars. They also think there still may be water in some places underneath the surface.

You may have read a book or seen a movie that featured "Martians." There's no evidence of any little green men on Mars, but some scientists do think they've found proof that tiny, microscopic creatures once lived on Mars. The evidence comes from meteorites found on Earth. Other scientists say they don't believe it, so we don't know the right answer.



Images Courtesy NASA/JPL-Caltech

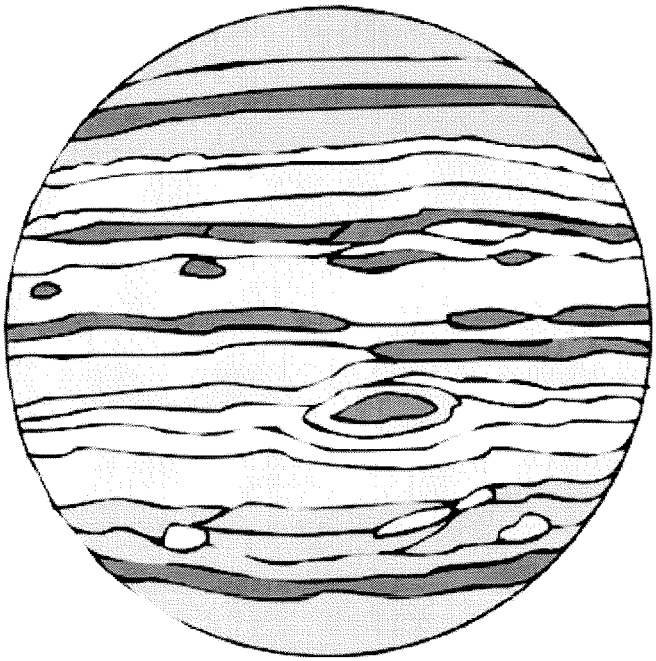
Scientists have sent radio-controlled robots to Mars. These machines, called rovers, have cameras, microscopes, and drills on them. Scientists can drive the rovers around the Red Planet, just like the radio-controlled toy cars many kids have on Earth. The rovers are actually able to send pictures back to Earth.

While rovers roam the planet every day, no person has ever set foot on Mars. NASA has made plans for a manned mission to take place decades from now. Perhaps then we'll learn the truth of whether there was once life on a planet besides Earth.

Name: _____

Jupiter

by **Cynthia Sherwood**



If Jupiter were a person, it might run around chanting "I'm number one! I'm number one!" That's because Jupiter is the largest planet in our solar system and the one that spins the fastest. It also has the most moons of any planet and the largest moon. Jupiter also has the strongest gravity of all the planets. Ancient astronomers knew what they were doing when they named Jupiter after the Roman king of the gods.

It would take about a thousand Earths to fill up Jupiter. But for a gigantic planet, Jupiter moves very fast. It rotates on its axis about every ten hours, compared to Earth which takes 24 hours. Jupiter takes about 12 years to orbit the sun.

Jupiter isn't first in everything. It's the fifth planet from the sun and it's only the third brightest object in the night sky, behind the moon and Venus.

Jupiter is one of the gas giants. Its surface is made of thick red, brown, yellow, and white clouds. One huge area of that surface is called the "Great Red Spot." That's where a storm three times bigger than Earth has raged for more than 300 years! Imagine winds stronger than a hurricane lasting for centuries.

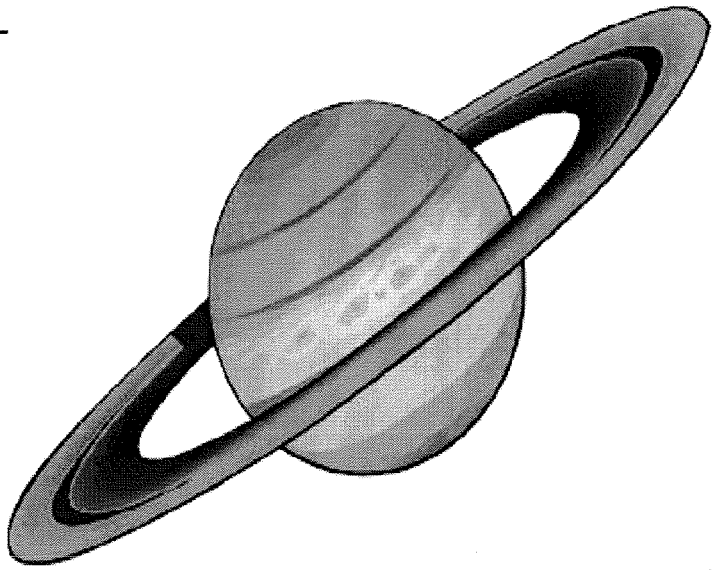
Jupiter has at least 63 moons. Most are fairly small, but four are quite large. They were first discovered by the astronomer Galileo in the year 1610 using one of the earliest telescopes. The largest of Jupiter's moons is named Ganymede. It's even bigger than the planet Mercury!

Six space probes have traveled to Jupiter, so scientists have a lot of information about the planet. You can do your own study of Jupiter just by staring at the night sky. If you see a really bright star that's high in the sky, you're probably seeing Jupiter, the number one planet.

Name: _____

Saturn

by **Cynthia Sherwood**



If you don't count Earth, the most beautiful planet in our solar system may be Saturn. Saturn has seven thin rings that surround its middle but don't actually touch it. The rings are made of billions of pieces of ice and can only be seen with a telescope.

You can spot the rest of Saturn using only your eyes. It's the second largest planet in the solar system and it's the third brightest planet in the sky. It usually looks yellow.

Saturn is the sixth planet from the sun and is named after the Roman god of Agriculture. Scientists believe Saturn is a giant ball of gas, with no solid surface. Inside they think there's a hot solid core of rocky material, surrounded by an outer core of gas. Saturn is considered one of the four "gas giant" planets.

If you've ever been through a hurricane, you know what extremely strong winds are like. But even a hurricane is nothing compared to the winds on Saturn. Its strongest winds blow at more than a 1,000 miles per hour (1,600 kilometers per hour)! Saturn is also quite cold because it's so far from the sun. The temperature is about 285 degrees below zero Fahrenheit (minus 176 Celsius).

In 2004, a spacecraft named the "Cassini" began to orbit Saturn. This was the first in-depth and close-up view of the planet. Cassini has given us amazing pictures of Saturn, its rings, and its moons. Scientists have discovered that Saturn's largest moon—named Titan—is similar to Earth before there was life.

By the way, if you were born on Saturn, you'd have to wait a long time for your birthday to arrive. The length of a Saturn year is 29.5 Earth years, because that's how long it takes Saturn to rotate around the sun.

Name: _____

Uranus

by **Cynthia Sherwood**

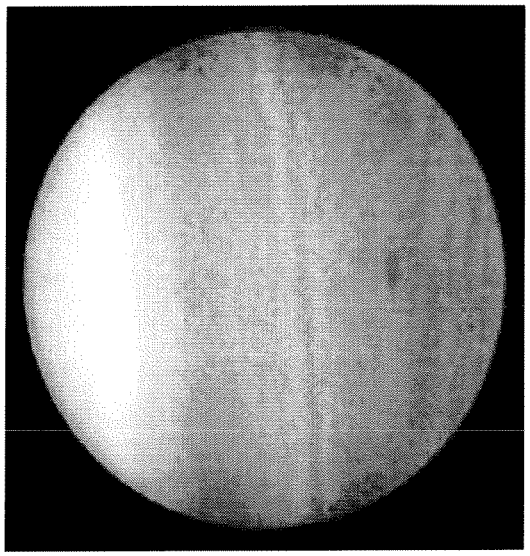


Photo of Uranus : NASA/Space Telescope Science Institute

Uranus is a giant icy ball of gas and liquid, with a solid center. It's the seventh planet from the sun and the farthest that you can see without a telescope. Although Neptune is even farther from the sun, Uranus is the coldest planet in our solar system. The temperature of its atmosphere is minus 350 degrees Fahrenheit (minus 212 Centigrade).

When viewed from space, Uranus is a pretty pale blue color. The color comes from clouds on its surface made up of tiny crystals of methane gas. Uranus also has rings like Saturn, though they aren't very noticeable. The rings are made of ice and rock.

Did you know....

Uranus is a very windy planet. On the surface, hurricane-like winds are blowing at speeds of around 200 miles per hour (322 kilometers per hour).

Uranus is so big that 50 Earths could fit inside of it.

At least 21 moons orbit around Uranus, somewhat like a Ferris wheel. But the most unique part about Uranus is that it's tilted. On Earth, we have the North Pole and the South Pole. But everything is topsy-turvy in Uranus. Its poles are on its sides and it orbits the sun on its side. The strange way that it spins can mean nights on some parts of Uranus last more than forty years! Scientists think a planet as big as Earth may have crashed into Uranus at some point, tipping it onto its side.

There's another fun fact about Uranus—it's the only planet named after a Greek god instead of a Roman god. Uranus was the Greek god of the sky and the husband of Earth.

Name: _____

Neptune

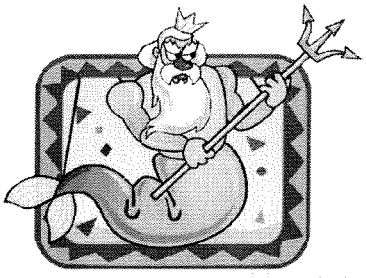
by **Cynthia Sherwood**

Neptune is the eighth planet from the sun and the one that's the farthest away. (Pluto is even farther, but it doesn't count since most astronomers no longer consider it a planet.) Neptune is a cold, dark place that's the smallest of the gas giants. It was named after the Roman god of water and the sea.

Neptune is a ball of gas and ice, with a rocky core. Thick bright blue clouds cover its surface. They're made up mainly of frozen methane gas. Like the other "gas giant" planets, winds that blow Neptune's clouds around are very strong. Scientists say winds reach speeds of up to 700 miles an hour (about 1,120 kilometers per hour).

Neptune isn't quite as cold as Uranus, but its largest moon, Triton, is even colder. Triton has a surface temperature of minus 390 degrees Fahrenheit (minus 234 Celsius), which is the coldest known temperature in the solar system. Scientists think that Triton used to be a large comet that became trapped by Neptune's gravity.

How it Was Named...



Neptune was named for the Roman god of the Sea. Early astronomers may have named it after the sea god because of its deep blue color.

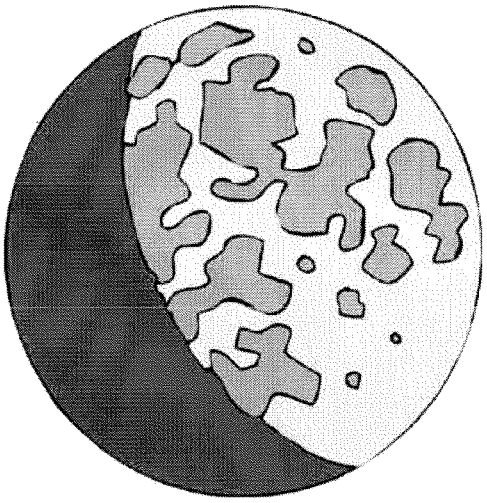
Because it's so far away, Neptune only has had one visit from a spacecraft. NASA's Voyager 2 flew by Neptune in 1989. Voyager discovered a huge storm on Neptune that it called the "Great Dark Spot," similar to Jupiter's "Great Red Spot." But later pictures from the Hubble Telescope found that the Great Dark Spot had vanished.

Luckily for us, Neptune and Earth don't have much in common. But one thing is very similar. The force of gravity pulling you down is almost the same on Neptune and Earth. Of course, if you tried to walk on Neptune, you'd be pulled in towards the center because there's no solid surface to stand on.

Name: _____

Our Moon

by **Cynthia Sherwood**



Jupiter and Saturn have more than sixty moons each. Neptune has thirteen. Mars has two. But if somebody says "the moon," we know exactly what they're talking about. It's Earth's moon, our closest neighbor in outer space.

The moon is the second brightest spot in the sky, after the sun. It orbits around the Earth once a month, going through "lunar phases." Sometimes the moon will look like a skinny curved sliver called a "crescent." Later, it becomes a glowing full moon. These phases are caused by the changing angles of where the Earth, moon, and sun are relative to one another.

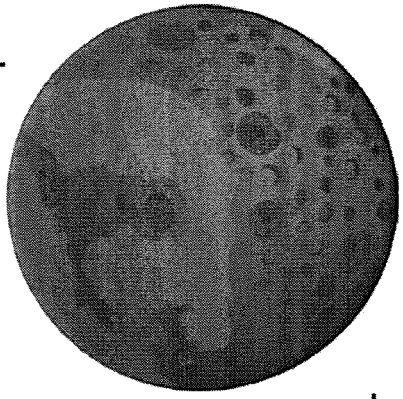
The moon might be the closest thing to us in space, but it's still far, far away—about a quarter of a million miles away! It's also much smaller. About fifty moons could fit inside Earth. Temperatures can be extreme — as hot as 250°F or as cold as minus 250°F.

That's why astronauts had to wear special spacesuits when they first landed on the moon. Besides protecting them from the extreme temperatures, the suits provided enough oxygen for the astronauts to breathe.

July 20, 1969 is one of the most important dates in history. It's when America's Apollo 11 astronauts landed on the moon. The first man to walk on the moon was Neil Armstrong. Right afterward, he said some of the most famous words ever: "That's one small step for man, one giant leap for mankind."

You might ask your parents, grandparents, or teachers where they were when we first landed on the moon. If they were born and weren't too young, they'll remember. Life has never been quite the same here on Earth now that we've explored our closest neighbor in space.

Name: _____



Planets and Dwarf Planets

by Shauna Hutton

Wow! Technology has improved so well in the last several years that we keep finding more and more objects in our solar system! Because of this, scientists have had to come up with new categories for objects in space. This included reclassifying Pluto as a dwarf planet, in 2006.

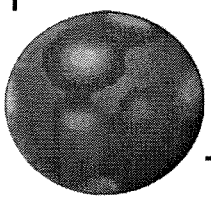
The eight planets in our solar system are classified as inner planets (Mercury, Venus, Earth, and Mars) and outer planets (Jupiter, Saturn, Neptune, and Uranus).

The International Astronomical Union (IAU) gives the new definition of planet as an object in space that:

- is in orbit around the sun
- is nearly round in shape
- has cleared the neighborhood around its orbit
- is not a satellite

Each planet travels around the sun in a specific path, called an orbit. "Clearing the neighborhood around its orbit" means there are no objects similar to the planet at roughly the same distance from the Sun. In other words, a planet is not located in an asteroid belt or surrounded by clusters of other space objects.

A satellite is an object that revolves around a larger planet. They can occur naturally, like the moon of a planet, or they can be man-made, like the Hubble Space Telescope.



There are currently five dwarf planets listed. They are: Ceres, Pluto, Eris (pronounced ee'-ris), MakeMake (pronounced mah-kee-mah-kee), and Haumea (pronounced hah-oo-may-ah).

Eris was a very important discovery in 2005. Since it was larger than Pluto, some astronomers thought it should be considered a planet. However, since Pluto and Eris are located in an asteroid belt, other astronomers began to think maybe Pluto and Eris were both very large asteroids. In 2006, Astronomers decided it was time to update the current definition of a planet and create the new category of dwarf planets.

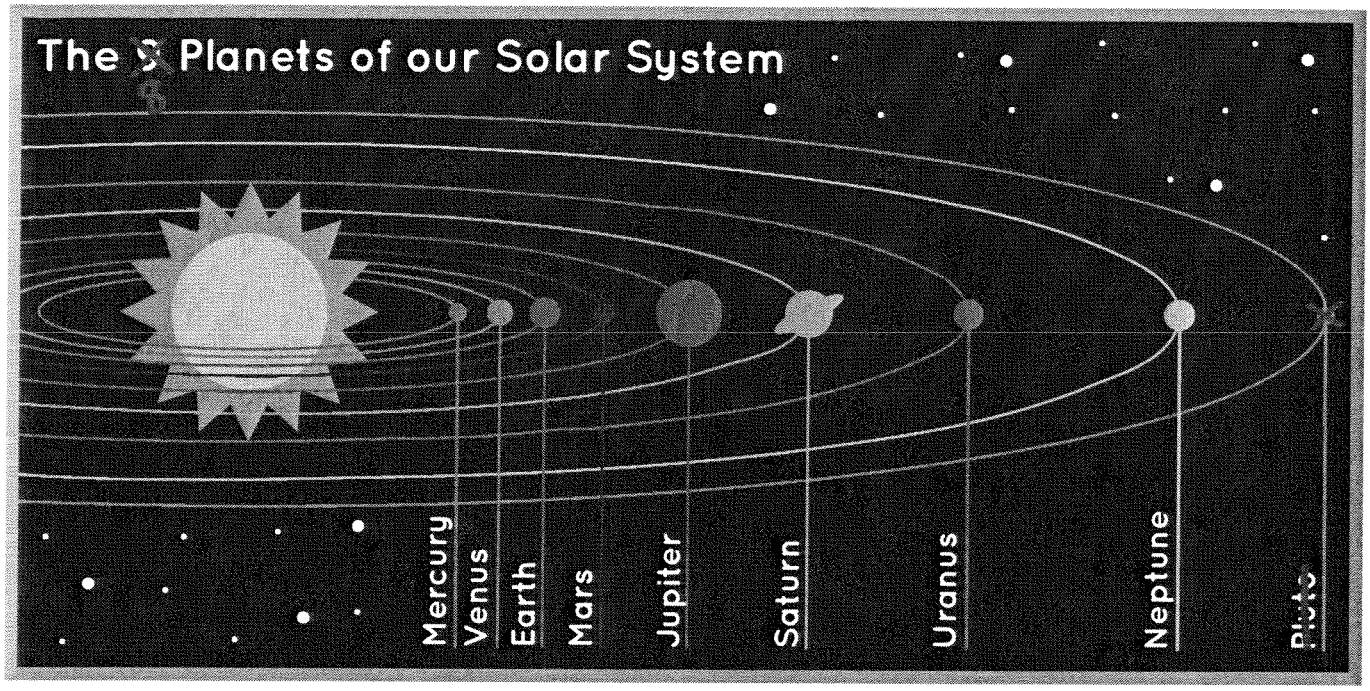
Dwarf planets are similar to planets except they don't clear their orbit like planets do. The IAU defines a dwarf planet as an object in space that:

- is in orbit around the Sun
- is nearly round in shape
- has **not** cleared the neighborhood around its orbit
- is not a satellite

This is a very exciting time. New objects in space are still being discovered! Scientists say there will likely be more dwarf planets announced in the next few years. What will be the name of the next dwarf planet? What name would you choose?

What is Pluto?

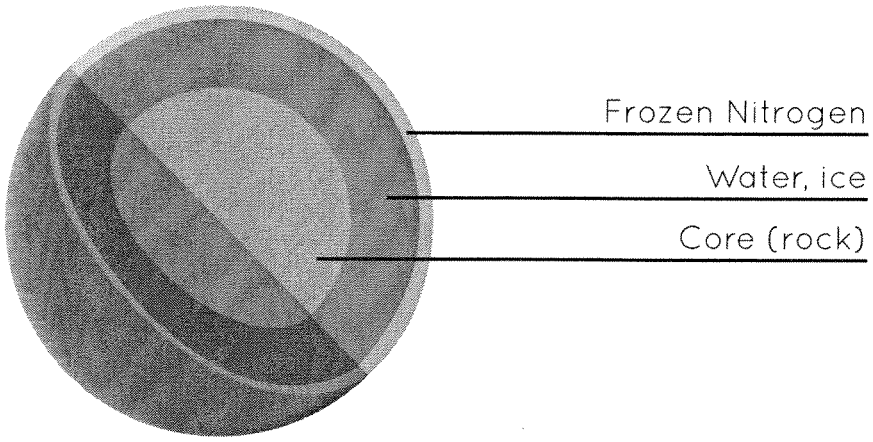
What constitutes a "planet" by our definition?



Pluto is a dwarf planet that used to be considered as one of the nine planets of our solar system. A dwarf planet is a celestial body that is big enough to have its own gravitational field, making it round like the planets. However, a dwarf planet is not able to sweep up or expel debris from its orbital path, like normal planets do.

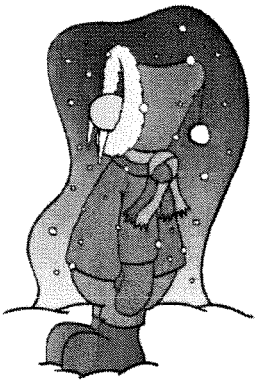
In 2006, Pluto was downgraded from a planet to a dwarf planet because it could not sufficiently sweep up or expel debris. This new ruling has met lots of controversy. Some astronomers believe that Pluto and a few other more massive and distant dwarf planets should be classified as "planets" instead.

Possible structure of Pluto



Name: _____

Winter



Winter is the best season of the year. During the winter months, temperatures are usually colder and there are fewer hours of daylight. The winter months in North America are December, January, February, and March.

Cold winter temperatures are caused by the tilting of the Earth. When Earth's Northern Hemisphere is tilted away from the sun, there are fewer hours of daylight and the temperature is colder. When the Northern Hemisphere tilts towards the sun, there is more daylight time and the temperatures are warmer. The tilting of the Earth as it spins causes the seasons to change.

Animals have special ways of preparing themselves for winter. Some animals, like birds and butterflies travel long distances, or *migrate*, to warmer temperatures during the winter months. Other animals go to sleep, or *hibernate*, during the winter. Bears, gophers, snakes, and bats hibernate. Squirrels and raccoons don't migrate or hibernate. Instead, they gather extra food during the fall months and store it away so they have plenty to eat during the winter.

In some areas, winter is a time when snow falls and gathers on the ground. People who live in these places can enjoy special winter activities like skiing, sledding, or snowboarding. They can also build snowmen and snow castles. When the water in lakes and ponds freeze, people can ice skate or play ice hockey. Some people even cut a hole in the ice and go ice fishing!

Name: _____

Pictures in the Stars

by Kelly Hashway

Have you ever stared at the clouds and tried to see pictures in them? Well, this is very similar to how ancient astronomers named the constellations.

Constellations are groups of stars, and today there are 88 officially recognized constellations. Each is named for a figure or object that astronomers saw when they viewed the star group. Most of the constellations are named after characters in mythology. Hercules, Draco, Orion, and The Great Bear are just a few. Others are named after the signs of the zodiac, like Sagittarius, Capricorn, and Scorpius. But the way they were named is very similar. Just like we look at clouds today and see figures and other objects, the astronomers looked at the stars and saw things.

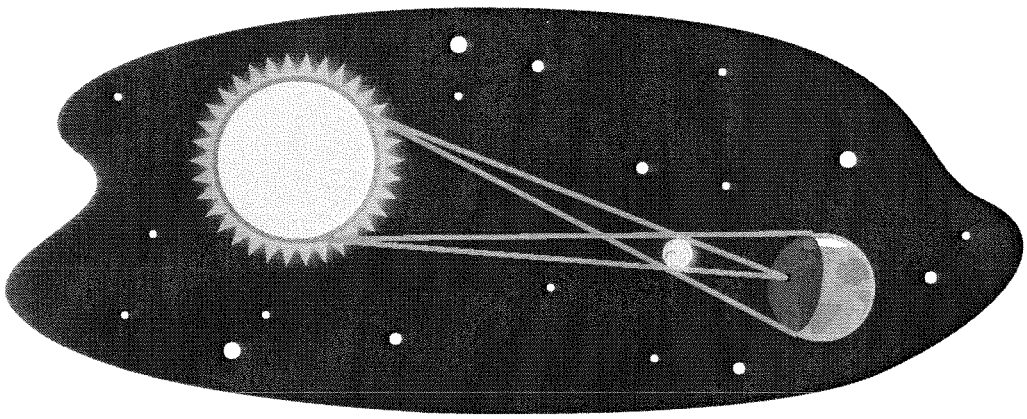
But if you've ever played this cloud gazing game with your friends, you've probably noticed that different people see different things in the clouds. You may see a bear, while your best friend sees a lion in the very same cloud. This was also the case with naming the constellations. And as a result, the same constellation can be known by different names across the globe.

One of the best-known constellations is the Big Dipper. If you've ever seen it in the sky, then you know it looks like a scooper or a dipper. But the ancient Greeks called the Big Dipper "Ursa Major" or "Big Bear". The ancient Irish and French called the Big Dipper the "Chariot," and the British referred to it as the "Plough". So you can see how star gazing and studying the constellations to find shapes in the patterns can cause a single constellation to have multiple names.

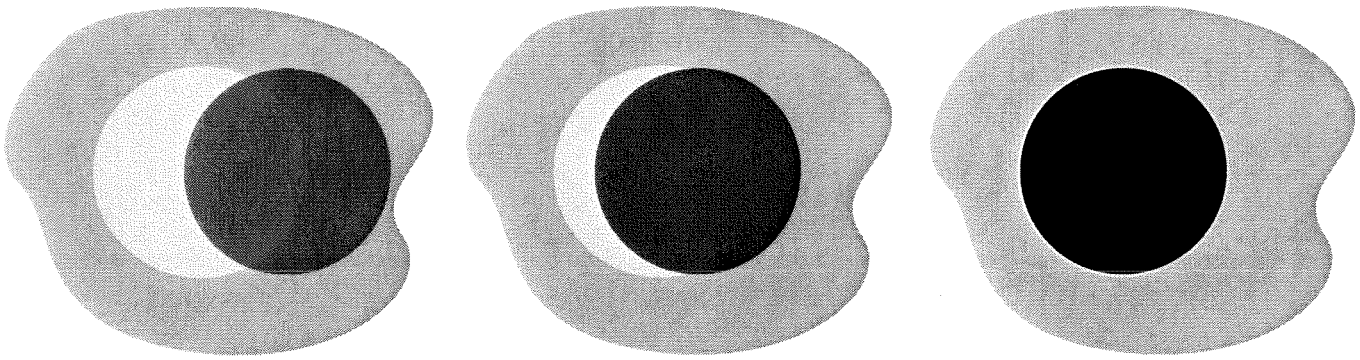
Another thing that contributes to these differing names is the expansion of the universe. The stars are moving and changing positions in the sky, which can make them look less like what they were originally named and more like something completely different. The constellation Cassiopeia originally looked like a W, but today it appears to be a squiggly line. Astronomers believe that the Big Dipper will look like a number five in 50,000 years.

Imagine what you will see the next time you look at the stars.

Solar Eclipse vs. Lunar Eclipse

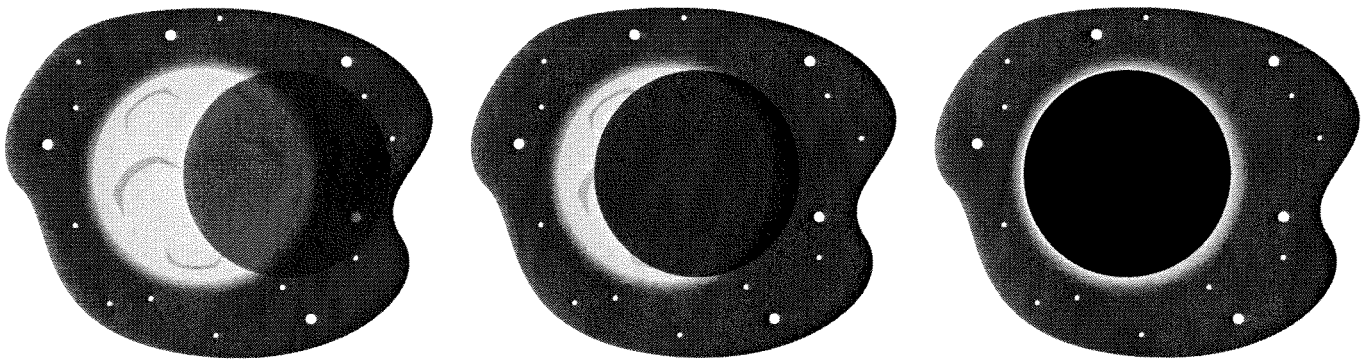


An *eclipse* is an obscuring of light caused by the passage of one object between a source of light and another object.



Solar Eclipse

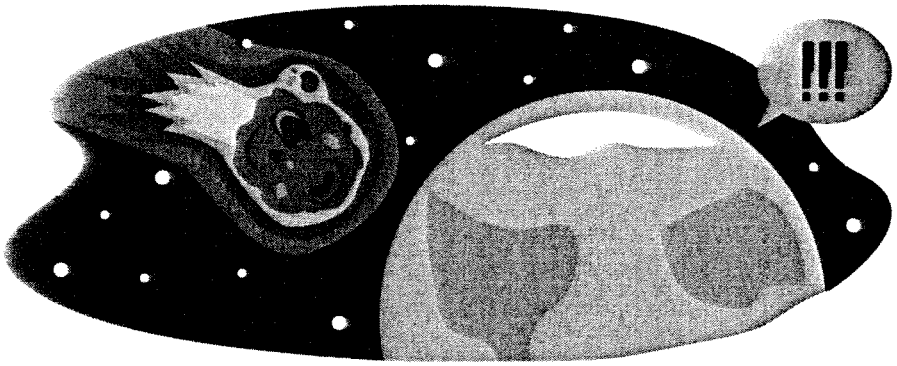
A *solar eclipse* occurs when the moon moves between the sun and the earth, partially or fully blocking the sun. There are two to five solar eclipses every year.



Lunar Eclipse

A *lunar eclipse* occures when the earth moves between the sun and the moon. There are at least two lunar eclipses every year.

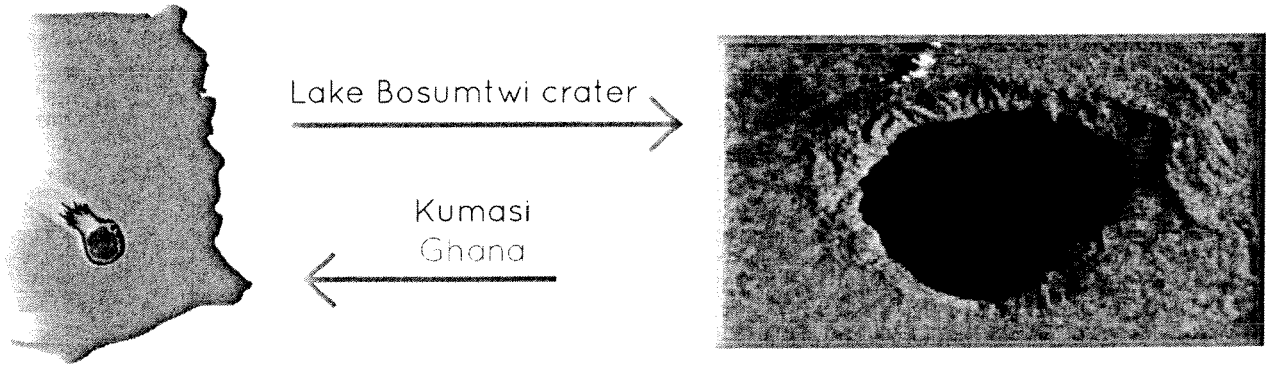
Crazy Craters Around The World



Craters are bowl-shaped depressions in the ground caused by the high velocity impact of a meteorite or asteroid. Here are some of the most well-known craters all over the world:

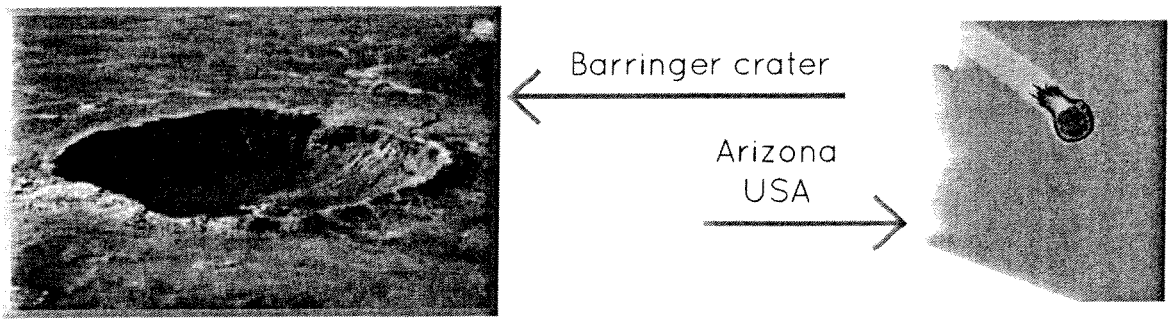
Lake Bosumtwi crater

-Located in Kumasi, Ghana
-The impact of the meteorite opened up a crater that slowly filled with water, creating Ghana's only natural lake.
-Lake Bosumtwi crater is 10.5 kilometers across.



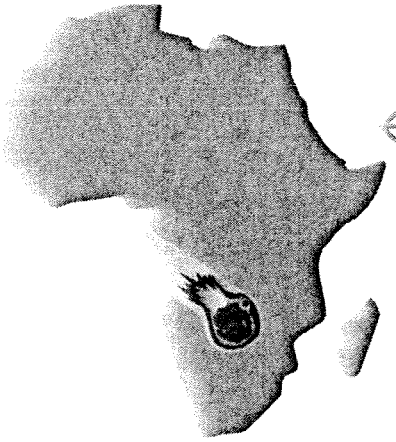
Barringer crater

-Located in the state of Arizona, USA
-Best preserved impact center
-Also known as Meteor Crater, Coon Butte and Canyon Diablo
-Barringer Crater is relatively small. It measures only 1.2 kilometers in diameter.



Vredefort crater

-Located in the Free State Province of South Africa and named after the town of Vredefort, which is situated near its center.
-Largest verified impact crater on Earth
-Scientists estimate that Vredefort crater was created by an asteroid roughly 5-10 kilometers in diameter.
-Vredefort crater is about 300 kilometers wide, and more than 2 billion years old!

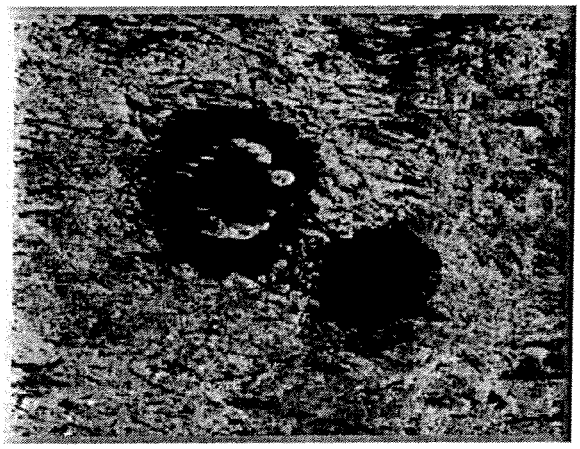


Free State Province
South Africa

Vredefort crater

Clearwater Lakes

-Located in Quebec, Canada
-These two lake craters were caused by a pair of asteroids that crashed into Earth simultaneously
-West Clearwater Lake has a 32 kilometer diameter, and East Clearwater Lake has a 22 kilometer diameter.



Quebec
Canada

Clearwater Lakes