Are plants alive?

Key stage 1

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All living things do the four life processes

- **Movement** – plant leaves move towards light
- **Reproduction** – plants produce babies (seeds)
- **Nutrition** - plants use the sun's energy to make food
- **Growth** – plants are always growing

Activity

Can you think of anything that is alive?

Can you think of anything not alive?

Can you think of anything that was once alive but that is not alive now?

Can you think of anything that has never been alive?

Do plants need to eat, drink and breathe to grow?

Eating

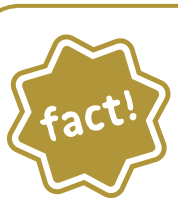
Plants are unable to move to find food, so they have developed a specialised system of creating their own food from sunlight. This is called **photosynthesis**. The sunlight is trapped in the leaves by a chemical that makes the plant look green.

Breathing

Plants take in oxygen from the soil and surrounding air, and the leaves take in carbon dioxide for photosynthesis. This is breathing, but without lungs.

Drinking

Plant roots take up water from the soil, which is a sort of drinking. Chemicals are also dissolved in the water. The plant needs these for growth, but is unable to make them itself. The plant has a circulatory system, which carries water from the roots to all the other parts of the plant.

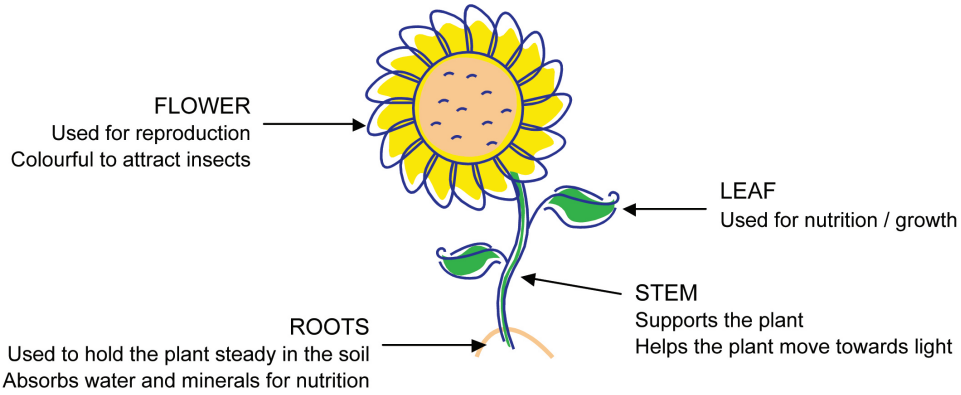


Plants make a very large contribution to the oxygen we breathe every day – if it wasn't for them we would all suffocate!

Do Plants need anything else to grow?

Plants need **sunlight** to create their food and **soil,** to help them take up nutrients, and to anchor the roots to stop them falling over!

Do you know the names for the parts of a plant ?



Activity

- Get children to draw and label a plant diagram
- Then get children to add to the diagram showing environmental factors which the plants also need to grow.

Further work

1. Grow plants with different environmental factors missing and record how this affects growth. *ie* With light, without light. With water, without water.
2. Discuss which parts of the plant we eat

Does a plant need water to grow?

Method A - Plant 2 seeds, water one pot (labelled A) and leave the other dry (labelled B). Keep the pots on a sunny windowsill and monitor to check if they both grow after 2 weeks (you may need to water pot A again during this time).

Method B – Use living plants making sure they are both the same type and similar sizes. Only water one of them, observe what happens to the plants over a month. You can also show that a plant given too much water will die by watering a third plant with so much water that it is always stood in water.

Does a plant need sunlight to grow?

You will need 2 identical plants, place 1 on a sunny windowsill and place 1 on the same windowsill but cover it with a light proof box. Ensure both plants are watered the same amount but ensure that the plant in the box gets no sunlight. Observe what has happened to the plant kept in the dark... is it a healthy looking plant?

Does a plant move?

Method A -Take 2 identical plants and place them on a windowsill. Take 2 light proof boxes and cut a hole on the right hand side of one and on the left hand side of the other – this is the light source for the plant. Place the boxes over the plants ensuring each plant has only one source of light available. Observe whether the plants in the boxes move towards the light source.

Method B - Grow a few pea plants in pots. Once they are growing healthily you will see that 'tendrils' will appear (they are like green hairs) the plant will use these to help it climb. Once the tendrils are seen place a small stick next to the plant and place the tendril on the stick, leave overnight and observe in the morning – has the plant tendril wrapped tightly around the stick?

Capillary action and surface tension

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Capillary action – how water travels by pulling itself up tiny tubes

Capillary action helps explain the ability of water to climb, and also to spread along / through surfaces. Water molecules spread a thin film by leapfrogging over one another and then clinging to the surface of the substance over which they are moving.

In plants, water molecules move through narrow tubes that are equivalent to our veins

In soil, water will also move long distances by spreading its moist film from particle to particle.

- Plants and trees couldn't survive without capillary action. It allows water to travel from the roots of a tree up its long trunk and into the leaves. In some cases the water will have climbed up to 50 metres above ground level.
- Capillary action also explains how water wets many materials. When you use a towel to get dry, the water is travelling from your skin up into the fibres of the towel.

Surface tension

Surface tension is a measure of the strength of the water's surface. The attraction between the water molecules creates a strong film. This film permits water to hold up substances heavier and denser than itself.

- Surface tension determines the shape of this water droplet.
- Some aquatic insects, such as the pond skater, rely on surface tension to walk on water. Without it they would sink.

Capillary action and surface tension working together

When you spill your glass of squash (which is, of course, mostly water) on the kitchen table you rush to get a paper towel to wipe it up.

First, you can thank surface tension, which keeps the liquid in a nice puddle on the table, instead of a thin film that spreads out and drips onto the floor.

When you put the paper towel onto the spilled drink the liquid moves to the spaces between and inside the paper fibers by capillary action.

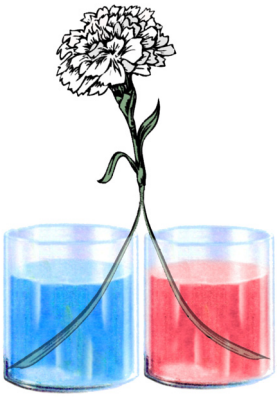
Experiments demonstrating capillary action

Coloured celery veins

Place a stalk of celery in a glass of water that has been coloured with food coloring. You might want to use a piece of celery that has begun to wilt, as it is in need of a quick drink.

Leave for an hour.

If you look at the cut end of the celery then you will see how the coloured liquid has entered the veins. If you measure and slice the celery further up the stalk you can work out how far the liquid has travelled.

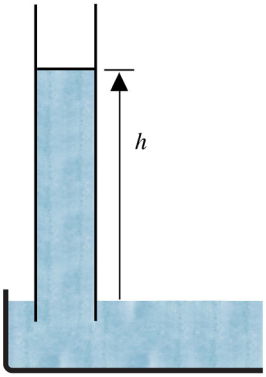


Coloured carnations

Take a white carnation. Ask an adult to carefully split the stem with a sharp knife.

Put each half into a different glass of colored water. Leave for an hour.

When you return the flower should have started to change colour as the dye has travelled up through the carnation stem into the flower petals.



Capillary action using narrow tubes

Another example of capillary action can be observed by looking at water in a thin glass tube (a test tube or tall, thin drinking glass will do). Place the glass in a vessel of water (washing up bowl). Watch how the water travels up the inside of the glass.

The molecules at the edge reach for – and stick to – the molecules of the glass just above them. At the same time they tow other water molecules along with them.

At the same time, the water surface pulls the entire body of water to a new level. This happens until the downward force of gravity is too great to overcome and the water stops ‘climbing’.

Carrying out experiments

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Stages to remember

Can you think of any experiments that you have already carried out?

When carrying out an experiment there are a number of stages that you should consider:

- **Aim**
  What are you trying to find out?

- **Prediction**
  What do you think will happen?

- **Is the experiment a fair test?**
  In the experiment what thing will you alter and what will you keep the same.

- **Measurements and observations** (results)
  Collect your measurements and observations together in a results table.

- **Displaying results**
  Sometimes it is easier to see the results in a graph or chart.

- **Conclusions**
  What have you learned? Did your prediction came true or not?

Earthworms

The gardener's friend

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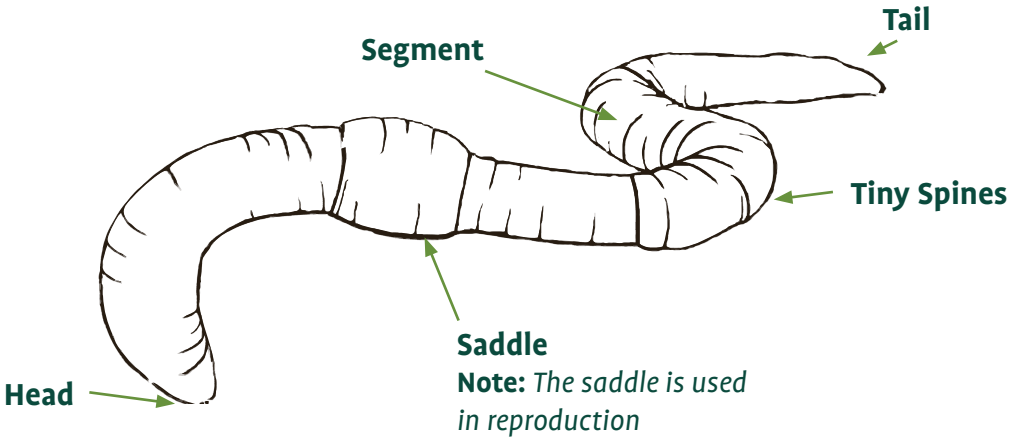
Worm Facts

- Worms evolved 300 million years before the dinosaurs, and there are almost 2,000 different species of earthworm in the world!
- Worms are invertebrates. This means that they have no backbone or internal skeleton.
- They can live for up to 10 years.
- Worms can regenerate. But a worm chopped in half will not re-grow into two worms. Usually it's only the head end that lives on.
- Earthworms in the UK tend to grow to a maximum of 30 cm, but giant earthworms in Australia and Africa can grow up to 4 m long!
- Earthworms eat dead plant matter in the soil. They will also travel to the surface and pull bits of leaf and other plant matter down into the soil to compost underground.
- As earthworms move through the soil they create tunnels, which help plant roots to breathe and also allow for water to drain away. They also fertilise the soil with their poo! Their poo is known as *wormcasts*.
- They are also useful in other ways, as many birds, insects and mammals eat these juicy invertebrates for their dinner!



How do worms move?

- Earthworm bodies are divided into small pieces (segments), with a head at one end and a tail at the other. The worm's flesh is mostly muscle and it moves by contracting (squeezing and shrinking) and stretching its body.
- Worms feel slimy because they make a substance that keeps their skin wet and helps them to move through tunnels that they create in the soil.
- Each piece of the earthworm is covered in tiny hooked spines that help it to move through the soil. If you gently run your hand along the worm from the tail to the head you will feel them!

Worm experiments

Observing the worm

Spend some time watching a worm move and see if you can see it contracting and stretching. Try and measure the worm when stretched for a maximum length, and when not in motion for a minimum length. Stroke the worm to identify the head and tail ends.

Discuss how the worm moves through the soil using muscles and spines.

How many worms?

Make up a solution of weak soapy water in a large watering can and pour this solution onto a one square metre area of lawn. Count how many worms come to the surface to avoid the water logging.

You can then calculate how many worms there are likely to be in a particular area.

Further work

Make a wormery to see how worms move soil

You will need

- Large jam jar or plastic bottle
- Various soils, leaves and sand
- Some worms!

1. Clean your jam jar or plastic bottle. Remove the narrow neck of the bottle to make it easier to fill.
2. Begin to fill your container to about three-quarters full with 2 cm thick layers of compost, then sand and then leaf matter. Repeat until nearly full. Add a small amount of water to make the soil damp and top up with leaves.
3. Dig up some worms and add to the wormery.
4. Cover the bottle or jar with a cloth and store it in a cool dark place. After a few days you will begin to see the layers mixing together and may even see some worm tunnels and casts. Watch and see how the worms mix up the layers.
5. Once the experiment is complete return the worms to your vegetable garden or compost bin.

Germination

What happens when a seed begins to grow?

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Seeds

A seed is a protected package produced by flowering plants. Seeds help plants to propagate (make more plants), but they can also help the plant survive unfavorable conditions, like a freezing winter.

A typical seed consists of three main parts:

1. The **seed coat** protects the contents against drying out, infection and attack by predators. It may also have hooks or other structures that attach the seed to passing animals, which means that it can be distributed more easily.
2. Within the seed coat is the **embryo**. It already contains a root tip, stem tip, and specialised seed leaves called cotyledons.
3. Between these two structures lies the **stored food** that the embryo digests and uses as an energy source when it starts to grow. Sometimes, as in beans, the stored food is in the cotyledons of the embryo rather than in separate endosperm cells.

Did you know?

- Some seeds require a period of dormancy (rest) before they can germinate (sprout and grow).
- Some seeds need to pass through the gut of an animal, or sometimes exposure to extreme temperatures (fire or repeated freeze-thaw) to germinate.
- Some seeds can remain dormant for hundreds of years and still germinate when the conditions are right.

What conditions are needed for a seed to begin growth?

Seeds remain dormant or inactive until conditions are right for germination. Every variety of seed requires a different set of conditions for successful germination. Though this depends greatly on the individual seed variety, but in general all seeds need:

- **Water**
- **Oxygen**
- **Correct temperature**
- **Light**

Water

Germination requires moist conditions. The water works in two ways:

1. Mature seeds are typically extremely dry and need to take up lots of water before the seed begins to swell, cracking the seed coat.
2. Water is also required to break down the food store in the seed, which allows it to germinate and grow non-photosynthetically (without light) until it reaches the light. Once the seedling starts growing, it requires a continuous supply of water and nutrients.

Oxygen

Oxygen is available to the seed from within the compost. If the soil is waterlogged, it might cut off the necessary oxygen supply and prevent the seed from germinating. Once the seed coat is cracked, the germinating seedling requires oxygen for its metabolism (using the nutrients to grow).

Temperature

Seeds germinate over a wide range of temperatures. Many prefer temperatures slightly higher than room-temperature (peppers and tomatoes). Often, seeds have a set temperature range for germination and will not germinate above or below a certain temperature.

Light

In addition, some seeds may require exposure to light before they can germinate.

Watch a seed grow into a seedling

Germination

When a seed is exposed to the correct conditions, water and oxygen are taken in through the seed coat. The embryo's cells start to enlarge. Then the seed coat breaks open and a root emerges first, followed by the shoot that contains the leaves and stem.

Establishment

The first leaves that you see growing are actually not leaves. They are the seed leaves, or cotyledons (food reserves contained in the seed). During establishment, the seedling is not carrying out photosynthesis (capturing energy from sunlight to convert into food). It is just using the reserves of energy from inside the seed.

Growth

Once the seedling gets its first true leaves (not the cotyledons) it can create its own energy through photosynthesis. At this point the seedling is beginning its lifecycle.

Activity

1. Germinate some seeds on tissue paper so that you can see the seed coat break open and the root and stem emerge.
2. Try altering the conditions required for germination: water, temperature and light. See if this affects how many seeds germinate.
3. Grow a seed in a jam jar using paper to support the seed against the walls of the jar instead of compost. Then you will be able to view the seedling growing. By placing cotton wool in the centre of the jar it will help support the paper and seedling.

How plants grow

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Why?

To grow, plants need:

- Light (from the sun or artificial light),
- water (not too much otherwise it will rot),
- warmth (not too hot as may scorch, not too cold as many will not grow),
- air (they take carbon dioxide from the air to grow),
- a growing medium (to act as an anchor for the plant roots. Most often this is compost or soil, but it can be materials such as cotton wool for quick growing seeds),
- and a bit of care and attention.

How?

Materials:

- 4 small clear pots, such as plastic yoghurt pots or cups.
- A packet of quick growing seed, such as mustard or cress.
- Paper towels or cotton wool and a watering can or water bottle.
- A tray on which to stand pots, as well as clingfilm.
- Windowsill on which to grow the seeds, then somewhere dark for one pot and somewhere very cold (such as a freezer) if possible.

Do it!

1. Grow four pots of mustard and cress – see the *growit/cookit* mustard and cress worksheet for guidance on how to do this. If your time is constrained, then pots of mustard and cress can be easily be purchased from the supermarkets and other shops.
2. After 1-2 weeks, when the seedlings are about 2 cm tall:

a Pot 1 – keep on a windowsill and keep watered.

b Pot 2 – put in a box and put in a very dark place

c Pot 3 – put somewhere very cold, ideally a freezer.

d Pot 4 – leave on the windowsill, but do not water.

3. After a few days you should find that Pot 1 is still growing well, but all the other pots are dying or have died completely.

This will illustrate how plants need light, water, warmth and a growing media in which to grow.

Curriculum links

Key Stage 1
Science: SC2 – Green plants.
Citizenship: taking responsibility, nurturing / caring, understanding the needs of living things.

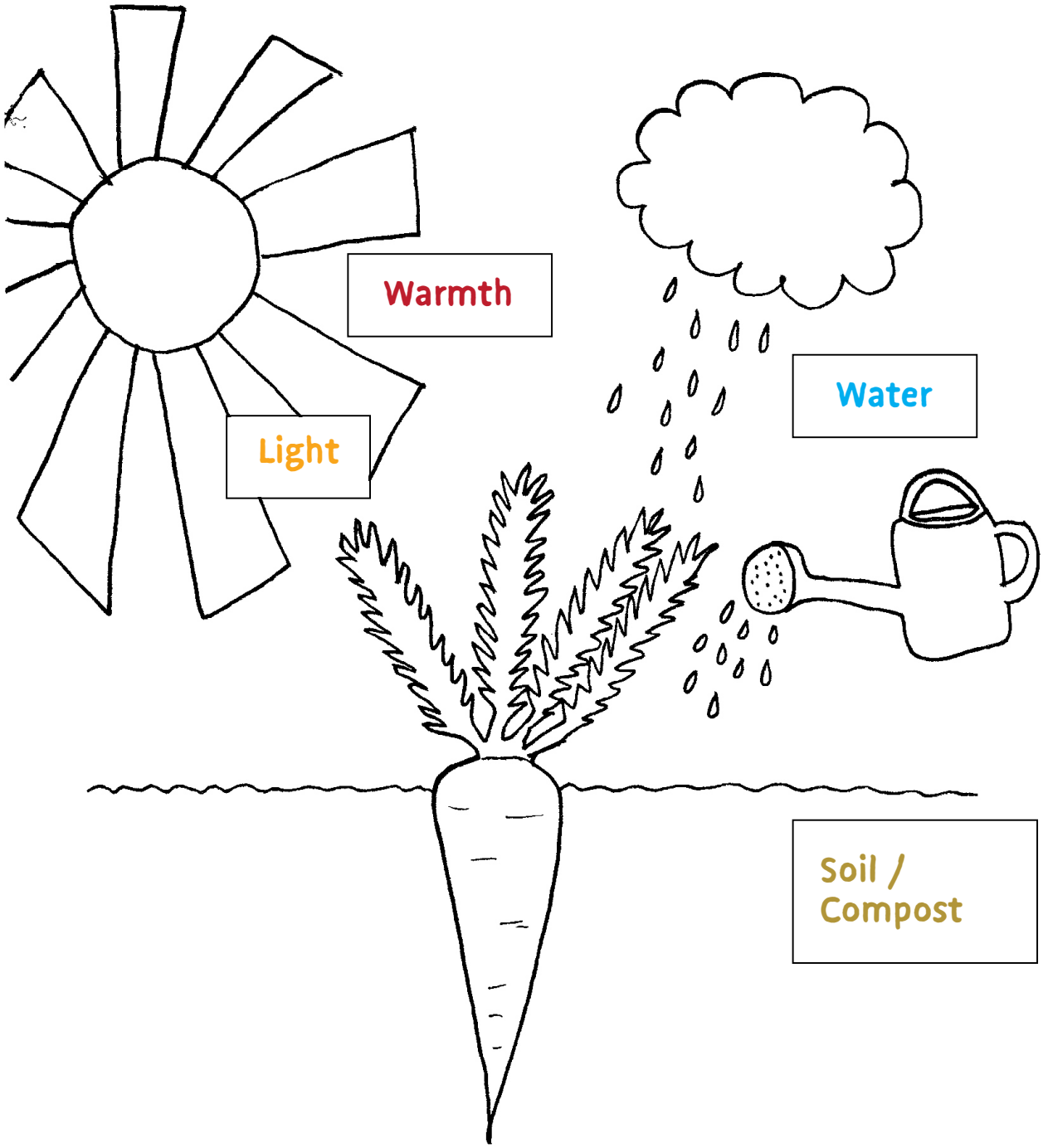
Key Stage 2
Science: SC2 – Green plants.
Citizenship: taking responsibility, nurturing / caring, understanding the needs of living things.

Extension: Art
The picture overleaf can be copied and used for Key Stage 1 pupils to colour in.

Key Stage 2 pupils could produce their own pictures to illustrate what plants need to grow.

What plants need to grow

Air – Carbon Dioxide



Name .....

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Mustard and cress

How plants grow part 2

Key stage 1
Science: SC2 – Green plants.

Citizenship: taking responsibility, nurturing /caring, understanding the needs of living things.

Key stage 2
Science: SC2 – Green plants. Maths: Ma4 – Handling data

Citizenship: taking responsibility, nurturing /caring, understanding the needs of living things illustrate what plants need to grow

Why?

To grow plants need: Light, water, warmth, a growing medium and a bit of care and attention.

How?

Materials

1 Clear pots (such as plastic yoghurt pots /cups).

2 Packets of quick growing seed such as mustard or cress.

3 Paper towels/ cotton wool. Watering can / sprayers.

4 Clingfilm. Elastic bands. Recording Sheet (see overleaf)

Do it!

1 Fill the pots with dampened and scrunched up paper towels, leave a gap of 2cm from top of pot. Put a thin layer of cotton wool on top of the paper towels, water so damp but no excess of water in pot.

2 Sprinkle the seeds onto the surface of the cotton wool. This can be done by putting a small amount of seed (size of a 10p) into the palm of the hand and then gently tapping on the side of the hand so that the seeds are distributed evenly over the surface.

3 Cover the pots with cling film as it helps to keep the moisture in.

4 Get the pupils to write their names on the recording sheet and attach to the pot with an elastic band.

5 Pupils can either keep the pots in class to monitor and record or they can take them home to do as a homework exercise.

6 The pots should be stood in a warm spot on a window sill.

7 Every day check that the cotton wool is damp, if it feels dry water carefully.

8 The pots should be checked for signs of growth every day. After 5–10 days (depending on growing conditions) the roots should start to break through the seed coat.

9 A magnifying glass may help pupils to see the roots appearing.

10 A few days later the seed leaves will appear and the seedlings will grow.

11 When the seeds start to grow should be recorded on the sheet by ticking in the box (Key stage 2).

12 After 2–3 weeks pupils should have a good crop of mustard /cress. A taste test should be done with a family member or friend and the pupil should record what they said. Pupils could compare their growing and taste test results in class.

Mustard and cress recording sheets (Key stage 1)

Name	Taste test

Instructions

- Put your mustard and cress in a warm, light place indoors.
- Everyday check if the cotton wool is still damp, if it feels dry water carefully.
- Once the leaves appear take the cling film off the pot.
- Have a taste test of your crop with a member of your family or friend.
- Write what you both thought in the box above.
- Bring your slip back to school when completed.

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Mustard and cress recording sheets (Key stage 2)

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- Write what you both thought in the box above.
- Bring your slip back to school when completed.

Week 1	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Sown							
Water?							
Roots							
Leaves							
Week 2	**Day 8**	**Day 9**	**Day 10**	**Day 11**	**Day 12**	**Day 13**	**Day 14**
Water?							
Roots							
Leaves							

Name	Taste test

Instructions

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Leaves							
Week 2	**Day 8**	**Day 9**	**Day 10**	**Day 11**	**Day 12**	**Day 13**	**Day 14**
Water?							
Roots							
Leaves							

Water: where does it come from?

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Water facts

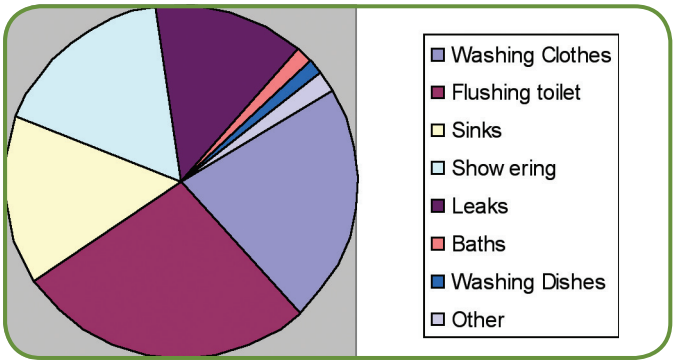
Water is essential to life on earth. We need water to grow food, keep clean, provide power, control fire, and last but not least, we need it to stay alive!

Did you know?

- A person can live about a month without food, but can live only about 1 week without water.
- Water can change states. It can be a liquid, a gas, or a solid (ice).
- We cannot create new water. All the water in our world is the same water that was around when the dinosaurs were alive 100 million years ago.

Total water	%
Oceans	97
Ice-caps & glaciers	2
Groundwater	0.7
Lakes, streams & rivers	0.01
Soil moisture	0.005
Atmosphere	0.0001

How do you use water at home?



To provide enough clean fresh water for people, water is cleaned at drinking water treatment plants before it is used.

And after water is used, it is cleaned again at waste water treatment plants before being put back into the environment.

Ways to save water

Question If water is constantly being cleaned and recycled through both the earth's natural water cycle and water treatment works, why do we need to conserve it?

Answer People use up our planet's fresh water faster than it can naturally be replenished.

At school and at home, you can help protect our water resources.

- Turn off the tap in your bathroom while you brush your teeth. This can save up to 5 litres a minute! If the entire adult population of England and Wales did this, we could save ***180 million*** litres a day, enough to supply nearly 500,000 houses.
- Take shorter showers. Get a timer and time yourself.
- Fill a jug or bottle with tap water and put it in the fridge, rather than running the tap every time you want a cold drink!
- Collect rainwater in water-butts and use a watering can instead of a hose to water the garden.