

## Forces

Forces are pushes or pulls. Forces can:

- change the shape or size of an object
- change the speed things are moving (make them move faster or slower)
- change the direction of a moving object.

The unit for measuring force is the **newton (N)**.

**Friction** is a force caused by two things rubbing together. **Air resistance** and **water resistance** are kinds of friction.

Solid things, like your chair, push up on you. Upwards forces from water or air are called **upthrust**. Things float in water because of upthrust.

**Contact forces** need to touch the thing that they are affecting. Examples of contact forces are:

- friction
- air resistance
- water resistance
- upthrust.

Some forces do not need to touch the thing that they are affecting. They are called **non-contact forces**. There are three non-contact forces:

- **magnetism**
- **gravity**
- **static electricity**.

## Weight and mass

Your **mass** is the amount of substance in your body. Your mass is measured in **kilograms (kg)**. Your weight is a force caused by gravity pulling on your body. The newton (N) is the scientific unit used to measure forces, and so it is also used as the unit for weight.

Wherever you take an object, its mass will not change but its weight depends on the force of gravity. An object on the Moon would have a smaller weight than on Earth, because the Moon's gravity is not as strong as Earth's.

On Earth, gravity pulls on every kilogram of mass with a force of 10 N.

## Friction

Friction is a contact force. Friction can:

- slow things down
- produce heat
- wear things away
- make a noise.

Friction can be increased by using rough surfaces, or by using materials such as rubber that have a lot of friction.

Friction can be reduced by using smooth surfaces, or by **lubrication**. Things like oil or grease are **lubricants**, and help things to move past each other easily.

## Density and floating

You can decide if something will float by working out its **density**. Density is the mass of a certain volume of something, and it can be calculated using this formula:

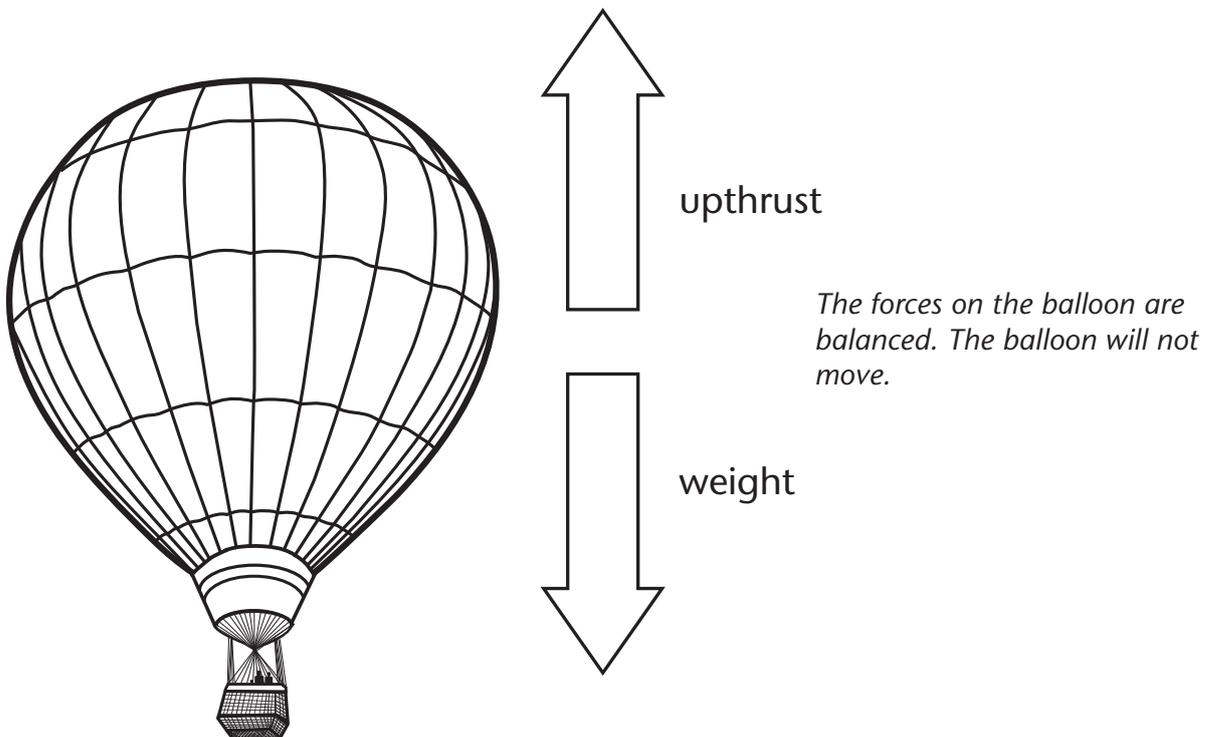
$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

The units for density are  $\text{g/cm}^3$ .

The density of water is  $1 \text{ g/cm}^3$ . If an object has a density less than  $1 \text{ g/cm}^3$ , it will float. If its density is greater, it will sink.

## Balanced forces

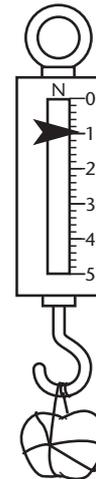
**Balanced forces** are forces that cancel each other out. Balanced forces do not change the speed that something is moving.



## Measuring forces

Elastic materials will stretch with a force and then return to their original shape when the force is taken away. Materials like Plasticine will stretch with a force but they will not return to their original shape afterwards. Plasticine is not elastic.

Springs are used to measure the size of a force because they are elastic. A big force stretches a spring further than a small force. **Force meters** have springs inside them.



*This force meter is measuring a force of 1 N*

## Speed

To measure how fast something is travelling, you need to measure the distance it travels and the time taken. Units for speed are **km/h** or **m/s** or **mph**. The unit for speed depends on the units you have used to measure the distance and the time.

## Stopping distances

A moving car takes some time to stop. The distance it travels while the driver is deciding to stop is called the **thinking distance**, and the distance it travels while it is slowing down is called the **braking distance**. If you add the two distances together you get the **stopping distance**.

Stopping distances are longer if the road is wet or icy, if the car has worn tyres or if the driver is tired or has been drinking alcohol. Stopping distances are also longer if the car is travelling faster.

## Distance–time graphs

A journey can be shown on a **distance–time graph**. This graph shows a person running, then stopping for a rest, then walking slowly. The steeper the line on the graph, the faster they are moving.

