

The Earth and the Moon

BEFORE WE START, LET'S CHECK

What you already know

Fill in each blank choosing the correct word.

- The earth moves around the _____. (sun / moon)
- There are _____ planets in the solar system. (nine / eight)
- The moon is a natural _____ of the earth. (planet / satellite)
- The sun is a _____ and it does not move. (planet / star)
- The earth shows _____ kinds of movements. (two / four)

What you will know

What is inside the earth?



How are the conditions on the moon?



Why does the moon appear in different shapes?



What are different expeditions to the moon?



EARTH

The earth is a **planet** as it moves around the sun in a fixed orbit. It is also called the '**Blue Planet**' as it appears blue when viewed from the space. It is because almost 70% of the earth's surface is covered with water.

The earth is a unique planet. It is the only planet, where life is known to exist in the whole universe.

The earth shows two kinds of movements.



the earth

First, it spins on its axis.

This movement is called **rotation**.

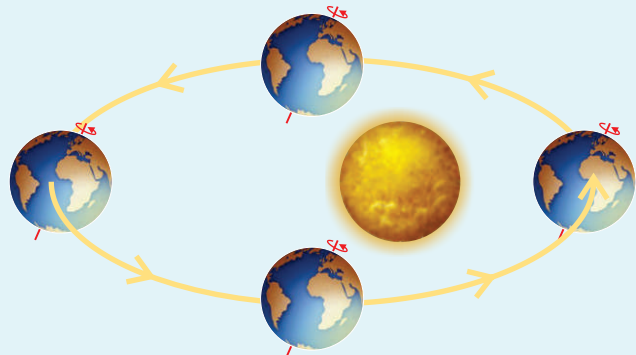
The rotation of the earth causes day and night.



Second, it moves around the sun in a fixed orbit.

This movement is called **revolution**.

The earth takes about a year to complete one revolution.



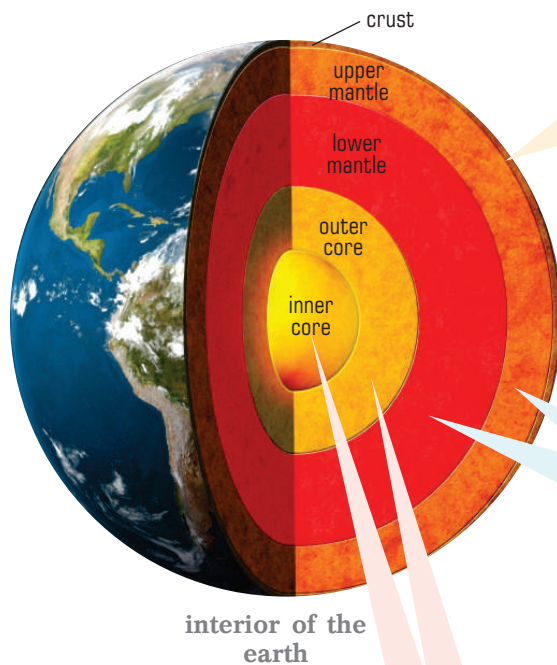
The earth's surface is made up of mountains, valleys, plains, rivers, oceans and seas. All these features make our earth a very beautiful place to live on.

Do you know what lies beneath the surface? Let us learn about the internal structure of the earth.

Interior of the earth

Just as an onion is made up of various layers, the earth is also made up of three concentric layers. These layers are the **crust**, the **mantle** and the **core**.

The structure of the earth is similar to that of an egg. The earth's crust is like the shell of an egg, its mantle is like the egg white and the core is like the yolk.



Crust: The crust is the topmost solid layer. It is the coolest of the three layers. It is very thin. Its thickness varies from around 5 km (in the ocean floor) to around 70 km (the land where we live, called the continental crust). The crust is made up of solid rocks, soil and sand.

Mantle: The middle layer of the earth is called the mantle. It lies just beneath the crust. It can be divided into two parts: the upper mantle and the lower mantle.

The upper mantle is up to 670 km below the earth's surface. It is made of both solid and melted rocks.

The lower mantle is found between 670 km and 2,890 km below the surface. It is made of solid rock. The rock is hot enough to melt, but is solid due to the pressure over it.

Core: This is the innermost layer of the earth. It lies below the mantle and in the centre of the earth. The core is divided into two parts: the outer core and the inner core.

The **outer core** extends to a depth of around 5,150 km beneath the surface. It is made of iron and nickel and is very hot. The temperature ranges between 4,000°C and 5,000°C. This is so hot that the iron and nickel there are liquid.

The **inner core** is a huge metal ball. It extends another 1,500 km toward the centre of the earth. It is mainly made of iron. But the metal stays solid because of the immense pressure surrounding it. The inner core is the hottest part of the earth. The temperature of the ball is about 6,000°C almost as hot as the surface of the sun.

MOON

All of you must have seen the moon in the night sky. Though the moon and the sun look almost the same in size, but the moon is tiny in comparison to the sun. It looks big because it is very near to the earth. It is around 3,84,000 km away from the earth. The moon is a **natural satellite** of the earth. A natural satellite is a heavenly body that orbits a planet. The moon takes about 27.3 days to complete one revolution around the earth.



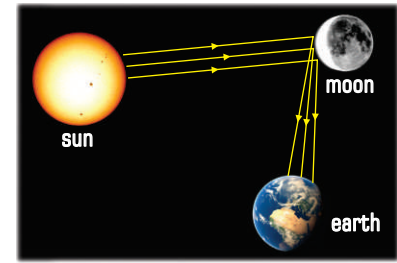
the moon

The moon was probably formed 4.5 billion years ago. It is believed that a large object hit the earth and blasted out rocks. These rocks together orbited the earth. They eventually melted, joined together, cooled and became the moon.

Why the moon shines

The moon does not have any light of its own, yet when full, it is the brightest object in the sky. The moon shines when the sun's light falls on its surface and is reflected back to the earth.

Let's perform an activity to understand this.



the shining of the moon



Fun and Learn



Take a mirror, a duster, a globe and a torch.



Place the globe on a table. Switch on the torch and place it at a small distance away from the globe.



Switch off the room light. Stand behind the table. Hold the mirror and adjust it. You will see some part of globe is also shining.

What happens? The torch light first falls on the mirror. From there, it is reflected to the globe. Similar process takes place on the moon and it shines.

Conditions on the moon

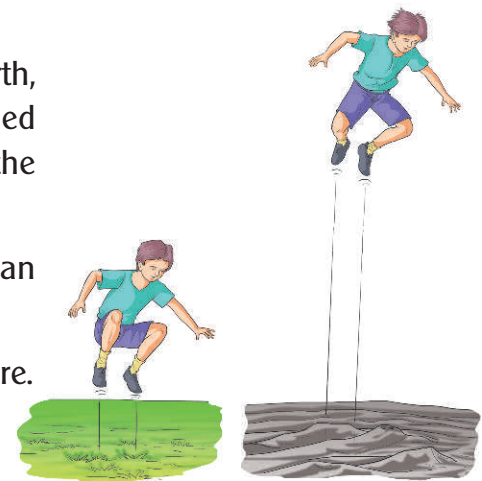
The moon is about one-fourth of the earth in size. Like the earth, the moon also pulls all objects towards itself. This is called gravity. But the gravity of the moon is only one-sixth of the gravity of the earth.

It means that if you can jump 1 metre on the earth, you can jump 6 metres on the moon.

Due to this weak gravitational pull, the moon has no atmosphere.

The absence of atmosphere results in many phenomena.

- * The moon has no wind or weather.
- * As sound waves need air to travel, no sound can be heard on the moon. So the moon is an absolutely quiet place.
- * We know that on the earth, the atmosphere absorb some of the heat coming from the sun. But on the moon, days become extremely hot in the absence of an atmosphere.



Similarly at night, in the absence of an atmosphere, all the heat from the moon's surface escapes. So, it gets freezing cold.

The average surface temperature of the moon is 107°C during the day and -153°C at night.

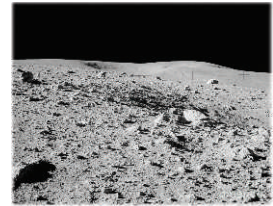
No atmosphere means no protection from the **meteoroids** falling from the space. That is why, many meteoroids hit the moon's surface now and then.

The surface of the moon

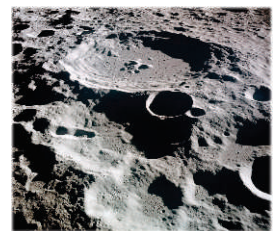
The surface of the moon is covered with rocks and dust. It has tall mountains and flat lava plains.

Mons Huygens is the tallest mountain on the moon. It is almost half as tall as Mt. Everest, the tallest mountain on the earth.

There are many large and deep circular hollows on the surface of the moon. They are called **craters**. They were formed from meteoroids, **asteroids** and other rocks falling from space. Some of the craters are hundreds of kilometres wide. You can see craters using a telescope. Due to the absence of an atmosphere, the surface of the moon can be seen clearly.



moon's surface



craters

Movements of the moon

Like the earth, the moon also shows two kinds of movements: rotation and revolution.

But the time taken by the moon to rotate on its axis is equal to the time it takes to orbit the earth. That is why we always see only one side of the moon. The other side or the far side is always turned away from us. Now we can see it in the photographs taken from space.



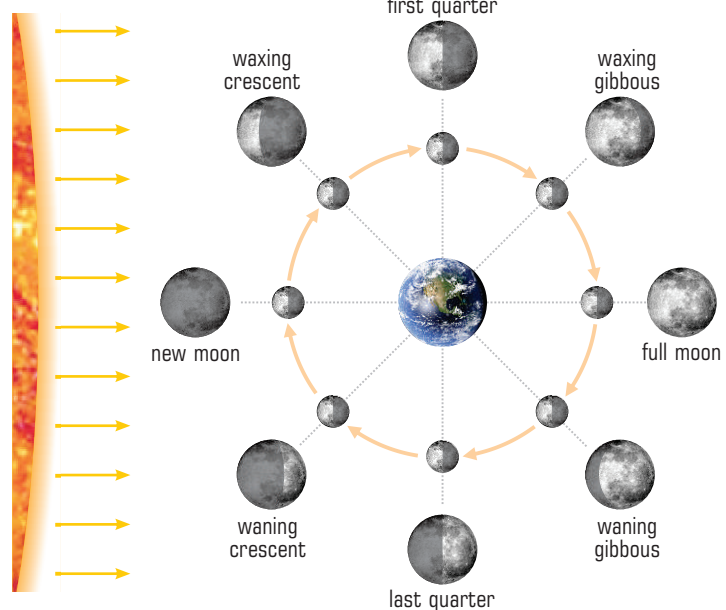
the far side of the moon

Phases of the moon

Moonlight is actually the light from the sun reflected off the moon's surface. As the moon orbits the earth, the relative positions of the sun, the earth and the moon keep changing. Thus, the lighted part of the moon as seen from the earth also keeps changing.

That is why the shape of the moon appears to change every day.

The changing shapes of the moon are called the **phases of the moon**.



phases of the moon

When the side of the moon facing the earth is not lit by the sun, no moon is visible. We call it the **new moon**. Gradually, some of the illuminated part of the moon faces the earth and we see that part of the moon.

On a day when the whole side of the moon that is lit by the sun faces the earth, the whole moon appears to be illuminated. We call it the **full moon**.

All the phases of the moon from a new moon to a full moon are known as **waxing phases** of the moon. 'Waxing' means 'increasing'.

After the full moon, the illuminated part of the moon, as seen from the earth, keeps decreasing and finally becomes invisible. All the phases of the moon from a full moon to a new moon are called **waning phases** of the moon. 'Waning' means 'decreasing'.



Thus, the phases of moon appear in a cycle. It takes the moon 29.5 days to go from one new moon to next. This period is called a **lunar month**.

The moon and tides

Tides are the rise and fall in the levels of the sea. During a **high tide** the level of the sea rises. During a **low tide**, the level of the sea becomes low.

On average, high tides occur 12 hours 24 minutes apart.



high tide



low tide

The difference of height between a high tide and a low tide at a place is called the **tidal range**. The tidal range can be as low as less than 1 metre or it can be as high as more than 16 metres.

Tides are caused by the gravitational pull of the moon and the sun exerted on the earth. As the moon is much nearer to the earth than the sun, its gravitational pull is much more.

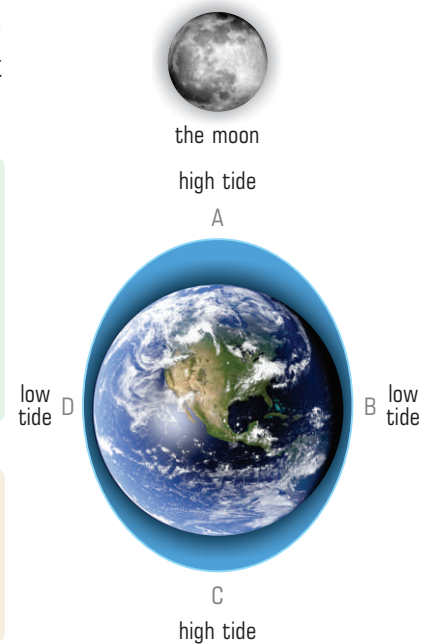
The moon's gravity exerts a pulling force on the earth. Since the water on earth is always moving, the moon is able to pull at it. Let us now study how tides occur.

Look at the side A of the earth. This side faces the moon and is nearest to it. Thus the gravitational pull is highest here, pulling the water towards the moon, causing a bulge of water.

Now look at the side C of the earth, which is farthest from the moon. Here, the water bulges out as a result of the earth spinning.

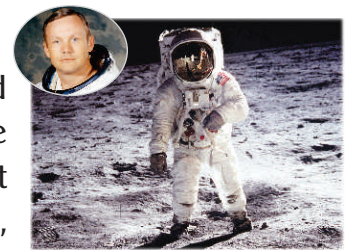
Therefore, side A and side C of the earth face **high tides** in this position.

Now look at the side B and side D of the earth. These sides are facing **low tides**. Do you know why? It is simple. The total mass of the oceans does not change. So the part of water that is added to the high water regions A and C, have come from these regions B and D.



Man on the moon

In 1969, a spacecraft from the USA, named Apollo 11, was launched with three **astronauts**. On 20 July, 1969, it landed on the surface of the moon. Neil Armstrong and Edwin Aldrin respectively became the first and second human beings to set foot on the moon. The third astronaut, Michael Collins, remained in the spacecraft.



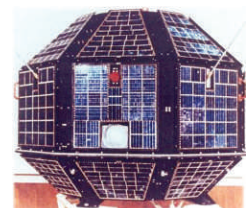
Neil Armstrong

After them, ten more men walked on the moon till 1972. Eugene Cernan of America became the last man to step off the moon's surface. No human has landed on the moon since then. These astronauts brought back samples of rocks and dust from the moon to study them.

India's Space Missions

Like some other big countries, India has also launched several space missions. Some of the highlights of Indian space programmes are as follows:

- ✳ On 19 April, 1975, India launched its first artificial satellite, named Aryabhata, into space.
- ✳ On 3 April, 1984, Rakesh Sharma became the first Indian to go into space.
- ✳ On 19 November, 1999, Kalpana Chawla became the first Indian woman to go into space.
- ✳ On 22 October, 2008, India launched its first mission to the moon, named *Chandrayaan I*. On 14 November, 2008, a small spacecraft landed on the moon's surface.
- ✳ On 5 November, 2013, India launched *Mangalyaan*, a spacecraft which is orbiting the planet Mars since 24 September, 2014.



Aryabhata



Rakesh Sharma

Words to Remember

planet	–	a very large body in space that moves around the sun in a fixed orbit
crust	–	the outermost layer of the earth
mantle	–	the middle layer of the earth
core	–	the innermost layer of the earth
natural satellite	–	a heavenly body that moves around a planet in a fixed orbit
gravity	–	the force that pulls objects towards the centre of the earth, the moon, etc
meteoroid	–	small pieces of rocks or metals that move in space
crater	–	a large bowl-shaped hollow caused by the impact of a meteoroid, an asteroid, etc.
asteroid	–	a rocky body orbiting the sun, much smaller than a planet
phases of moon	–	the changing shapes of the moon as seen from the earth
new moon	–	the time when no moon is visible from the earth on a clear night sky
full moon	–	the time when the moon appears as a large shiny disk
waxing phase	–	the phase from a new moon to a full moon
waning phase	–	the phase from a full moon to a new moon
tides	–	the periodic rise and fall in the levels of the sea
tidal range	–	the difference of height between a high tide and a low tide at a place
astronaut	–	a person who travels in space on a spacecraft

Points to Recall

- * The earth is sometimes called the 'Blue Planet' due to the massive presence of water on its surface.
- * The earth shows two kinds of movements: rotation and revolution.
- * The earth is made up of three concentric layers: the crust, the mantle and the core.
- * The crust is made up of rock, soil and sand.
- * The mantle and the core are made up of rocks, both solid and molten.
- * The moon is a natural satellite of the earth and completes one orbit in 27.3 days.
- * The moon shines because of the sunlight reflected from its surface.
- * The moon has a very weak gravitational pull due to which there is no atmosphere on the moon.
- * The moon has no wind, weather, sound and protection from meteoroids.
- * Days are boiling hot and nights are freezing cold on the moon.
- * The moon's surface is rocky and dusty and has many large hollows called craters.
- * We see only one side of the moon always.
- * Moon appears to change its shape every day, which is called phases of the moon.
- * The gravitational pull of the moon and the movement of the earth cause the level of the sea rise and fall periodically.
- * Neil Armstrong was the first man to set foot on the moon and Eugene Cernan was the last man to set foot off the moon.
- * India has sent a spacecraft, named Chandrayaan I, to the moon.

Exercises

A. Tick (✓) the correct option.

1. Which of the following is the thinnest layer of the earth?

(a) crust

☐

(b) upper mantle

☐

(c) lower mantle

☐

(d) core

☐

2. The moon takes about _____ days to orbit the earth.

(a) 29.5

☐

(b) 27.5

☐

(c) 27.3

☐

(d) 29.3

☐

3. The gravity of the moon is _____ of the gravity of the earth.
 (a) one-fourth ☐ (b) one-third ☐ (c) one-fifth ☐ (d) one-sixth ☐
4. Which of the following is not found on the moon?
 (a) wind ☐ (b) clouds ☐ (c) rain ☐ (d) all of these ☐
5. In which year was Chandrayaan I launched into space?
 (a) 1975 ☐ (b) 2013 ☐ (c) 2008 ☐ (d) 1997 ☐

B. Choose the appropriate word and fill in the blanks.

1. The earth's mantle is like an egg _____. (white / yolk)
2. The _____ core is a huge metal ball. (outer / inner)
3. The phases of the moon from the full moon to new moon is called _____. (waxing / waning)
4. The lunar month is a period of _____ days. (27.3 / 29.5)
5. _____ tide occurs on the side of the earth facing the moon. (High / Low)

C. Answer in one or two words only.

1. Name the two metals present in the core of the earth. _____
2. What are large hollows on the moon's surface called? _____
3. What do we call the moon which is not visible on a clear night sky? _____
4. Name the last man to set off the moon. _____
5. Name India's first artificial satellite. _____

D. Answer in one sentence only.

1. Why cannot we talk on moon?
2. Which is the tallest mountain on the moon?
3. Why can we see surface of the moon clearly through a telescope?
4. How can we see the other side of the moon?
5. What do you understand by 'tidal range'?

E. Answer in a few sentences.

1. Explain the innermost layer of the earth.
2. Why is the inner core of the earth solid, and not liquid even after an extremely high temperature there?
3. Why is there so much difference in day and night temperatures on the moon?
4. Why is only one side of the moon visible to us?
5. Explain the phenomenon of high tide with a diagram.

Creative Skills



Brainstorm

1. In 1993, Javier Sotomayer of Cuba jumped a height of 2.45 m which is still a world record. How high would he have jumped on the moon?
2. The footprints left by the astronauts on the moon can be seen clearly even today. How is it possible?





TELL YOUR TEACHER

Read the following passages. Then tell your teacher the answers to the questions that follow.

- Raghu lives in Mumbai. His father is a fisherman. They live in a small hut near the sea coast. Today is a full moon night. Raghu's father has gone to the sea to catch fish. Raghu and his mother are very much worried? Can you say what the cause of their worry is?
- Apollo 11 took 3 astronauts to the moon. Two of them landed on the moon and became the first and second persons to walk on the moon. The third astronaut remained in the spacecraft. What according to you would he have been thinking at that time?

FIND OUT



What is ISRO? When and where was it established?



Who was Aryabhata? What was his major contribution to the field of mathematics?

Project

- Take some modelling clay and a thick thermocol sheet. Draw different phases of the moon on the sheet. Using a paper knife, make hollow spaces in the moon sketches. Now make different shapes of the moon using the clay. Paste them in the hollow spaces. Label them and present it to your teacher.
- Write a brief bio-sketch of any one of the following personalities:
 - Vikram Sarabhai
 - Rakesh Sharma
 - Kalpana Chawla
 - Sunita Williams

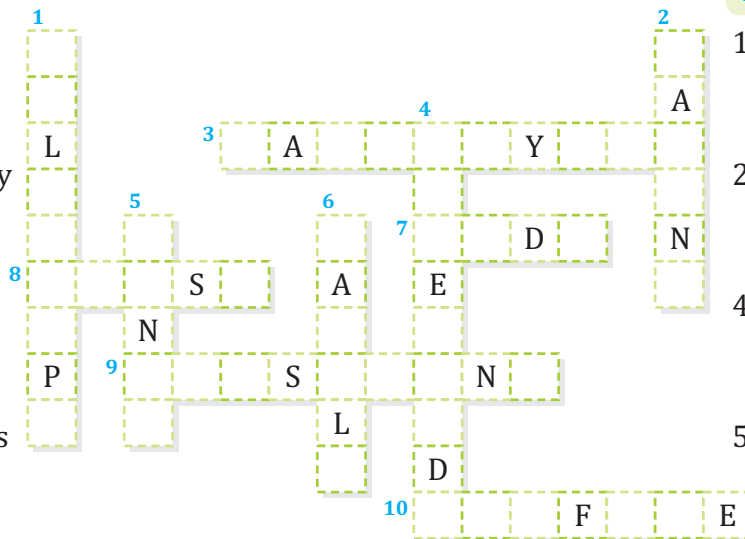


Crossword

Read the clues and fill in the crossword.

Across (→)

- This Indian spacecraft is orbiting the Mars.
- The moon's gravity is the major cause of this.
- It is the thinnest layer of the earth.
- The first man to walk on moon was Neil _____.
- The _____ of the moon is rocky and dusty.



Down (↓)

- We can see the surface of the moon using this.
- It is the phase of the moon that starts after a full moon.
- They are small solid bodies orbiting the sun.
- A _____ month consists of 29.5 days.
- It is the middle layer of the earth.