By the end of this unit of work you should be able to

- state what a force is.
- state that force is measured in newtons (N).
- state how a force is measured.
- state that equal forces in opposite directions are called balanced forces.
- state that an object acted on by balanced forces stays still, or moves at a steady speed in a straight line.
- give an example of balanced forces.
- explain what is meant by unbalanced forces.
- calculate the size of the total force from a diagram showing two unbalanced forces.
- give an example of a situation involving unbalanced forces.
- state that an object acted on by unbalanced forces accelerates or decelerates.
- state that mass is a measure of the amount of matter in an object.
- state that mass is measured in kilograms $(\mathrm{kg})$.
- state that if an object is taken to a different planet, its mass remains the same.
- state that gravity is a force.
- state that the force of gravity pulls objects towards the centre of the Earth.
- state that the force of gravity on an object is called its weight.
- state that the weight (force of gravity) acting on each 1 kg on Earth is 10 newtons.
- calculate the weight of an object on earth, given its mass in kg.
- state that the strength of gravity is different on different planets.
- state that the strength of gravity on the Moon is less than on Earth.
- explain why an object weighs less on the Moon than on Earth.


## What is a Force?

Simple forces include push, pull, turn, stretch, squeeze.
A force can change an object's

- speed,
- direction of movement
- shape

A spring balance or Newton balance can be used to measure the size of a force. Forces are measured in newtons ( $\mathbf{N}$ ).

## Balanced forces

Sometimes more than one force can be applied to the same object. If these forces are the same size but in opposite directions, they can "cancel out." The forces are then said to be balanced (e.g. two equal teams in a tug o' war).


When the forces acting on an object are balanced, the object will either

- Not be moving or
- Moving at a steady speed in a straight line.
(This is known as Newton's First Law.)


## Unbalanced forces

If two forces acting on an object are not equal and opposite, then we say these forces are unbalanced.


The unbalanced force is 150 N to the right.
If the forces are unbalanced, the object speeds up or slows down.

## Mass and Weight

The mass ( $m$ ) of an object is a measure of how much matter there is in the object. This is measured in kilograms (kg) and is constant no matter where an object is. Your mass would be the same on the moon as it is on Earth.

The weight (W) of an object is a measure of the force of a planet's gravity on that object. Because it is a force, weight will be measured in newtons. Your weight changes when you go to different planets.

The gravitational field strength $(\mathrm{g})$ is the number of newtons pulling on each kilogram. On earth $g=10 \mathrm{~N} / \mathrm{kg}$, on the moon $\mathrm{g}=1.6 \mathrm{~N} / \mathrm{kg}$ on Jupiter $g=26 \mathrm{~N} / \mathrm{kg}$.

The weight (W) of an object can be calculated using the formula

```
W = mg
```

The weight on Earth of a 50 kg girl would be $\mathrm{W}=50 \times 10=500 \mathrm{~N}$
On Jupiter her weight would be $W=50 \times 26=1300 \mathrm{~N}$

## Friction

Friction is a force which always tries to slow things down, or stop them moving. Sometimes friction is useful, for example in the brakes on a car, or the soles of your shoes.

If you want to move fast, friction can be a problem. It slows you down, and can cause heat to be produced.

Here are some ways that friction can be reduced:

- Wheels
- Ball bearings
- Oil or other lubrication
- A layer of air, like in air hockey or a hovercraft.
- Streamlining (making something aerodynamic).


## Calculating Speed

You can calculate the speed of an object by using the formula speed = distance time

