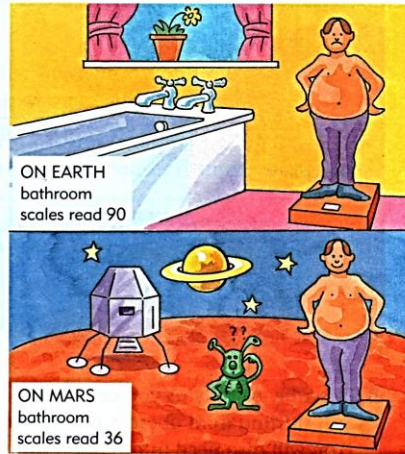# Lose weight – become an astronaut

Now that Malcolm is older, he isn't so active and he has started to put on weight. Malcolm wants to lose weight. He reads in a magazine that people weigh less on Mars. He wishes he could go there.

Though Malcolm would weigh less on Mars, his body is still exactly the same. There is just as much of him. He still has exactly the same **mass**.

What is mass?

Mass tells you how much there is of something. A 10 kg bag of potatoes contains twice as much potato as a 5 kg bag, so it has twice the mass. We measure the mass of things in **kilograms** (kg).

1 Malcolm says his weight is 90 kg. This is wrong. What should he say?

What is weight?

When you drop something it falls downwards. That is because the force of gravity pulls it. The size of this force on an object is called **weight**. Objects with more mass have more weight. That is because there is more mass for the force of gravity to act on. We measure forces in **newtons**.

2 (a) What is the force that causes weight?
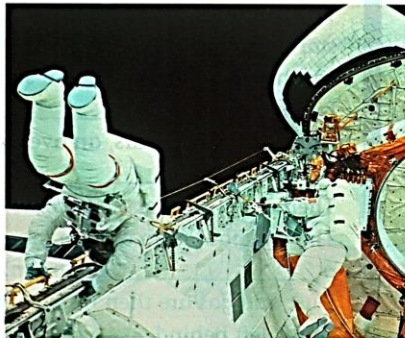
(b) In which direction does this force act?

3 Copy and complete the following sentence.

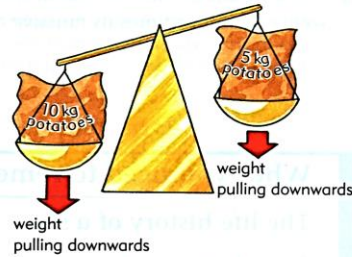Weight is a _____ so we should measure it in _____.

What's the difference?

If two objects are in the same place, the one with more mass also has more weight. But mass and weight aren't the same thing. You will have the same mass wherever you are because you have the same amount of body. Your weight might not always be the same.

4 Look at the picture of astronauts. How much do the astronauts weigh? Explain your answer.

ON EARTH
bathroom
scales read 90

ON MARS
bathroom
scales read 36

weight
pulling downwards

weight
pulling downwards

More mass means more weight.

In space the force of gravity can be very, very small …

… so astronauts have hardly any weight.

5 Copy and complete the following sentences.

The _____ of an object stays the same, unless you take some of it away. The _____ of an object can change if the force of _____ is different.

Working out weight

Weight depends on how much mass an object has. It also depends on the force of gravity. The diagrams show the weights of two objects on Earth.
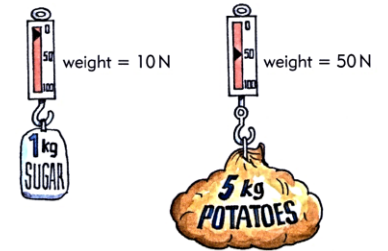
6 Copy and complete the following sentence.

On Earth, each 1 kilogram of mass has a weight of about _____ newtons.

We say that Earth's force of gravity is **10** newtons per kilogram (10 N/kg). We can work out the weight of an object as follows:

$$\frac{\text{weight}}{\text{(newtons)}} = \frac{\text{mass}}{\text{(kilograms)}} \times \frac{\text{force of gravity}}{\text{(newtons per kilogram)}}$$

7 Look at the examples in the pictures and work out the missing numbers.

Malcolm goes planet hopping

Malcolm has a mass of 90 kg. On Earth the force of gravity is **10** N/kg. Therefore, his weight is 90 × 10 = 900 N.

8 Copy the table. Complete the table to show how Malcolm's weight would change in different parts of the solar system.

weight = 10 N

weight = 50 N

1 kg SUGAR

5 kg POTATOES

mass = 6 kg
weight = ?

mass = 60 kg
weight = ?

mass = 0.5 kg
weight = ?

mass = ? kg
weight = 12 000 N

	Malcolm's mass (kg)	Force of gravity (N/kg)	Malcolm's weight (N)
Earth	90	10	900
Moon	90	1.6	
Mars		4	
Jupiter		23	

What you need to remember [Copy and complete using the **key words**]

Lose weight – become an astronaut

An object always has the same _____. We measure this in _____.

The _____ of an object is the force of gravity that acts on it. We measure this in _____.

On Earth the force of gravity is about _____ N/kg.

We can work out weights like this:

$$\frac{\text{weight}}{\text{(_____)}} = \frac{\text{_____}}{\text{(kilograms)}} \times \frac{\text{force of gravity}}{\text{(_____ per _____)}}$$