

# The Universe

## Earth

- What does Earth look like from space?
- How was Earth made?
- When did life begin on Earth?

Find the answers in *Earth*. Learn how Earth is still being formed today. Discover that our solid Earth is not completely solid deep inside. See evidence that Earth has been touched by asteroids from outer space.

Read the **Universe** series to answer your questions about space. Increase your knowledge about the Sun, the Moon, Earth, the solar system, and the farthest stars. You will be amazed by the mysteries of the night sky.

Titles in the **Universe** series:

Comets, Asteroids, and Meteors	Saturn
Earth	Stars and Constellations
Jupiter	The Sun
Mars	Uranus, Neptune, and Pluto
Mercury	Venus
The Moon	



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# Earth



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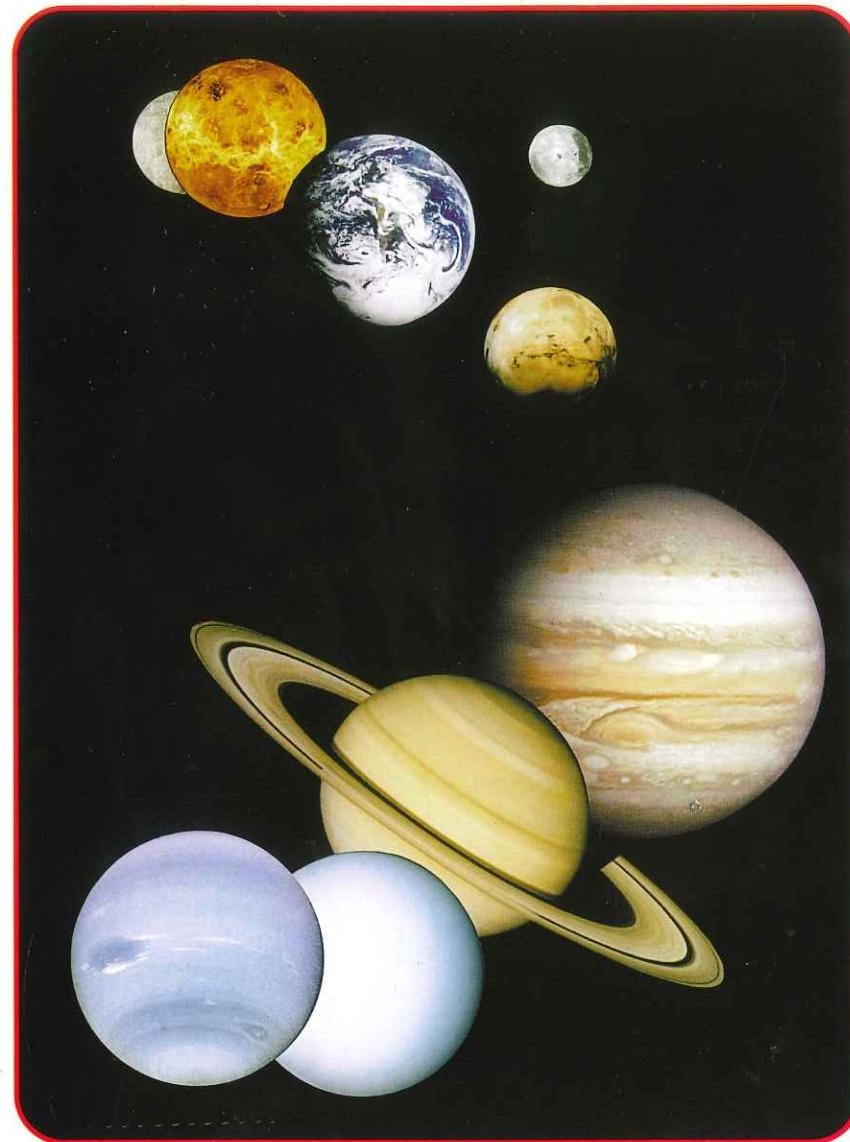
Stuart Clark



# What Does Earth Look Like from Space?

The planet we live on is called Earth. From space, it looks like a giant, colored ball. Earth is mostly blue because a lot of our planet is covered in water. These are the seas and oceans. The land is colored brown and green and split up into **continents**. The North and South **Poles** are covered in white ice. Clouds drift around Earth.

*This picture shows planet Earth from space.*

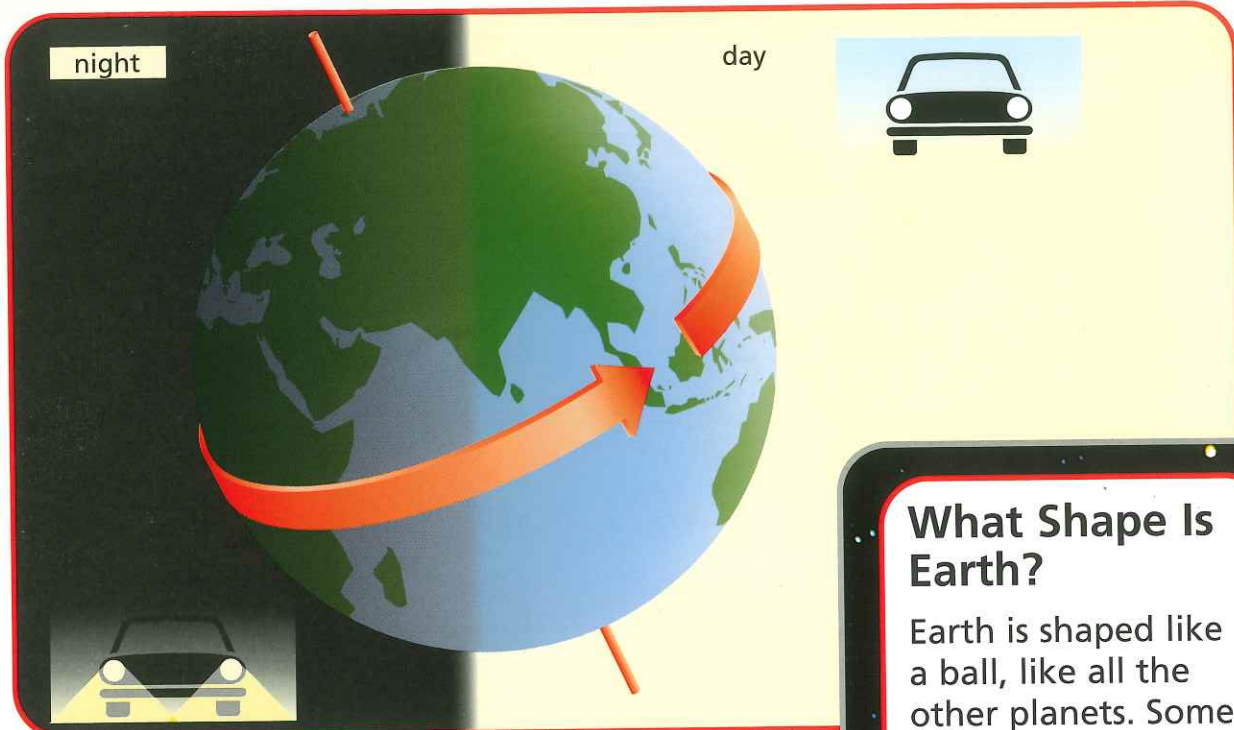


*An artist put photos of the nine planets of our solar system into one picture. Can you see Earth?*

## Our solar system

Earth is one of nine planets that **orbit** the Sun. Earth is the third planet from the Sun. Mercury and Venus are both closer. Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto are all farther away. The Sun gives out light and warmth. The closer a planet is to the Sun, the hotter it will be. There are also billions of small objects, just a few miles across, that orbit the Sun. These are the rocky **asteroids** and the icy **comets**. Together, the Sun, the planets, and all the smaller objects are called the **solar system**.





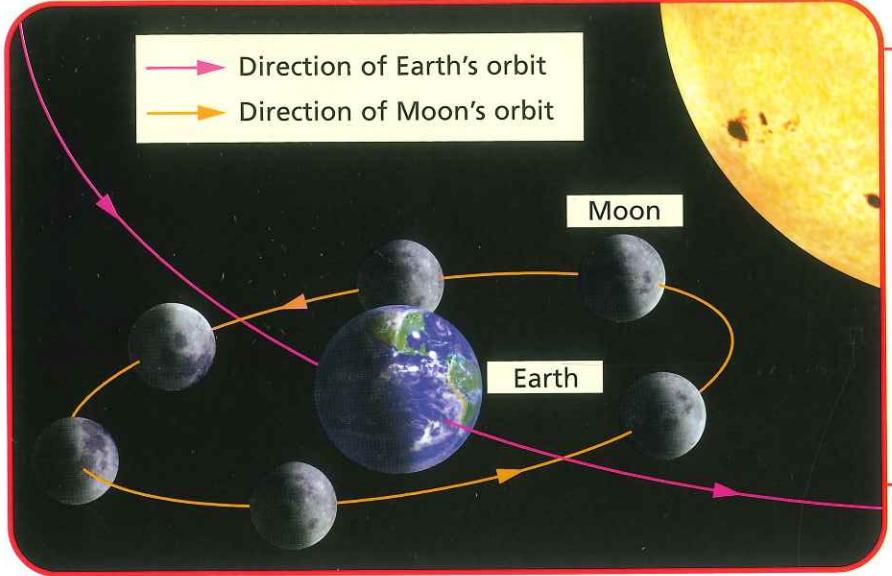
*Earth is always spinning on its axis. While one side is facing the Sun (and has day), the other is in darkness (and has night).*

### Day and night

Standing on Earth, it looks as if the Sun climbs in the sky in the morning, travels across the sky, and drops below the horizon at night. In fact, the Sun does not actually move through space. Instead, Earth spins slowly, making it look as if everything moves across the sky. As Earth spins, it shows different sides to the Sun. For the side of Earth facing the Sun, it is daytime. At the same time on the other side of Earth, it is night. It takes 24 hours for Earth to spin around once.

### What Shape Is Earth?

Earth is shaped like a ball, like all the other planets. Some ancient people thought Earth was flat and if they traveled far enough toward the horizon, they would fall off the edge of the world! Anyone who sailed far on a ship knew this was not true. When they could no longer see the land, the ship simply disappeared below the horizon. This proved that Earth's surface curves slowly downward, like the surface of a ball.



*While Earth orbits the Sun, the Moon orbits Earth. Both Earth and the Moon are spinning on their axes as the Earth orbits the Sun.*

### Earth force

Earth has **gravity**. This is the force that keeps us on the ground. Gravity also stops the air we breathe from floating off into space. The **Moon** is caught in the gravity of Earth but is moving so fast that, instead of falling to Earth, it travels around it.

It takes about one month for the Moon to travel around our planet. During that time, the Moon always shows us the same face. Dark markings on the Moon are very old lava flows from volcanic eruptions.

### How Was Earth Named?

The name Earth comes from **Old English** and German. It was being used before the year 1150. It is the only planet in the solar system whose English name is not based on Greek and Roman **myths**. To the Romans, the Earth goddess was called Tellus, meaning "fertile soil." The Greeks called her Gaia.



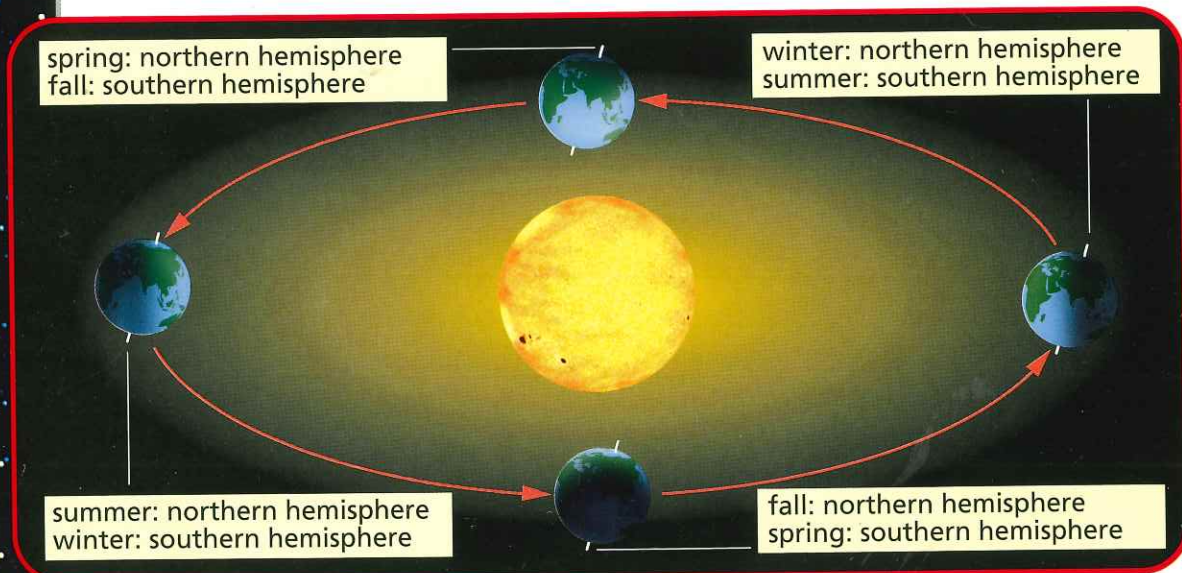
# Why Does Earth Have Seasons?

Earth follows an almost circular path around the Sun called an **orbit**. All the other **planets** in the **solar system** also orbit the Sun. It takes Earth one year to travel all the way around its orbit. During that time, Earth goes through four seasons: spring, summer, fall, and winter.

## Going for a spin

As Earth moves through its orbit, it also spins on its **axis**. The axis is an imaginary line that runs from the **North Pole**, through the center of Earth, to the **South Pole**. Earth's axis is tilted. Instead of pointing straight up, it has been knocked over to the side a little. When the North Pole is leaning toward the Sun, it is summer in the north.

Six months later, Earth has moved halfway around its orbit and the North Pole is now leaning away from the Sun. When this happens, it is winter in the north. When the North Pole is leaning away from the Sun, the South Pole is leaning toward the Sun. So, when it is winter in the north, it is summer in the south.



*The seasons change according to Earth's position in its orbit around the Sun. But the position of the axis always stays the same.*



*These photos were taken over a period of 24 hours in Norway, near the Arctic Circle, during the summer. Even at midnight (sixth picture from the left) the Sun does not go below the horizon and, therefore, there is no night.*

## Night for three months

During the northern winter, the North Pole is tilted so far away from the Sun that the Sun never rises above the **horizon**. It is night there for three whole months. The same thing happens at the South Pole six months later. When it is summer in the north, the Sun stays in the sky above the North Pole so it is daylight for three whole months. Again, this happens at the South Pole six months later, when it is summer there.

Not all places on Earth have spring, summer, fall, and winter. The **equator** is an imaginary line around the middle of Earth, halfway between the North and South Poles. The area near the equator is known as the **tropics**. In the tropics, it is hot all the time. Some places have a wet season when it rains a lot. At other times of the year, it is very dry. Many deserts are found near the equator. This is where the temperatures are hottest and there is very little rain.



# Why Can We Breathe on Earth?

Earth is covered with a thin blanket of **gases**, called the **atmosphere**. The special mixture of gases in Earth's atmosphere is called air. Although many other **planets** have their own atmospheres, no other planet in the **solar system** has an atmosphere with the mixture of gases we call air. For this reason, it would be impossible for humans to breathe on the other planets. If astronauts land on other planets, they will need to bring air (oxygen) with them.

## Earth's atmosphere

The special gas in the air that we breathe is called oxygen. We need oxygen to change the food we eat into the energy we need to live. Nearly all living things need oxygen to stay alive. Fires need oxygen to burn, too. Not all our atmosphere is oxygen. Most of it is a gas called nitrogen. Nitrogen puts fires out. If there were more oxygen in our atmosphere and less nitrogen, fires would burn faster and spread more quickly.



*The clouds we see in the sky are part of Earth's atmosphere. If you were standing at the top of one of these mountains in South America, the clouds and mist would be all around you.*



*This picture shows Earth from space. You can clearly see the layer of atmosphere that covers Earth's surface. There are clouds in the atmosphere.*

The atmosphere is held around Earth by **gravity**. Some planets do not have atmospheres. This is because they are too small to have enough gravity to hold on to the gases. Instead, the gases float off into space.

## How Does Earth's Atmosphere Protect Us?

The atmosphere does a lot more than just give us air to breathe. It acts like a blanket, keeping our planet warm. It also blocks out harmful **radiation** from space called cosmic rays. When astronauts spend a long time in space, their spacecraft must have a special room with very thick walls to protect them from cosmic rays. An alarm tells the astronauts when to go into that room because the number of cosmic rays has become dangerous. A special layer in our atmosphere, called the ozone layer, also blocks most of the **ultraviolet light** from the Sun. In small amounts, ultraviolet light will give you a suntan, but large amounts can make people very ill and can cause skin cancer.



# How High Is the Sky?

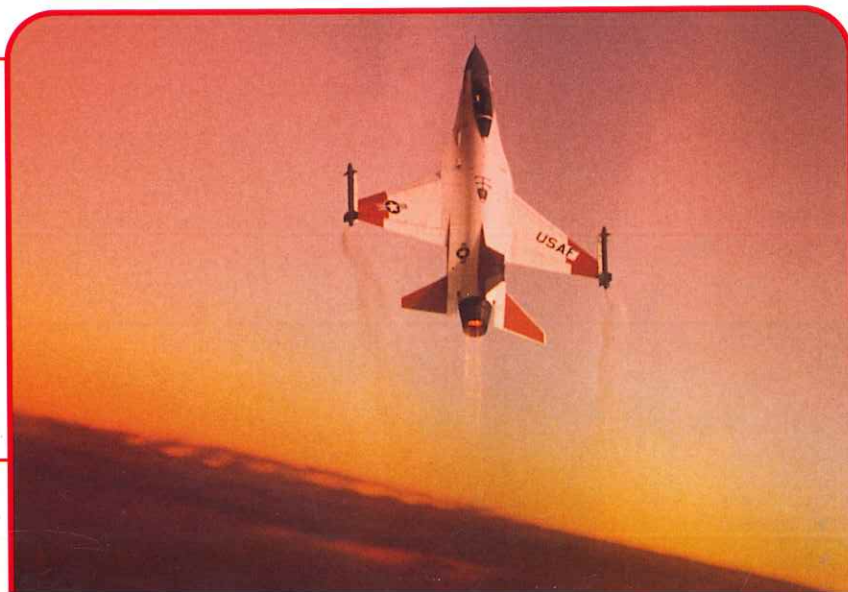
What we think of as the sky above our heads is actually Earth's **atmosphere**. The atmosphere stretches about 300 miles (500 kilometers) above the ground. As you get higher up, the atmosphere becomes thinner. This means there are fewer gases, including oxygen, around you. So, it gets harder to breathe.

The tallest mountain on Earth is Mount Everest. It rises almost 5.6 miles (9 kilometers) into the sky. At the top of the mountain the air is very, very thin. Most people who climb the mountain have to carry tanks of extra oxygen so they can breathe.

## Flying above the clouds

Jet airplanes fly about 6 miles (10 kilometers) above the ground. This is the highest that people can travel, unless they are astronauts going into space. Most clouds form between 1.5 miles (2 kilometers) and 3 miles (5 kilometers) above the ground. There are many different types of clouds. Scientists study the clouds to help predict the weather.

*This jet is high up in the atmosphere. At this height you can see how Earth's horizon curves.*



## Hot air

Entering Earth's atmosphere very fast can make things burn up. Sometimes, bright darts of light shoot across the sky. These are called shooting stars but they are not really stars. They are pieces of space dust coming toward Earth. They fly through space very quickly. When they hit the atmosphere they become very hot and burn up because of friction. Friction is what makes your hands warm when you rub them together.

## Spacecraft

Spacecraft in the lowest **orbits** circle Earth at 320 miles (520 kilometers). Over time, friction slows a spacecraft so much that gravity can pull it down. Like shooting stars, they hit the atmosphere and burn up. In 2001, the Russians used a spacecraft to push their space station *Mir* onto a **collision course** with Earth's atmosphere. The heat burned up most of the space station but not all of it. It was so big that some of it survived and fell into the Pacific Ocean.

*This is a picture of the Space Shuttle. It does not burn up when it reenters the atmosphere because it is covered in heat-proof tiles.*





# What Is Earth's Surface Like?

Land and oceans cover Earth's surface. There are many different types of land. Some parts are covered with jungles, others with snow. There are rugged mountains and hot, sandy deserts.

The oceans are very special. They are Earth's central heating system. They help warm up the cooler parts of the **planet**. In some houses, hot water is pumped around the radiators to keep the rooms warm. On Earth, warm water moves around the oceans, keeping some countries warmer than others.



*Earth has all sorts of weather. Storms in the tropics have very strong winds and produce huge amounts of rain.*

## The right distance from the Sun

Earth is very different from all the other planets in the **solar system**. It is the only one that has animals and plants living on it. This is because our planet is just the right distance from the Sun.

If Earth were closer to the Sun, it would be so hot that the water would boil away. If Earth were too far away from the Sun, it would be so cold that the oceans would freeze into solid ice. Without water, life on Earth would be impossible.



*Factories and power stations that burn fossil fuels are adding to the pollution in our atmosphere.*

## Is Earth's climate changing?

Scientists are now worried that Earth's **climate** is changing. For more than 20 years, Earth has been getting hotter. Part of this change is natural. Throughout Earth's history temperatures have been changing slightly. However, some of the present change is being caused by pollution, such as waste **gas** from cars and factories. The pollution hangs in the **atmosphere** and keeps in heat. This added heat affects the weather and can cause problems for plants and animals, including humans.



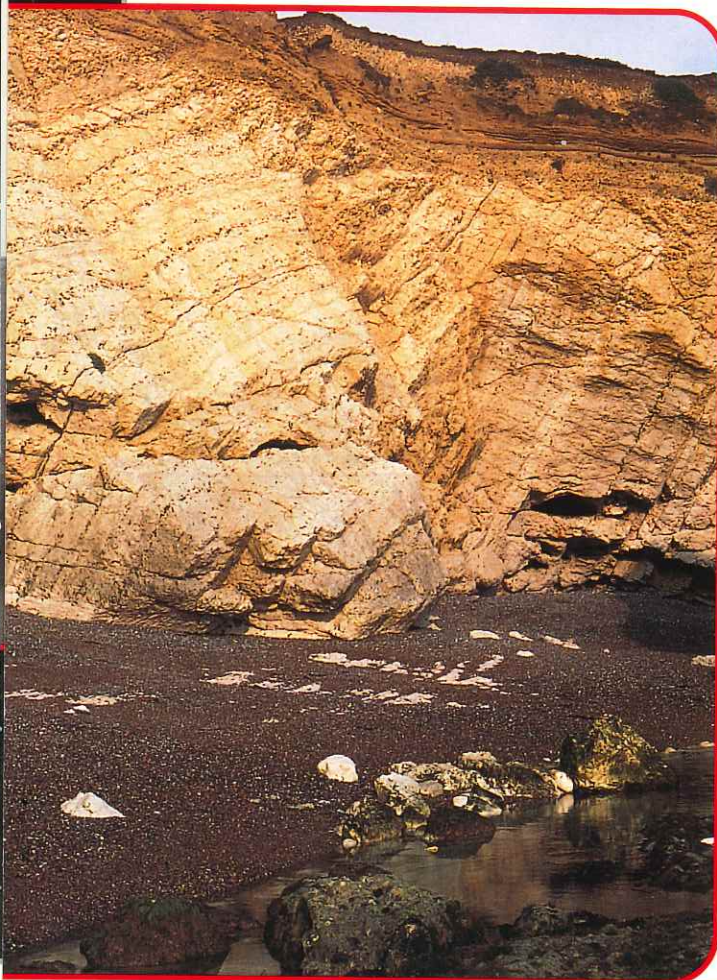
# What Is Earth Made Of?

Earth is made mostly of rocks. The rocks are made of many different **chemicals**. Scientists called **geologists** study rocks. When geologists know what a rock is made of, they can work out how it was formed. There are three different types of rock on Earth. These rocks make up the surface. The surface of Earth is called the **crust** and is usually between about 6 and 31 miles (10 and 50 kilometers) thick. In some parts under the oceans, it can be much thinner.

## Different layers

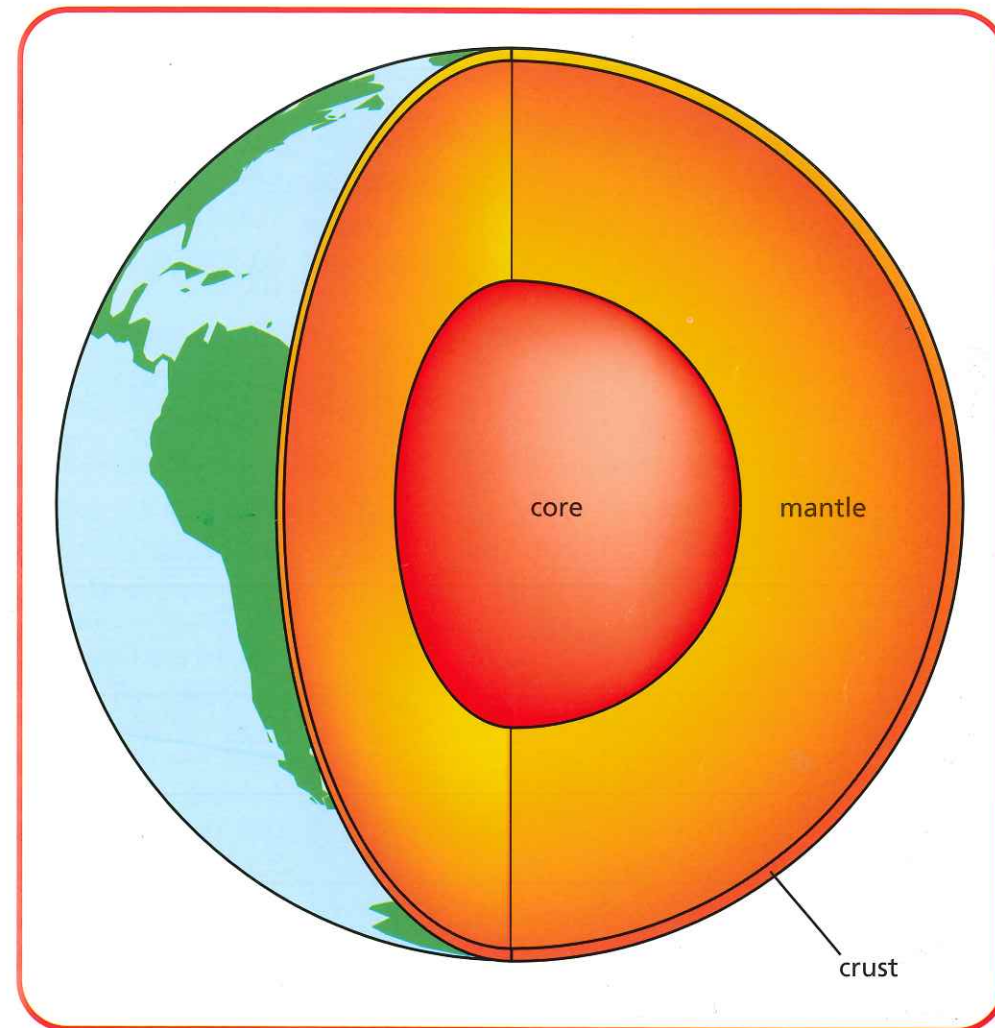
The first type of rock is called **igneous rock**. This makes up most of Earth's surface and was once **molten lava**. The lava erupts from **volcanoes** and then cools down to become rock. The second type of rock is called **sedimentary rock**. This is made of little bits of sand and other small matter that drift to the sea bottom. As more bits fall on top to form a new layer, the tiny pieces are squashed together and become a new rock. The third type is called **metamorphic rock**. This is made from igneous or sedimentary rocks that have been squeezed or heated inside Earth and turned into different rocks.

*You can see the different layers in this sedimentary rock along the coast of the Isle of Wight in Britain.*



## Inside Earth

Geologists can use special equipment to listen to sounds traveling through Earth. It is a good way to discover far away **earthquakes** and **volcanic eruptions**. This process is called **seismology**. It also helps scientists discover what is inside Earth. When scientists first listened to the inside of Earth, they found that at the very center of our planet is a large ball of metal, or **core**. It is mostly made of iron and nickel. The center of the core is solid, but near its surface the metal is so hot that it is molten.



*Inside Earth there are different regions of rock (the crust and mantle) and metal (the core).*

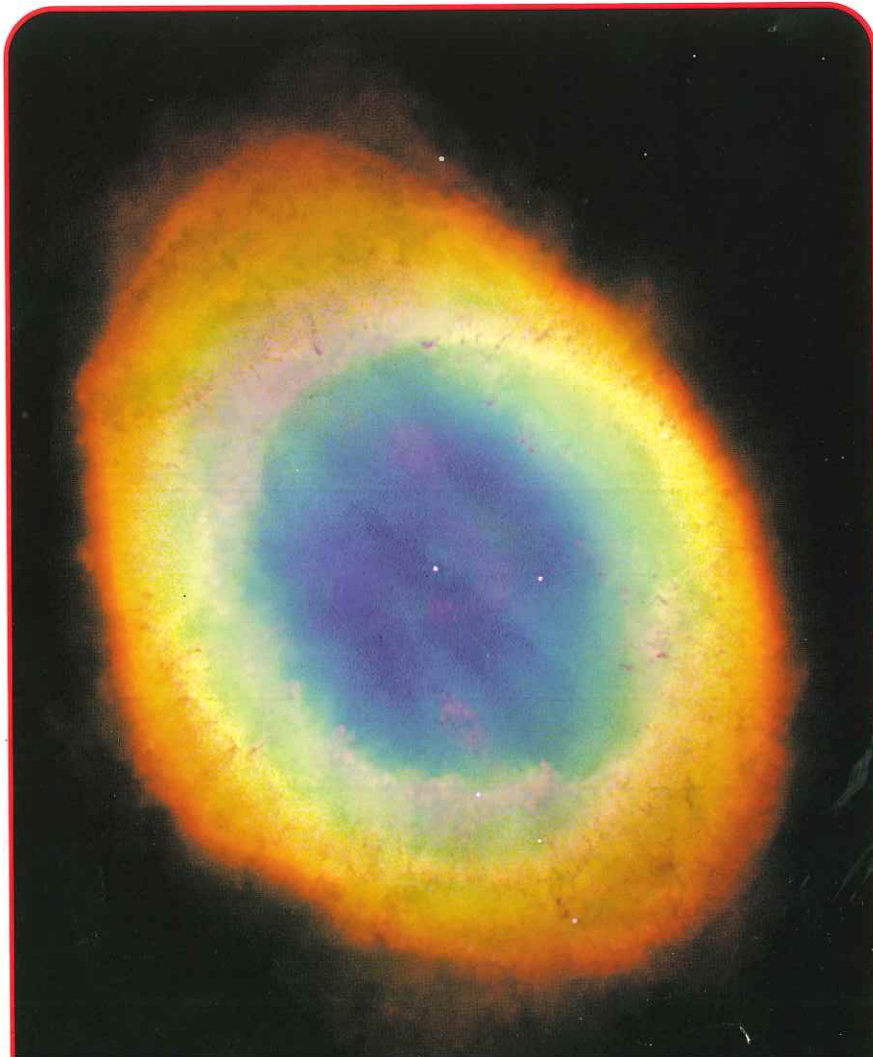


# How Was Earth Made?

**Geologists** are very good at measuring the different types of **chemicals** that make up the rocks on Earth. By measuring the amount of each chemical inside a rock, scientists can tell how old it is. With this method, geologists have learned that the oldest rocks on Earth are 3.8 billion years old. Mathematical calculations and a study of meteorites has shown that Earth is 4.5 billion years old.

**Astronomers** have worked out the age of the Sun. It is also 4.5 billion years old. This tells us that Earth, the Sun, and all the **planets** formed at the same time. A big clue about how

Earth was formed can be found in space.



*This brightly colored cloud of gas and dust, called a planetary nebula, is actually a dying star. But another type of nebula that surrounds a young star may have been the source of our solar system.*

## Clouds in space

When astronomers look into space, they see enormous clouds of gas and dust. Some of the clouds give off light in beautiful red, yellow, and green colors. The clouds are much bigger than planets or stars. Using telescopes to look inside them, astronomers can see that stars form inside these clouds. Planets must form inside them, too.

## Star making

As the clouds float through space, parts of them begin to move closer together. This is the first step in making a star. As the gas squeezes together, it heats up and becomes a star. Small clouds of dust then form around these very young stars. This is where astronomers think planets form. So, stars and planets form together, at the same time, and this is how scientists think our **solar system** was made.

## Planets forming

No one has ever seen a planet forming. Telescopes are not powerful enough to see any detail in the dusty clouds that surround young stars. Astronomers are working to build bigger telescopes that will see into the clouds. Until those telescopes are finished, astronomers have to rely on very powerful computers to help them calculate what happens when a planet forms. They believe it takes many millions of years for a planet to form completely.

Their calculations tell them that the dust in the cloud begins to stick together. This takes a long time. After many, many thousands of years, the dust sticks together to make rocks. Then, the rocks start to bump into each other. When this happens, they melt and stick together. As more of the rocks stick together, they form planets, and this is how scientists think Earth was made.



The Barringer Crater is in Arizona. It is about 4,000 feet (1,200 meters) wide and about 600 feet (180 meters) deep.

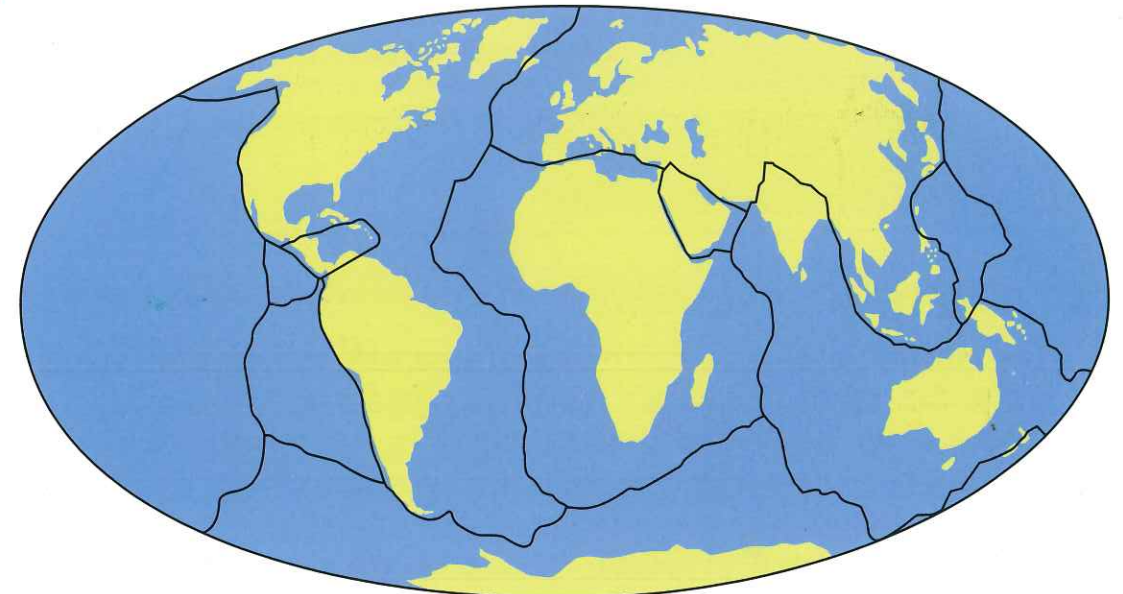


## Craters

Most of the rocks have come together over millions of years to make **planets**. But there are still some rocks that have not. The **craters** on the **Moon** were caused as these last pieces of rock were caught by **gravity** and crashed into the Moon's surface. There would have been many craters on Earth, too, but most of them have been worn away by the weather.

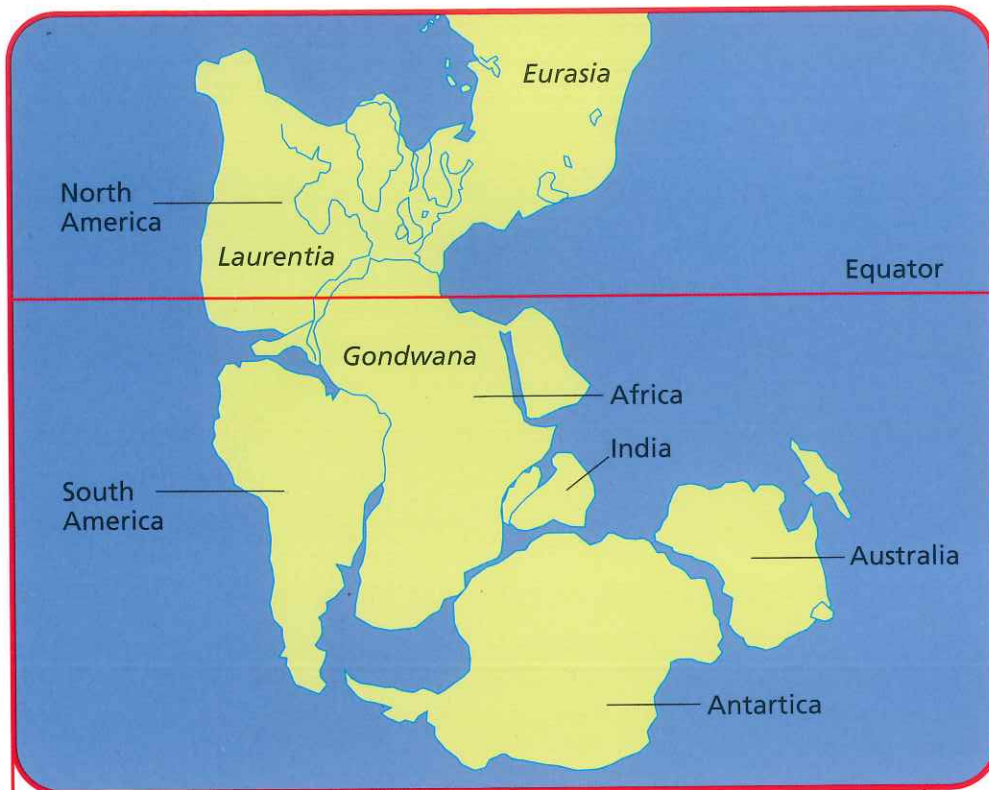
## The restless Earth

Even today, the temperature deep inside Earth is high. Some of the rocks are still **molten**. This is called **magma** and it behaves like a liquid. Earth's surface is not one solid **crust**. It is broken into large pieces called **plates**. The plates hold the **continents** and the oceans and they rest on the magma. As the liquid magma moves, so do the plates. Sometimes they collide. Other times they pull apart. When plates rub along each other, **earthquakes** happen. These shake the ground and can cause awful damage. The plate containing the Pacific Ocean rubs against the west coast of the United States, creating earthquakes from time to time. If continents collide, the plates can push up and make mountain ranges. The Himalayan mountain range in Asia is still growing from the collision of two plates.



Earth's crust fits together like a jigsaw puzzle. The pieces are called **plates**. Wherever two plates meet, or touch, earthquakes are possible.





*This is what Earth would have looked like 250 million years ago. You can see the huge continents Eurasia, Laurentia, and Gondwana. Also labeled here are some of the continents and countries as they are known today.*

## One huge continent

Most of the land on Earth was once a single huge **continent**. The continent split apart 250 million years ago. The pieces have taken all of that time to drift into their present positions. South America looks as though it would fit into Africa like a jigsaw puzzle piece because once, long ago, they were joined together.

## Volcanic eruptions

**Magma** can also rise to the surface of Earth and **erupt** through holes that become **volcanoes**. When magma flows out of Earth, it is called **lava**. As it hardens and turns into new rock, it builds large volcanoes.

It is very difficult to know when a volcano will erupt. Hundreds of years can pass between **volcanic eruptions**. A volcano is said to be "dormant" when it is not erupting. When it stops erupting forever, a volcano is said to be "extinct."

*Some volcanos erupt violently with explosions and huge clouds of ash. Others erupt with flowing lava and no explosions.*



## Changing Earth

There were times in the past when Earth was much colder than it is today. These times were called ice ages. Huge sheets of ice moved over the land and gigantic icebergs floated on the oceans. Some scientists think that ice ages may be caused when extremely large volcanoes erupt. Perhaps volcanoes throw clouds of ash into the **atmosphere** and stop sunlight from reaching Earth. Such an event might cause the temperature of our **planet** to drop and an ice age to happen.

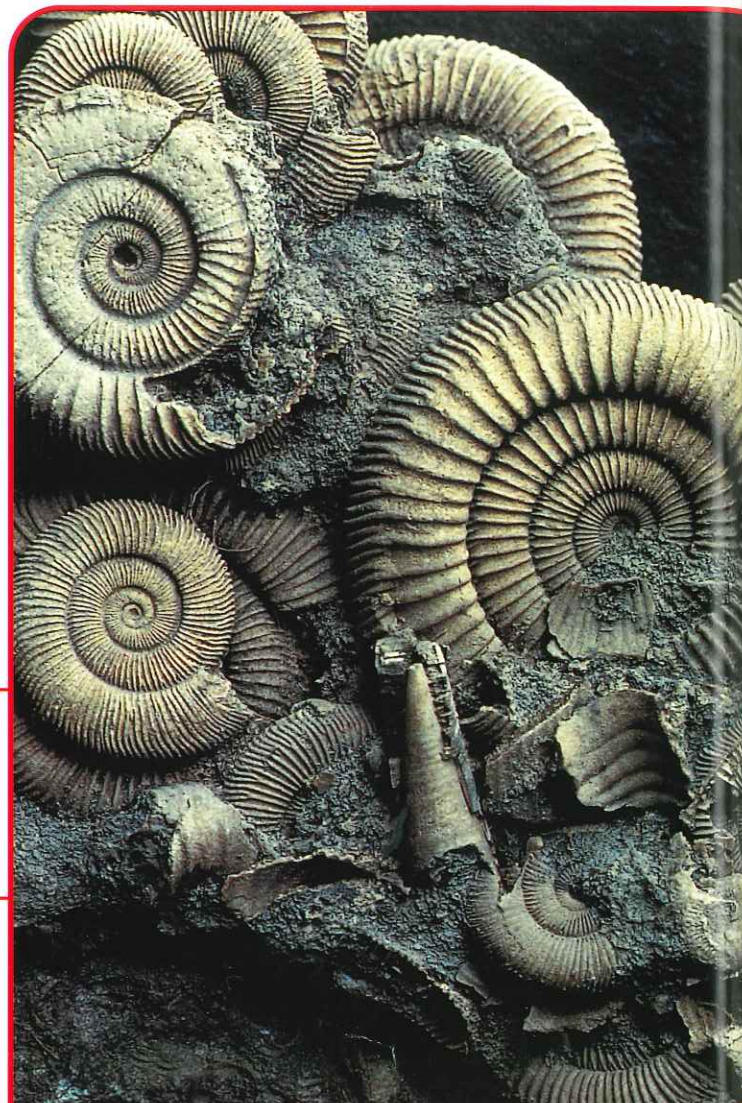


# When Did Life Begin on Earth?

Fossils are made when parts of dead animals or plants leave marks in **sedimentary rocks**. Scientists have found very old fossils in some rocks. These fossils are amazing because they are not like the large bones of dinosaurs. Instead, they are very tiny fossils of **bacteria**. These are the smallest life-forms found on Earth and can only be seen through a microscope. There are many types of bacteria. Some bacteria give us illnesses, while others live inside us and help us to digest our food. The rocks in which fossils of old bacteria have been found are about 3.5 billion years old.

Other scientists have found rocks almost four billion years old that were probably made from dead bacteria. So, it seems that bacteria were the first life-forms on Earth. No one knows exactly how bacteria formed in the first place. This is one of the most puzzling questions in modern science.

*Some of these ammonite fossils are around 380 million years old. Ammonites were a type of sea snail.*



## Plants and animals

For nearly three billion years, bacteria were the only kind of life that lived on Earth. They were found only in the oceans. Then, about 550 million years ago, life on Earth began to change. Groups of bacteria stuck together and worked together, becoming more complicated. Plants and animals developed. The first plants were like vines and the first animals were like jellyfish. Eventually both plants and animals found ways to leave the ocean and live on the land.

## Mass extinction

Animals and plants change all the time. Usually they become more and more complicated. This change is called evolution, and it means that animals and plants can adapt to new situations. One mystery that is still to be solved by scientists is why many types of animals die out suddenly. When this happens, it is called a **mass extinction**. There have been five mass extinctions during Earth's history.

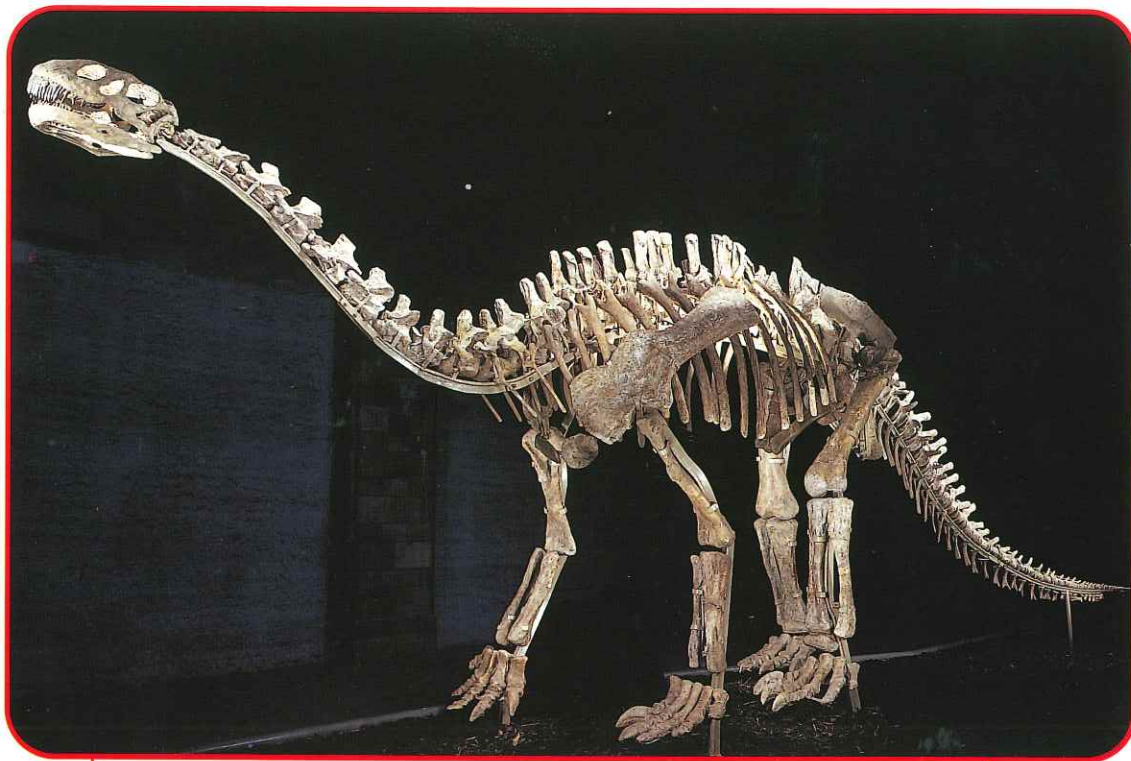


*Simple creatures, like this jellyfish, were some of the first animals to develop on Earth.*



## Death of the dinosaurs

A very important **mass extinction** took place 65 million years ago. This was when the last of the dinosaurs died out suddenly. The dinosaurs were giant animals that lived on Earth between 225 and 65 million years ago. Most scientists believe that they were finally wiped out when a gigantic lump of space rock, known as an **asteroid**, hit Earth. An asteroid is often the size of a mountain. If an asteroid crashes into a planet, it will cause powerful **earthquakes**. These terrible disasters probably killed the dinosaurs and a large number of other animals and plants. Scientists have found evidence that other mass extinctions may also have been caused by asteroids.



*This Shunosaurus dinosaur skeleton was found in China. The Shunosaurus was a plant-eating dinosaur, so even if it had survived the impact of the asteroid, it would probably have starved with no plants left to eat.*

## The birth of man

The extinction of the dinosaurs is important to us because after the death of these huge creatures, there was more food for smaller creatures called **mammals**. Mammals give birth to live babies rather than laying eggs. They also feed their babies with milk. Mammals began to **evolve** about 210 million years ago. Humans are highly developed mammals. They evolved from earlier, simpler mammals. Over millions of years, the first mammals gave rise to more complicated and more intelligent mammals. One of these groups evolved into human beings.



*This is an artist's idea of what early humans would have looked like about one million years ago.*

## Keeping Asteroids from Hitting Earth

There is always a small risk that another asteroid might hit Earth. **Astronomers** are building new telescopes and searching the skies for dangerous asteroids. If such an asteroid is discovered, instead of blowing it up, scientists will try to push it into a new **orbit** so it will not crash into Earth.



# Fact File



*While one half of Earth is in sunlight and has day, the other half is in darkness and has night.*

## Earth

*Length of day* 24 hours

*Size* Earth is 7,926 miles (12,755 kilometers) across.

*Distance from the Sun* 93 million miles  
(150 million kilometers)

*Time it takes Earth to go around the Sun* 365.25 days  
(Every fourth year we have to include an extra day in the calendar, February 29. If we did not do this, the seasons would shift. These years are called leap years.)

*Surface area* The surface of Earth measures 197 million square miles (510 million square kilometers).

*Average height of the land* 2,756 feet (840 meters) above sea level.

*Average depth of the oceans* 12,467 feet (3,800 meters)

The five tallest mountains above sea level:

Mount Everest	5.5 miles (8.8 kilometers)
K2 (Godwin Austen)	5.4 miles (8.6 kilometers)
Kanchenjunga	5.33 miles (8.59 kilometers)
Lhotse	5.3 miles (8.5 kilometers)
Makalu	5.3 miles (8.5 kilometers)

*The Himalayan mountain range is the highest in the world. It is always covered in snow and nothing lives on its mountain peaks.*



The five longest rivers:

Nile	4,145 miles (6,670 kilometers)
Amazon	4,000 miles (6,430 kilometers)
Yangtze	3,915 miles (6,300 kilometers)
Mississippi	3,741 miles (6,020 kilometers)
Yenisei-Angara	3,442 miles (5,540 kilometers)

Earth's atmosphere is made of:

Nitrogen gas	78 percent
Oxygen gas	21 percent
Argon gas	0.9 percent
All other gases	0.1 percent



# Glossary

- asteroid** lump of rock moving around the sun
- astronomer** scientist who studies space, **planets**, and stars
- atmosphere** blanket of gas around a **planet** or moon
- axis** imaginary line that a planet spins around
- bacteria** tiny, basic life-forms
- chemicals** substances that everything is made up from
- climate** weather conditions
- collision course** about to hit or crash into something
- comet** body of rock and ice traveling around the Sun
- continent** very large piece of land on Earth
- core** center, or middle part of Earth
- crater** large, bowl-shaped hole in the surface of a planet or moon caused by an **asteroid** crashing into it
- crust** outer layer of Earth
- earthquake** when the surface of Earth moves suddenly
- equator** imaginary line around the middle of Earth
- erupt** burst out
- evolve** change over time
- gas** substance like air
- geologist** scientist who studies rocks
- gravity** force that pulls all objects toward the surface of Earth or any other **planet**, moon, or star
- horizon** line where the land and the sky seem to meet
- igneous rock** rock made from **lava**
- lava** liquid rock that erupts from **volcanoes**
- magma** rocks inside Earth that are so hot they are liquid and runny
- mammal** animal that gives birth to babies and feeds them with milk
- mass extinction** when many types of animal die out very quickly
- metamorphic rock** rock changed by heat or squeezing

- molten** something that has been melted
- Moon** natural satellite that moves around Earth
- myth** old story told to explain how something came to be
- Old English** language people in England spoke before the year 1150. It is different from the English we speak now.
- orbit** path one object takes around another
- planet** large object that moves around a star
- Poles** two points—one at each end of Earth's **axis**—the North Pole and the South Pole
- radiation** energy rays from the Sun
- sedimentary rock** rock made up over time from layers of tiny bits of other rocks
- seismology** special way of listening for, and studying, **earthquakes**
- solar system** all the **planets**, moons, **asteroids**, and **comets** around the Sun
- space station** large human-made object that moves around Earth
- tropics** area of Earth around the **equator**
- ultraviolet light** type of special light that cannot be seen by humans
- volcanic eruption** when an active **volcano** spills melted rock on to the Earth's surface
- volcano** opening in a planet's surface through which hot, liquid rock is thrown up

## More Books to Read

- Downs, Sandra. *Shaping the Earth: Erosion*. Brookfield, Conn.: Millbrook Press, 2000.
- Rood, Ronald. *Incredible Earth*. New York: John Wiley and Sons, 1996.
- Van Rose, Susanna. *Earth*. New York: DK Publishing, 2000.