

## Forces

A force can

- change an object's **speed**.
- change an object's **direction**.
- change an object's **shape**.

Forces can be contact forces (pushing, pulling, friction) or non-contact (gravity, magnetism).

## Speed, Distance and Time

We often use the equation  $\text{speed} = \frac{\text{distance}}{\text{time}}$  when working with forces.

The unit we use to measure speed in science is the metre per second (m/s).

speed = ?	speed = distance /time
distance = 8 m/s	speed = 60/6
time = 26 s	speed = <u>10 metres per second</u>

## Gravity

The force of gravity is caused by mass. It is only noticeable for large masses like planets.

On earth, gravity is the same for all objects, and this causes everything to accelerate at the same rate when dropped.

## Friction

Friction happens when one surface slides over another. Friction always pushes **against** the moving object. This means that friction always slows down movement.

This can be useful, or it can be a problem depending on the situation.

There are two main reasons we might want to **increase** friction:

- anywhere we want to slow down movement;
- anywhere we don't want sliding to happen.

Car brakes are made of a high friction material and tyres are made of rubber to avoid skidding. Roads are gritted in winter for the same reason.

In motor sports, wider tyres are used to give greater friction for accelerating and cornering.

Sometimes we want to **decrease** friction. It takes work to overcome friction, and this energy is usually thought of as wasted energy. Machines with moving parts could waste far too much energy for them to be useful if we didn't control friction. Machines need to be lubricated to reduce friction. Car engines and bicycle chains would seize up if they weren't oiled regularly.

Many sports involve reducing friction as much as possible to allow faster movement. Examples are skiers waxing their skis and cyclists using low friction bearings in their wheels.

### **Air Resistance**

Air resistance is the friction between moving objects and the air.

Air resistance is useful if we want to slow an object down. The most obvious example of this is using parachutes. The bigger the parachute, the greater the air resistance – and so the slower the object will travel.

Cars are streamlined to reduce air resistance as much as possible. Sports cars are low to the ground and have curved panels to avoid drag.

Fast-moving athletes such as cyclists and skiers also streamline themselves. They wear specially designed clothing that is smooth and tight fitting and specially shaped helmets to reduce air resistance as much as possible.

## Structure of the Earth

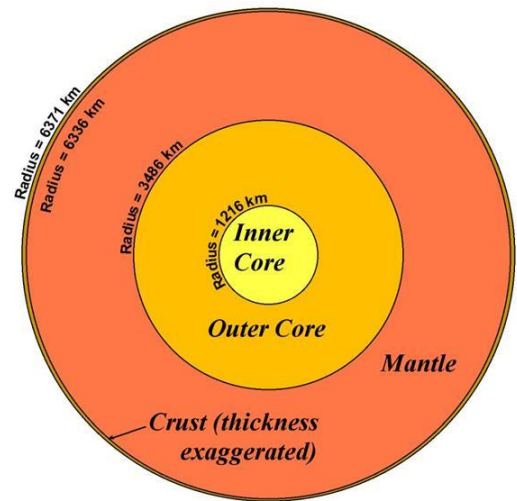
The Earth has a radius of 6 400 km. Inside, it is divided into four distinct layers.

**Crust:** The crust is the rocky layer at the outside of the earth. It is between 5 and 70 km thick. It is thinnest under the oceans.

**Mantle:** This is the thickest of the layers. It is solid, but it is soft enough to move around.

**Outer Core:** The outer core is made up of iron and nickel. It is much denser than the mantle. It is hot, so the metals are liquid. The movement of the inner core in the liquid metals causes the earth's magnetic field.

**Inner Core:** The inner core is also composed mainly of iron and nickel, but this is in a solid ball around  $\frac{3}{4}$  the size of the moon and as hot as the surface of the sun.



## Solar System

The Earth is a **planet** orbiting a **star** that we call the **sun**. We are part of a **solar system**. We have a **moon** orbiting around us. Understanding our place in space means we need to understand these words.

- **Star:** A huge ball of gas undergoing nuclear fusion to give out heat and light.
- **Sun:** Another word for star.
- **Planet:** A massive object that orbits a star. It must be large enough that its gravity pulls it into a ball.
- **Moon:** A natural object that orbits a planet.
- **Solar System:** A sun and all the planets, comets, asteroids and other objects orbiting it.

Our Sun has **eight** planets orbiting it. Mercury is closest. We are the third planet. Jupiter is the largest of the eight. This is the order of the planets:

1. Mercury
2. Venus
3. Earth
4. Mars
5. Jupiter
6. Saturn
7. Uranus
8. Neptune

## Day & Night

We have day and night on Earth because the planet spins. It takes 24 hours for the earth to spin once on its axis. In these 24 hours, we will face the sun for some of the time (daytime) and away from it some of the time (night).

## Year

A year is the time it takes for the Earth to orbit the sun. It takes us 365 days to go around the sun once.

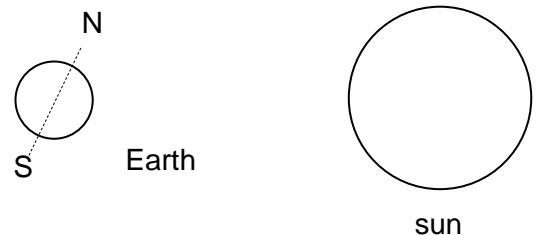
## Seasons

Earth has 4 seasons – spring, summer, autumn, winter. This is because the Earth is tilted compared to the sun.

Sometimes, the northern hemisphere is tilted **away from** the sun. This is what we call **winter**. The rays of heat and light hit at an angle, so they are spread out over a big area. This makes them **less intense**.



6 months later, the Earth is half way around its orbit. Its tilt is now **towards** the sun. We call this **summer**. The rays of heat and light hit almost vertically, so they are concentrated on a small area. This makes them **more intense**.



## The Moon

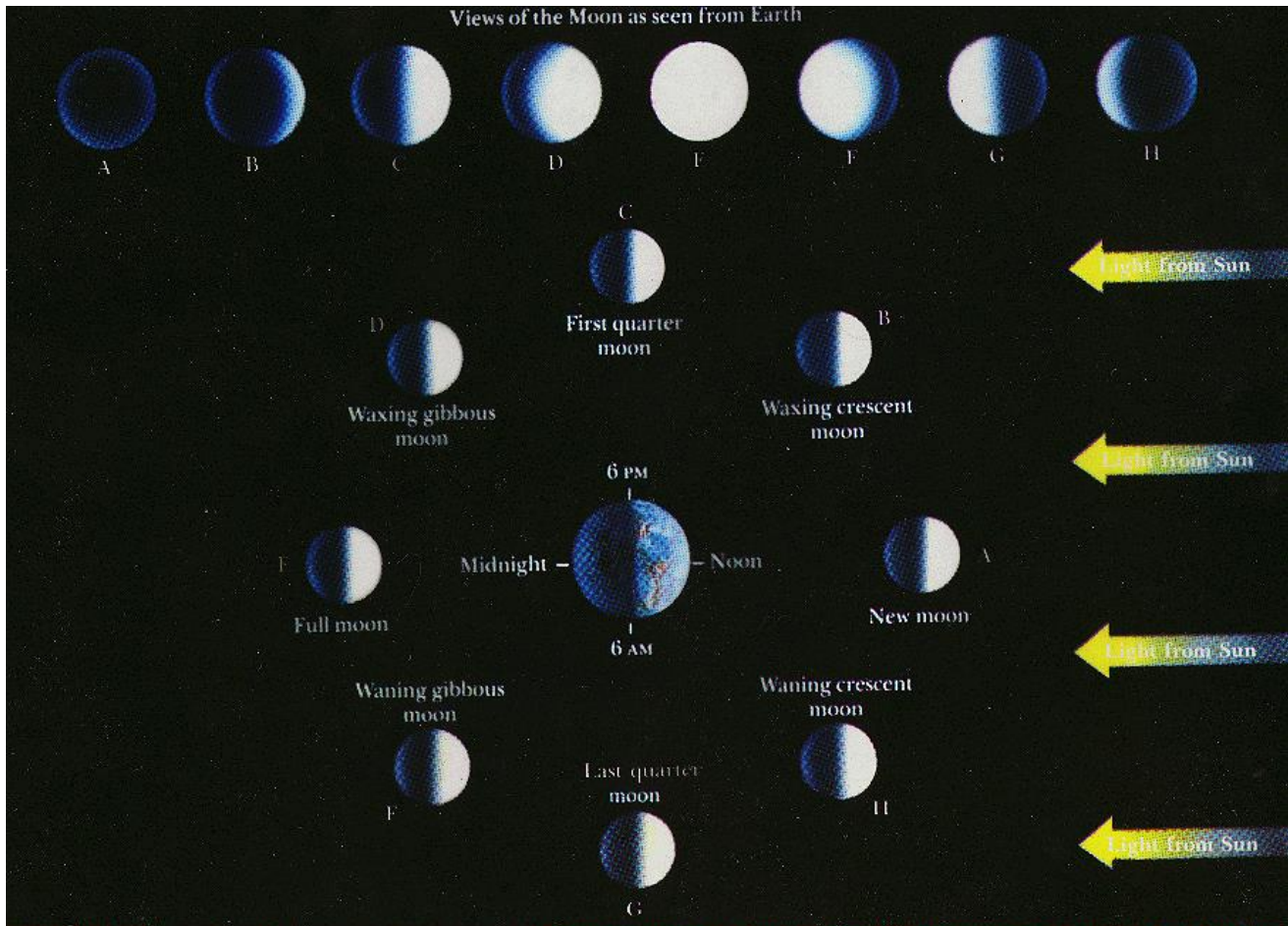
The moon is a solid ball of rock that orbits the Earth. It is around 400, 000 km above the surface of the Earth. It is much smaller than the Earth. Its gravity is only  $\frac{1}{6}$  of Earth's.

It takes the moon 28 days to orbit the earth. It also takes the moon 28 days to spin, so we only ever see one side of it. The moon ALWAYS looks the same to us!

## Phases of the Moon

Over the course of the 28 days, we don't always see a full moon. The different shapes we see are known as the **phases** of the moon.

We see the moon because the sun's light reflects off of it. Depending on the position of the sun and the moon, we'll only see a small bit of it.



It takes 14 days to go from no moon to full moon, and another 14 to go from full back to new. When the moon is getting bigger (first half of the cycle) we say it is **waxing**. When it is getting smaller we say it is **waning**.

We call this 28-day cycle a **lunar month**. There are 13 of these in a year.

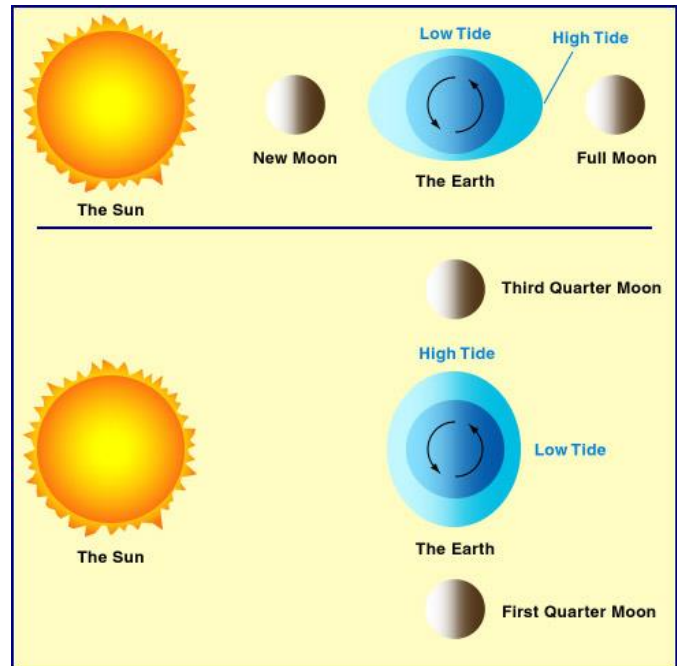
## Tides

Tides are mainly caused by the pull of the moon's gravity.

The moon pulls the water on the surface of Earth towards it. This causes a bulge under the moon, and flatter areas where water has moved away. There is another bulge at the other side of the planet too.

As the moon orbits the Earth, it drags the bulge of water with it. This means the high tide and low tide move around the planet. When it is high tide in Scotland, it will be low tide in America. The time between tides is 6 hours.

The sun's gravity also affects the water and tides, but to a much smaller degree. When the moon and sun pull in the same direction, we get higher tides than usual. When they pull at 90 degrees to each other, we get the smallest effect.



## Comets

Comets are huge balls of ice and dust. They are often called giant snowballs. They orbit the sun, but in an elliptical orbit.

When they get close to the sun, the heat causes part of the comet to melt. Huge plumes of dust and gas called a **tail** are visible from the earth. The tail always points away from the sun.

## Asteroids

Asteroids are large rocky or metallic objects orbiting the sun. They are not large enough to be called dwarf planets. There are huge areas of our solar system filled with asteroid fields.

## Meteors

Objects from space that enter our atmosphere are called **meteors**. They often burn up due to friction with the atmosphere. People often call them shooting stars. If any part of the meteor survives the journey to the ground it is called a **meteorite**