KS2 Outdoor Science Opportunities

For pupils in or working at KS2 level

How to use these resources

These activities can be as quick or extended as you choose. They can be used as starters, main activities, plenaries, revision lessons or intervention sessions.

The aim of these slides is to provide practical ideas to take curriculum science learning outside the classroom.

Please take and adapt these ideas in any way that suits you and your class. You may need to tweak an activity to suit the needs or numbers of your cohort, or you might see an idea for a different area that you feel would work in your current topic. The hope is that there is the flexibility to make the resources work for you.



Contents

⇒ Plants
(Year 3)

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(Year 3 / Year 4 / Year 5 / Year 6)

⇒ Materials and States of Matter
(Year 4 / Year 5)

⇒ Living Things and their Habitats
(Year 4 / Year 5 / Year 6)

⇒ Rocks, Soils and Fossils
(Year 3)

⇒ Light
(Year 3 / Year 6)

⇒ Sound
(Year 4)

⇒ Electricity
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⇒ Forces and Magnets
(Year 3 / Year 5)

⇒ Earth and Space
(Year 5)

⇒ Evolution and Inheritance
(Year 6)

Plants

- Year 3

Plant identification

Task pupils with finding and identifying as many plants as they can around the school grounds.

Which of these are pollinators? Depending on the season, can pupils find evidence of this?

Can they identify whether trees are deciduous or evergreen based on the trees' shape and/or its leaves?



Links to ID sheets available here

N.C. statement: identify and describe the functions of different parts of flowering plants: roots, stem/trunk, leaves and flowers (Year 3)

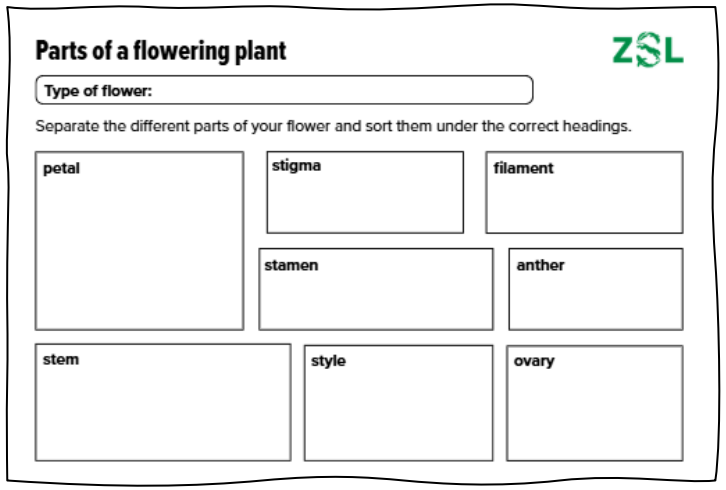
Parts of a plant

Allow pupils the chance to put their learning into practice by ‘dissecting’ a flower and identifying the different parts.

You may have appropriate flowering plants on site to use for this activity; otherwise, cheap bunches (with enough flowers for 1 between 2 pupils) will be required. Tulips, daffodils or alstroemerias are good choices for flowers with easily identifiable parts.

Pupils could draw and label images of the different parts on their sorting mats or use these to label pre-made diagrams.




Parts of a flowering plant

Type of flower:

Separate the different parts of your flower and sort them under the correct headings.

petal | stigma | filament | stamen | anther | stem | style | ovary

Sorting mat available here

N.C. statement: identify and describe the functions of different parts of flowering plants: roots, stem/trunk, leaves and flowers (Year 3)

Growing conditions

Ask pupils to investigate which locations in your outdoor area provide good conditions for plants to grow. Are there any plants already established to support their reasoning?



Ask each group to choose a spot in your outdoor area to plant a juvenile or mature plant. Groups are responsible for thinking about factors such as space to grow and how often/how much to water their plant. At the end of the project, which plant has been most successful? How important was the choice of location?

Alternatively, put all the plants in a similar location, but each group will deprive their plant of one of the requirements needed for growth. (Place a container over one of the plants to reduce the air it receives and ensure one is in a shaded spot with as little light as possible – discuss during your conclusion why these measures aren't foolproof and the limits of school-based experiments!)

At the end of the investigation, compare the plants and ask pupils to decide which requirement they think is the most vital for plant health and survival, using the results of the investigation to support their reasoning.

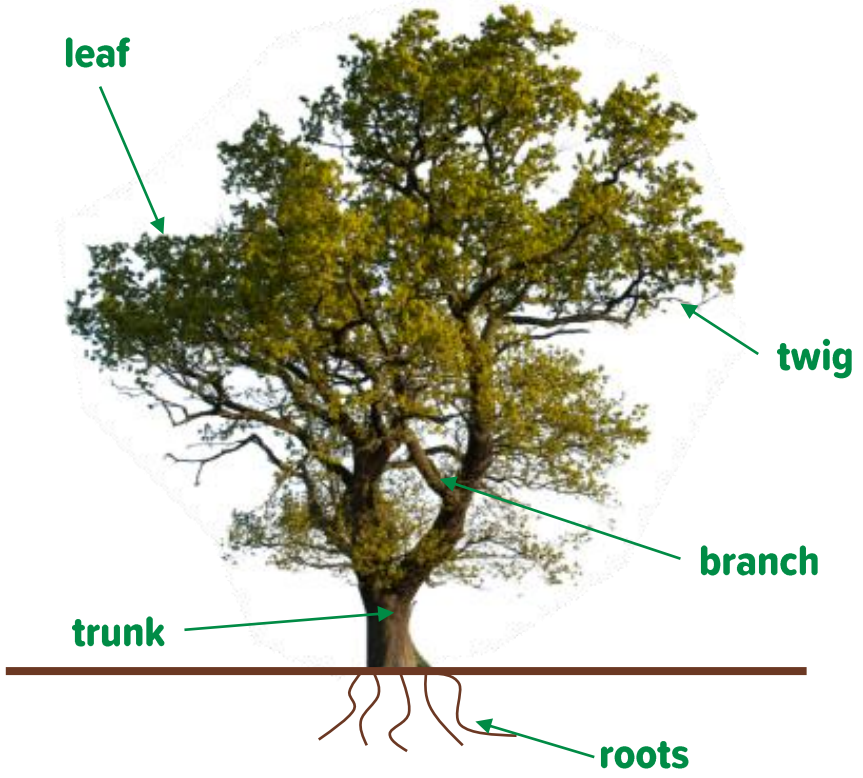
N.C. statement: explore the requirements of plants for life and growth (air, light, water, nutrients from soil, and room to grow) and how they vary from plant to plant (Year 3)

Tree functions

Explore a variety of trees around the school site and identify the different parts on each: roots, trunk, branches, leaves, flowers, plus anything else pupils may notice.

Sort the class into groups and encourage them to act out – in a manner of their choosing! – the functions of the different parts of the tree. Encourage them to explain how these link together to keep the tree alive and healthy.

You may also undertake activities like bark and leaf rubbings, or create a diagram using bark, twigs and other materials that pupils can find around your site that have fallen off the trees.



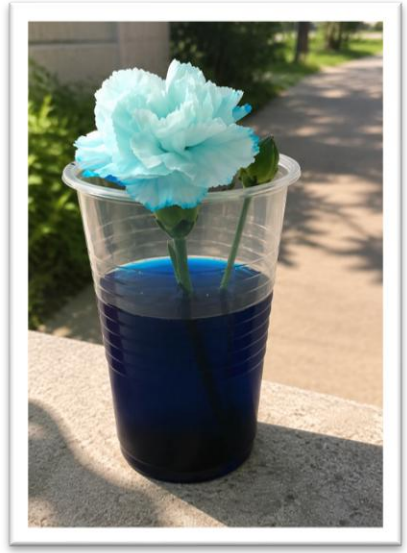
Tree functionality cards available here

N.C. statement: identify and describe the functions of different parts of flowering plants: roots, stem/trunk, leaves and flowers (Year 3)

Water transportation

The more time you can spare for this investigation, the better.

Start by filling two clear containers or cups with water and some food colouring. Put a stem(s) into each container. White flowers such as alstroemeria, carnations, daisies or gladioli work best. Ensure you have trimmed a small portion of the stems.



As a class, decide on a cold location and a warm location around your school site. Ideally, these will be a shaded area that does not get much sunlight throughout the main part of the day and an exposed area.

Ask pupils to predict what might happen to the flowers over the course of the day. Check on both examples every few hours to see if any colour streaks have started to appear.

At the end of the investigation, compare the flowers from the two locations. What do pupils notice? Hopefully, there will be more change in the flower(s) from the warmer location due to enhanced transpiration.

To allow pupils to further observe how the process works, split open the stems with a sharp blade to see the originally colourless ‘tubes’ that transport water running through the plants.

N.C. statement: investigate the way in which water is transported within plants (Year 3)

Seed hunt

Take pupils on a walk around your school site to find and collect examples of seeds. You may want to support pupils with an ID sheet while doing this.

Allow time to study the size, shape, texture and general appearance of the different types of seeds found, using magnifying glasses if these are available.

Working in groups, ask pupils to first sort the seeds using their own classifications – this could be linked to an observable characteristic or based on the type of plants the seeds have come from, for example. Then ask them to sort the seeds into groups based on how they might travel.

Use pupils' ideas to introduce seed formation and dispersal. Can they spot how certain seeds have arrived in different locations?







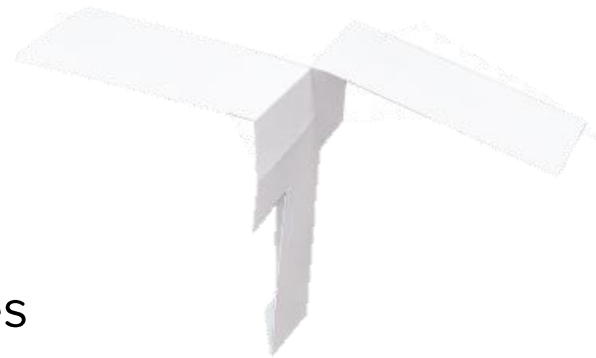


Links to ID sheets available here

N.C. statement: explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal (Year 3)

Methods of seed dispersal

The following ideas to practically investigate methods of seed dispersal could be done separately or run as a carousel:



1) Wind dispersal

This is a simple activity that allows pupils to consider the benefits of wind dispersal for certain seeds.

Provide pupils with a template for a paper seed helicopter (several examples are available online) and follow the directions for construction.

Take pupils outside to drop their helicopter seeds – from a height if possible. Encourage them to observe the spinning action and consider how this helps seeds to travel further.

This activity could be extended into a larger investigation by getting groups to experiment with different wings on their paper helicopters: either different shapes or different lengths. Pupils could record the time it takes for each helicopter seed to reach the ground and use their results to draw conclusions about which size/shape of wing is best for effective seed dispersal.

N.C. statement: explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal (Year 3)

Methods of seed dispersal

2) Explosion

Tie the end of a balloon and cut its top off. Attach this to a paper cup that has also had the bottom cut off, and secure in place with tape or an elastic band.

Fill the cup with natural loose parts from your outdoor area, or light items such as pom poms/small balls of scrap paper.

Hold the cup in the air, pull back the tied end of the balloon, and release: the objects inside the cup should shoot out like exploding seeds!

Pupils could try holding the cup at different angles to investigate how far they can spread the seeds.



N.C. statement: explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal (Year 3)

Methods of seed dispersal

3) Gravity



To add a hands-on approach to this sequence, get pupils to work together to make seed bombs (ideally outside as it can get messy!) and take charge of their own seed dispersals.

BBC Bitesize has a clear set of instructions and equipment needed: **Make your own Green Planet inspired seed balls**

Once made, pupils can throw their seed balls into free patches of soil.

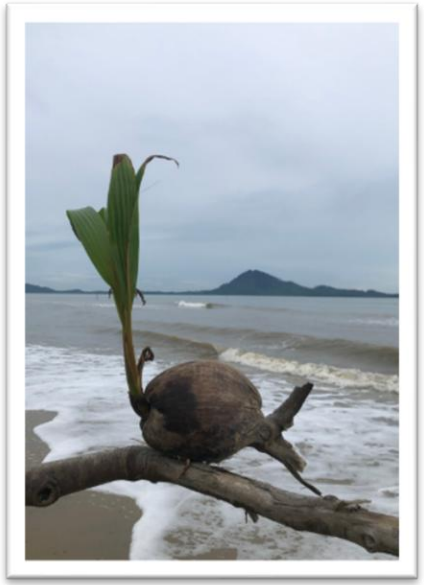
Discuss as a class which types of seeds rely on gravity for dispersal and why it is important they don't land too close to the parent plant. This is the same for the seed bombs: ensure they have enough space between them to support healthy growth!

Perhaps there are some examples to find around your site of seeds that have dropped as a result of gravity (e.g. horse chestnuts, acorns, apples). How far have they managed to travel?

N.C. statement: explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal (Year 3)

Methods of seed dispersal

4) Water dispersal



If you are able, bring in a selection of seeds for pupils to investigate. Examples of seeds dispersed by water include dates, coconuts and lotus flowers. Compare what happens when you put these seeds into a container filled with water versus other types of seeds, such as apple pips, conkers, beans or any other seeds you have access to.

Which can float and which sink? Of the seeds that float, do you think they could last the long journeys some water-dispersed seeds have to make? Are their coatings suitably waterproof?

Ask pupils to conclude which seeds have the features/adaptations needed to survive water dispersal. It is also worth noting that the parent plant has to release the seed at just the right time – times of high water means the seeds can travel further. Some travel across oceans before germinating!

N.C. statement: explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal (Year 3)

Methods of seed dispersal

5) Animal dispersal

Attach double-sided sticky tape, folded over pieces of Sellotape or small strips of Velcro to pupils' sleeves and ask them to move around outside, deliberately brushing against trees, bushes, fences, etc.

Investigate what has been captured during this activity. Many pupils may already have experienced sticky weed or burrs getting stuck to their clothes while out and about. Can pupils explain why this is a useful method of seed dispersal for some plants? What might the drawbacks be, if any?

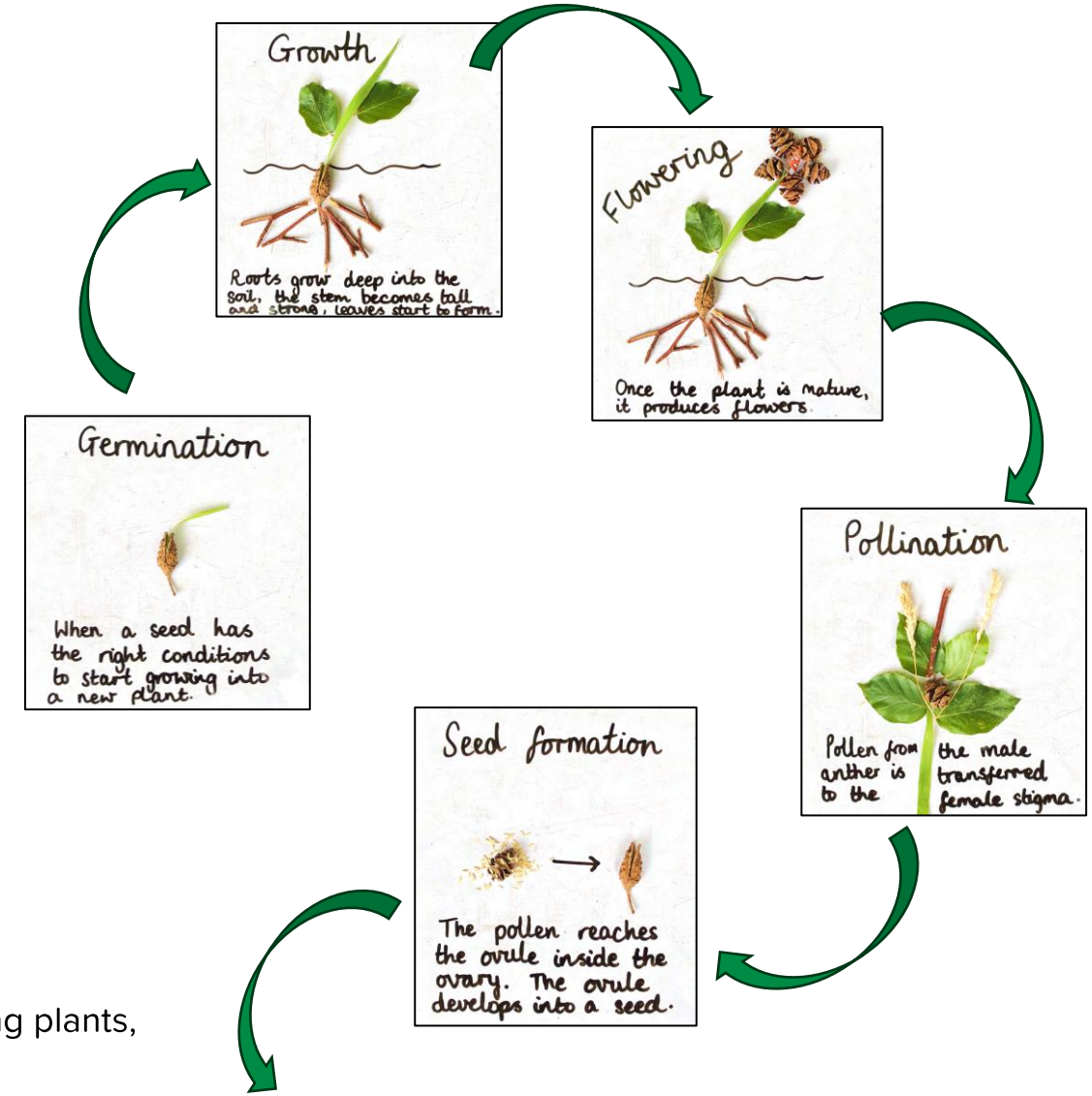


N.C. statement: explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal (Year 3)

Life cycles of flowering plants

Once pupils have learnt about the different stages of flowering plants, challenge them to recreate these outside using natural materials as far as possible (you may need to supplement with some art and craft resources depending on what your outdoor area has to offer).

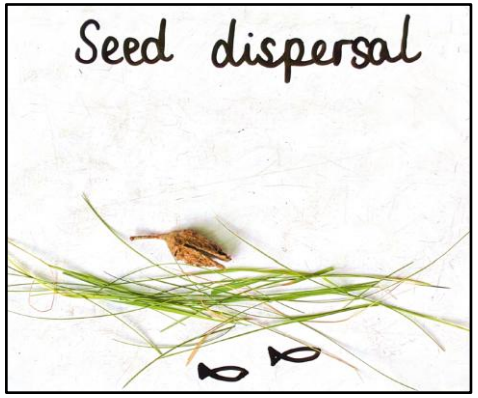
Pupils could work in small groups to create the whole life cycle, or you could split the class into groups for each stage and create a much larger piece, coming together at the end to explain the processes happening at each stage.



N.C. statement: explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal (Year 3)

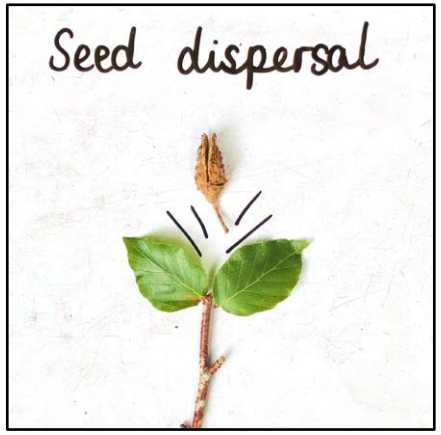
Life cycles of flowering plants











Parent plants spread their seeds using different methods.

Dispersal allows new plants to grow in different locations. And the cycle can begin again!

N.C. statement: explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal (Year 3)

Animals including Humans

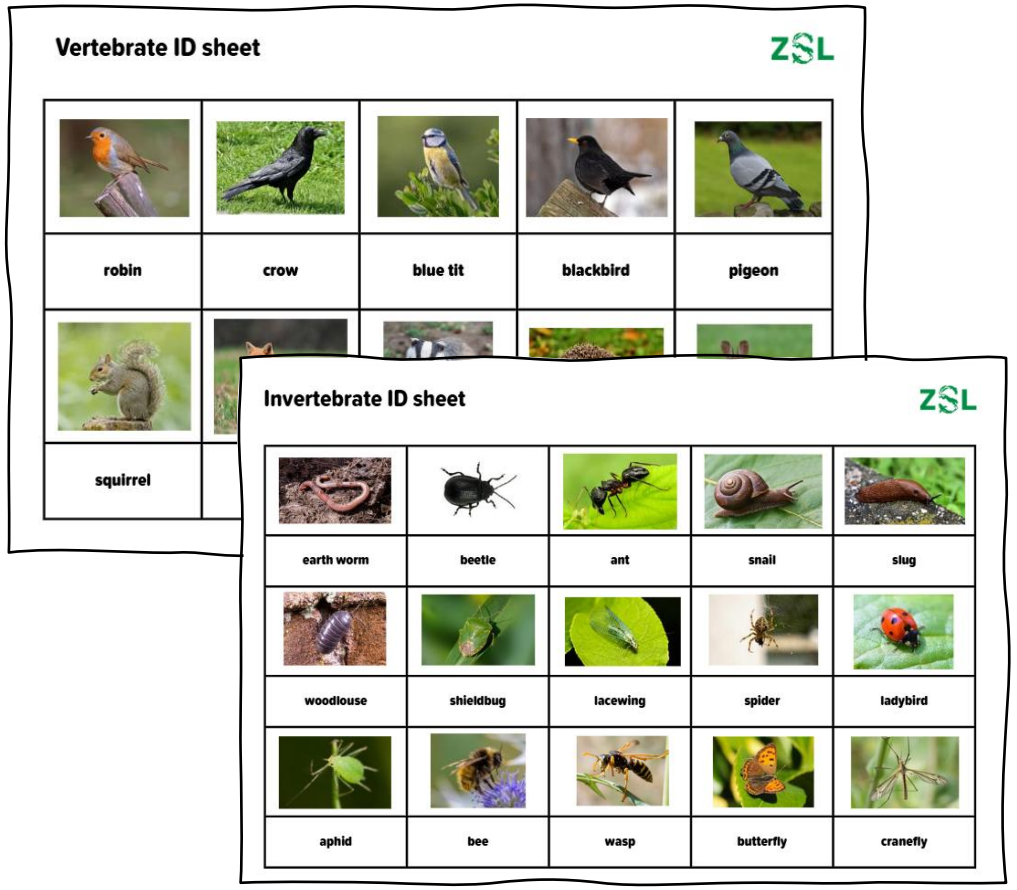
- Year 3
- Year 4
- Year 5
- Year 6

Vertebrates and invertebrates on your site

Identify examples of vertebrates and invertebrates around the school grounds. This could include finding evidence of animal tracks in your outdoor environment or recording bird song.

Take the opportunity to look at the outer skeletons of any insects found and encourage pupils to notice the way these are constructed to support the animal and allow it to move. What benefits and drawbacks can they think of/observe for having an exoskeleton?

Which invertebrates are examples of animals with hydrostatic skeletons? If they have come across worms or slugs in their search, what do pupils notice about the movement of these creatures?



Vertebrate and invertebrate ID sheet available here
Link to animal tracker ID sheets available here

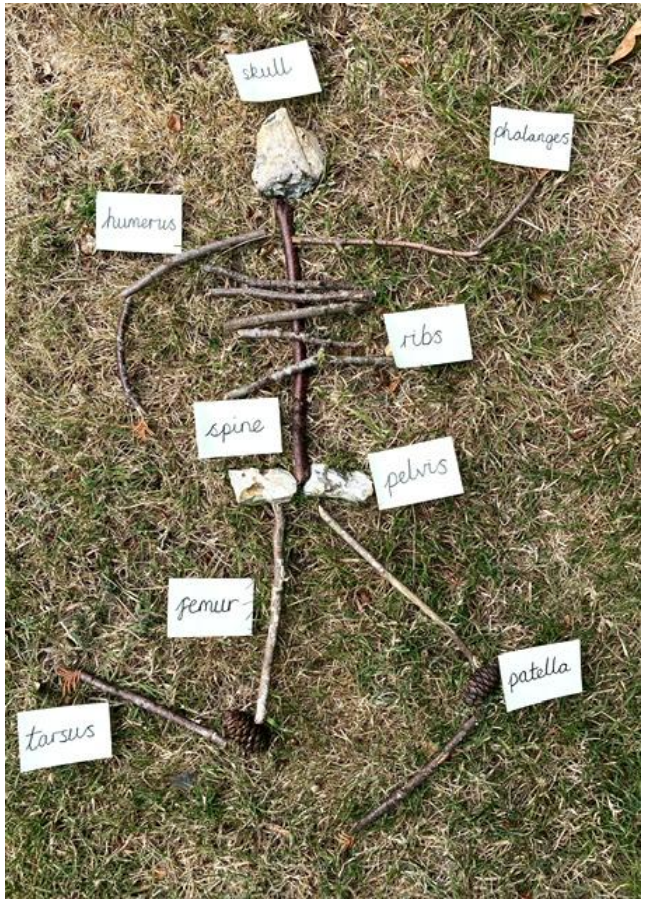
N.C. statement: identify that humans and some other animals have skeletons and muscles for support, protection and movement (Year 3)

Skeleton with natural materials

Once pupils are familiar with the human skeleton and can identify a range of bones, see if they can recreate a skeleton structure using natural materials from the outdoor area.

If you choose to construct these on the playground, pupils can use chalk to label the different bones. If you are working on grass, whiteboards or post it notes can be used to assess pupils' identification.

If you don't have enough resources in your outdoor area to create skeletal models, pupils could draw around an outline of someone in the group using chalk and then work together to draw in the bones they know.



N.C. statement: identify that humans and some other animals have skeletons and muscles for support, protection and movement (Year 3)

Exploring muscles



Take pupils outside to act out a range of movements, considering which muscles they are using whilst doing so. See if they can feel whether a muscle is contracting or relaxing.

Complete a pattern seeking investigation into whether higher activity levels translate to having stronger muscles amongst your class. Ask pupils to gather data on how much time they spend active each week. This can include extra-curricular clubs, playtimes, dog walks, etc.

Set a time limit and see, for example, how many squat jumps (or another appropriate exercise in line with the mobility needs of your class) each pupil can do in the given time. Track the results on a scatter graph against the time each pupil spends being active each week. Is there a correlation?

Pupils might identify that certain activities focus on different muscles. A footballer may have very strong legs but won't necessarily have the same upper body strength as a boxer. Ask pupils to consider which muscles they use most in the time they spend being active.

N.C. statement: identify that humans and some other animals have skeletons and muscles for support, protection and movement (Year 3)

Muscle strength vs. stamina







To understand the difference between muscle strength and stamina, set pupils challenges that require them to exert force for a short burst of time versus sustaining an activity for an extended period.

Have pupils fill up their class water bottles and see how many times they can lift it from the floor to over their head in 60 seconds to explore muscle strength.

To test stamina, you could time pupils completing the daily mile or set them a challenge like the beep test.

After both activities have been undertaken, ask pupils if they found one easier than the other. Does this make sense based on the extra-curricular activities they take part in or hobbies they enjoy?

It is important to remind pupils that all bodies are different and that small muscles does not equal weakness. Look at examples of athletes who train different muscles for different purposes and discuss how this benefits each. Pupils should also consider that some people have disabilities that affect their muscle strength, and that some people may do lots of exercise but may not gain or appear to gain muscle strength.

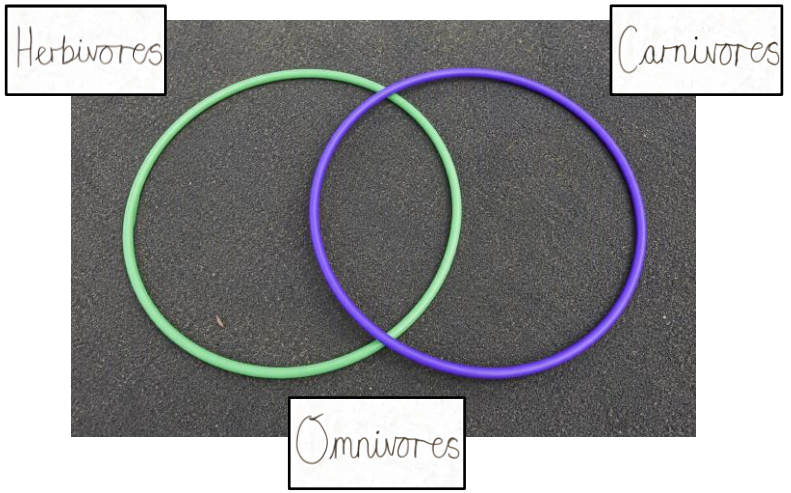
N.C. statement: identify that humans and some other animals have skeletons and muscles for support, protection and movement (Year 3)

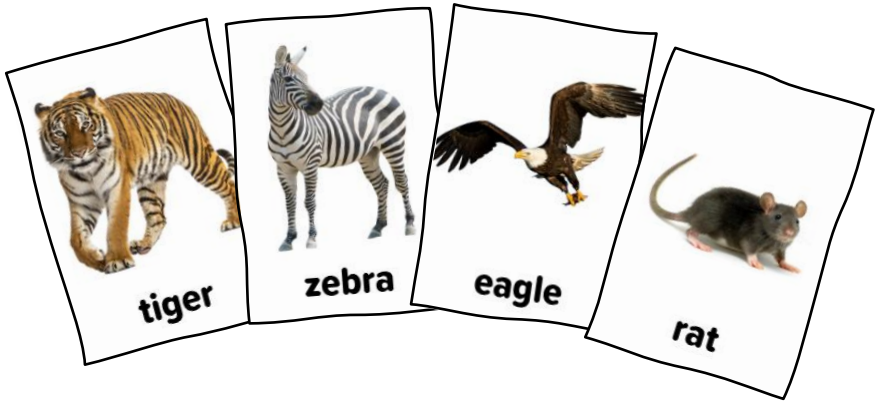
Classifying diets

Using hoops, ask pupils to create Venn diagrams with the headings ‘Carnivore’, ‘Herbivore’ and ‘Omnivore’. Provide pupils some picture cards to sort before adding some of their own examples.

Can they classify any living creatures from around your school environment? (If pupils include certain invertebrates, you might want to also introduce the term ‘detritivores’.)

If time, get pupils to consider and investigate where living things in your outdoor space might get their food from. Why do these animals need different diets from one another?





Animal picture cards available here

N.C. statement: identify that animals, including humans, need the right types and amount of nutrition, and that they cannot make their own food; they get nutrition from what they eat (Year 3)

Nutrients in animals' diets

Consider what sort of food is available for any animals that come into your school grounds. Once pupils are familiar with the different nutrients provided by certain food groups, can they identify which nutrients local wildlife are getting from their diets? (This could include from any animal feeders you might have.)

Which animals' diets are not supported in this environment? Do they think they could survive if they were responsible for getting all their food/necessary nutrients by foraging in the local area?

Discuss how the animals kept by places like farms and zoos rely on humans to provide the nutrients they need to survive. If they were a keeper for a particular animal, what would their creature need? What nutrients would it be getting from its diet?



Animal	What does it eat?	What nutrients does this provide?
Squirrel	Nuts, seeds, berries, insects	Fats, fibre, protein, vitamins
Robin	Worms, insects, fruit, berries	Protein, vitamins, water
Bee	Nectar, pollen, water	Protein, carbohydrates, minerals

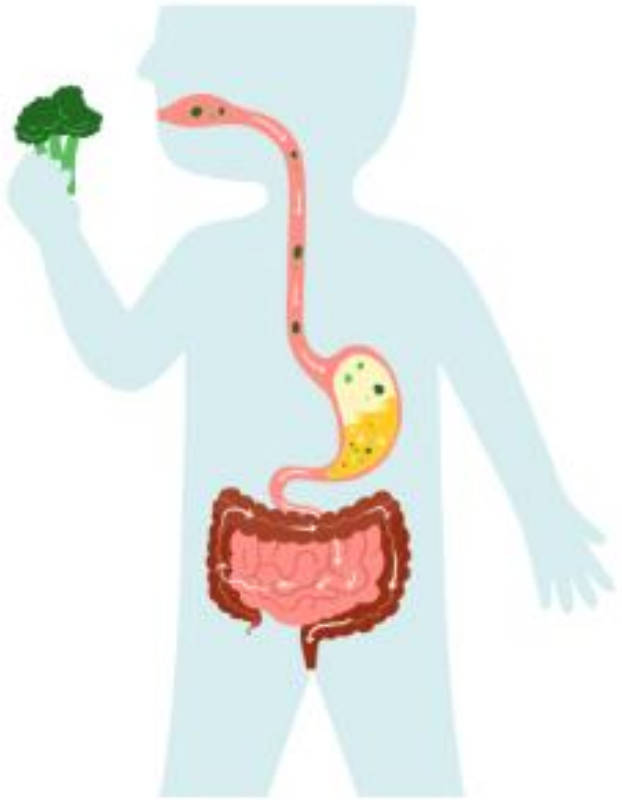
N.C. statement: identify that animals, including humans, need the right types and amount of nutrition, and that they cannot make their own food; they get nutrition from what they eat (Year 3)

Digestive system roleplay

To reinforce learning about the digestive system, take your class outside and split them into groups representing the different stages of the digestive system.

Choose something to pass along the system representing food (e.g. a soft ball, playdough, scrunched up paper); at each stage, pupils act out their organ's job (chewing, squeezing, mixing).

Allow pupils to take on different roles to reinforce the process.



N.C. statement: describe the simple functions of the basic parts of the digestive system in humans (Year 4)

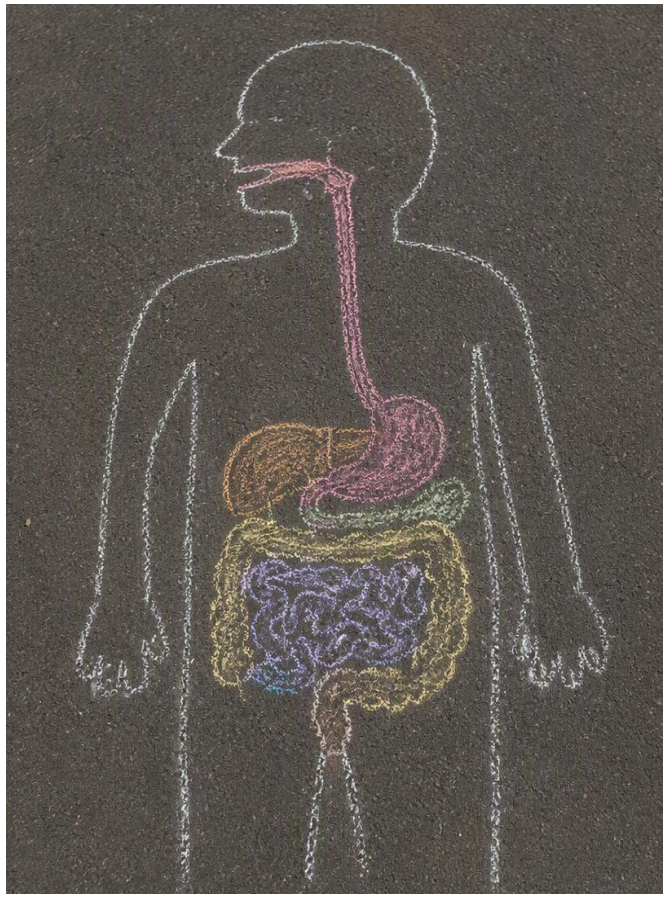
Digestive system walk-through

You can use chalk diagrams in two ways to learn about the digestive system with your class:

1) Prior to the lesson, draw a large diagram of the digestive system on the playground in chalk that pupils can then actually walk through.

   Go through as a class, stopping at each stage to learn about the functions. You could then challenge groups to take on the role of re-teaching the class about a particular stage to reinforce the learning.

2) After learning about the digestive system in class and looking at diagrams, take pupils outside to work on creating their chalk diagrams in groups. They then present their diagram to another group and talk them through the process that occurs at each stage.

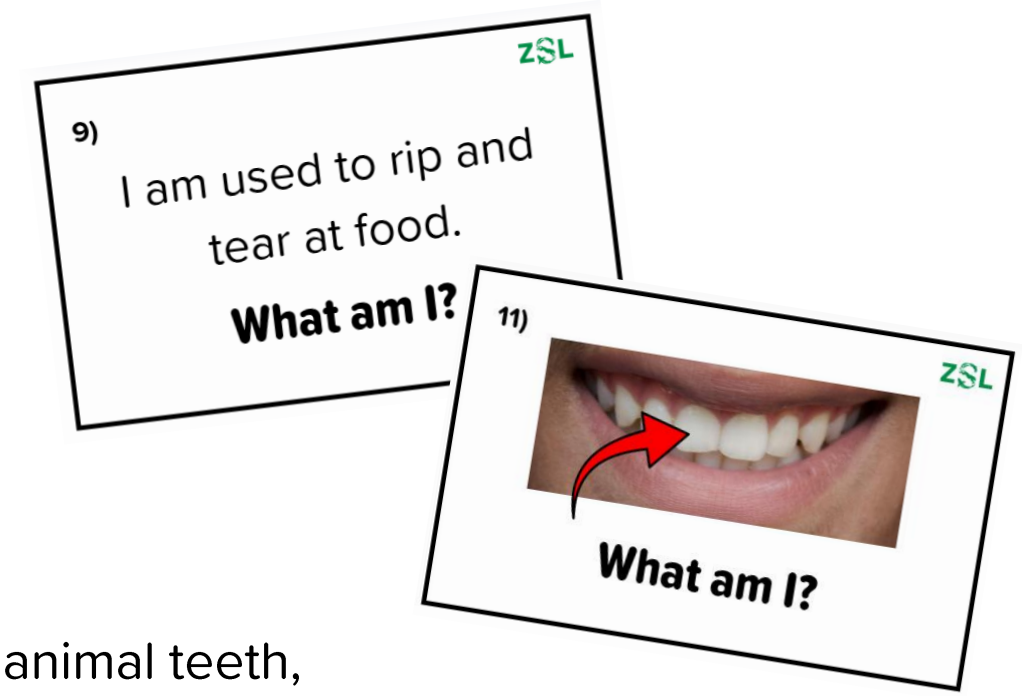


N.C. statement: describe the simple functions of the basic parts of the digestive system in humans (Year 4)

Tooth hunt

Place descriptions and pictures of different types of teeth around your outside area for pupils to find and answer. They do not have to be completed in any particular order.

Pupils have to identify the correct tooth type to match the descriptor. Go through the answers as a group to ensure there aren't any misconceptions when it comes to identifying the shape or function of a particular tooth.



There is also the option to include examples of different animal teeth, which pupils can link to their knowledge of diets from Year 3.

Teeth functionality cards available here

N.C. statement: identify the different types of teeth in humans and their simple functions (Year 4)

Teeth anatomy

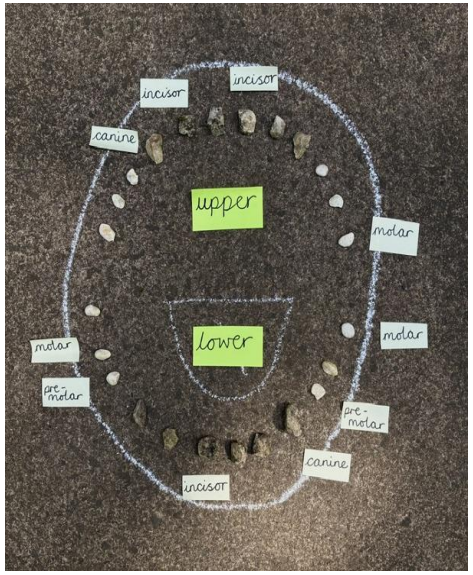
Using rocks to represent teeth, test your pupils' knowledge of labelling each type:

1) Set up a model of a mouth by drawing a large oval shape in chalk and arranging 32 rocks to represent the top and bottom sets of teeth.

   Label one of the top incisors to orient pupils' understanding of the model, then assign each pupil a tooth type to label. You could provide these or get pupils to write their own labels on post it notes.

   As a class, can you label the whole mouth correctly?

2) If you have enough rocks, pupils work in smaller groups to construct mouth diagrams that they then label.



If you wanted to make the activity a more permanent feature for the topic, cut a mouth shape out of a large piece of cardboard and use a hot glue gun to secure the rock teeth. This could then be used in cross-curricular PSHE activities linked to dental health, providing pupils with a large bristle brush and a piece of string or wool to replicate brushing and flossing teeth.

N.C. statement: identify the different types of teeth in humans and their simple functions (Year 4)

Food chains

Linking to previous learning from Years 2 and 3, pupils investigate which food sources they can identify in the outside area.

Where can you find producers?

Which animals are prey and which are predators?

Pupils use these discoveries to create food chains that exist on your school site.



producer



primary consumer



secondary consumer

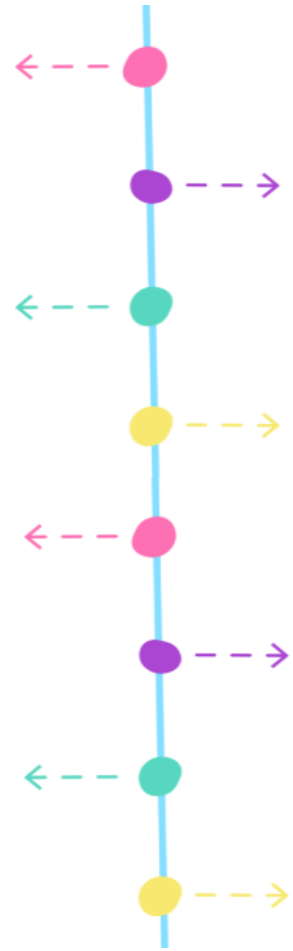
N.C. statement: construct and interpret a variety of food chains, identifying producers, predators and prey (Year 4)

Growth and development timeline

Create a large timeline across the playground in chalk with some age markers included (e.g. 1 year, 10 years, 18 years, 25 years…). Ask pupils to record on whiteboards or post it notes what they think might happen during particular stages of life (it does not have to be for a year marked on the timeline) and add it to the correct place. Encourage pupils to draw on the life experiences of their family and friends as well as their own.

Review what ideas the class already have about human development and growth. Discuss whether everyone develops at the same rate – e.g. some people might not learn to swim until they're adults; some people might never be able to walk – and whether they expect to always have the same experiences as their classmates throughout their lives.

You can also use outdoor chalk timelines or a washing line/string and pegs to plot foetal and childhood development. Provide pupils with pictures and descriptions of each stage that they have to order correctly, or pupils display their own development posters.



N.C. statement: describe the changes as humans develop to old age (Year 5)

Animal gestation periods

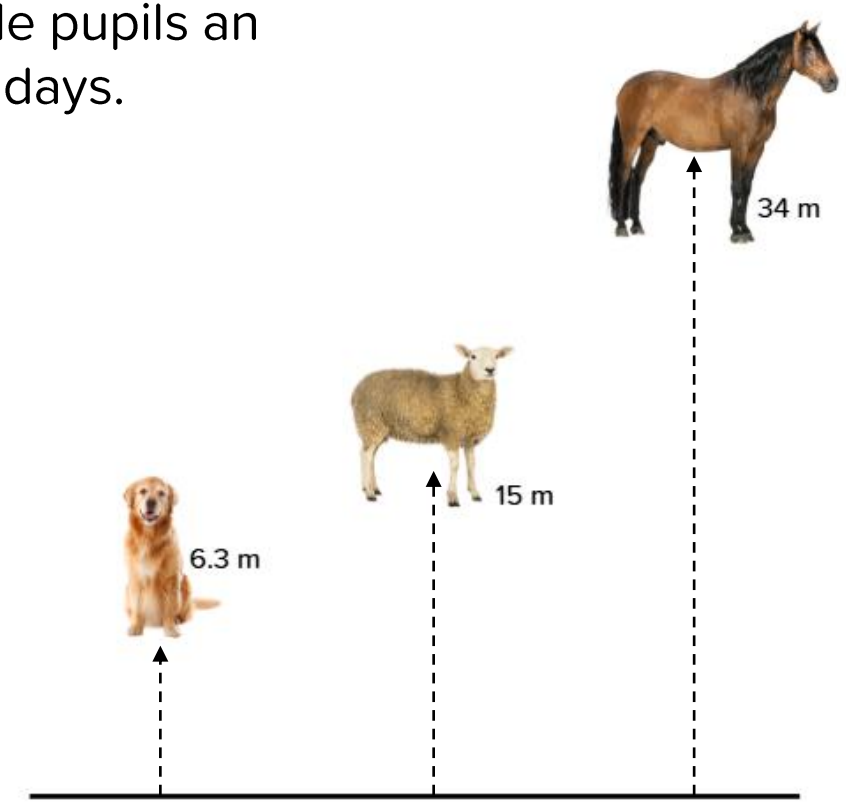
Ask pupils if they have any prior knowledge about the gestation periods of different animals. What factors might affect the length of an animal's gestation period?

To visually appreciate the difference in gestation lengths, provide pupils an animal card with information about its gestation period, given in days.

Create a scale for an outdoor distance challenge, e.g. 1 metre = 10 days of gestation, and ask pupils to calculate how far from a starting point their animal belongs.

Head outside to the playground or field and mark your starting line. Pupils then walk the distance they have calculated for their animal's gestation period.

What do they notice about animals that are close to the starting point versus animals that are a longer distance away?



Animal gestation cards available here

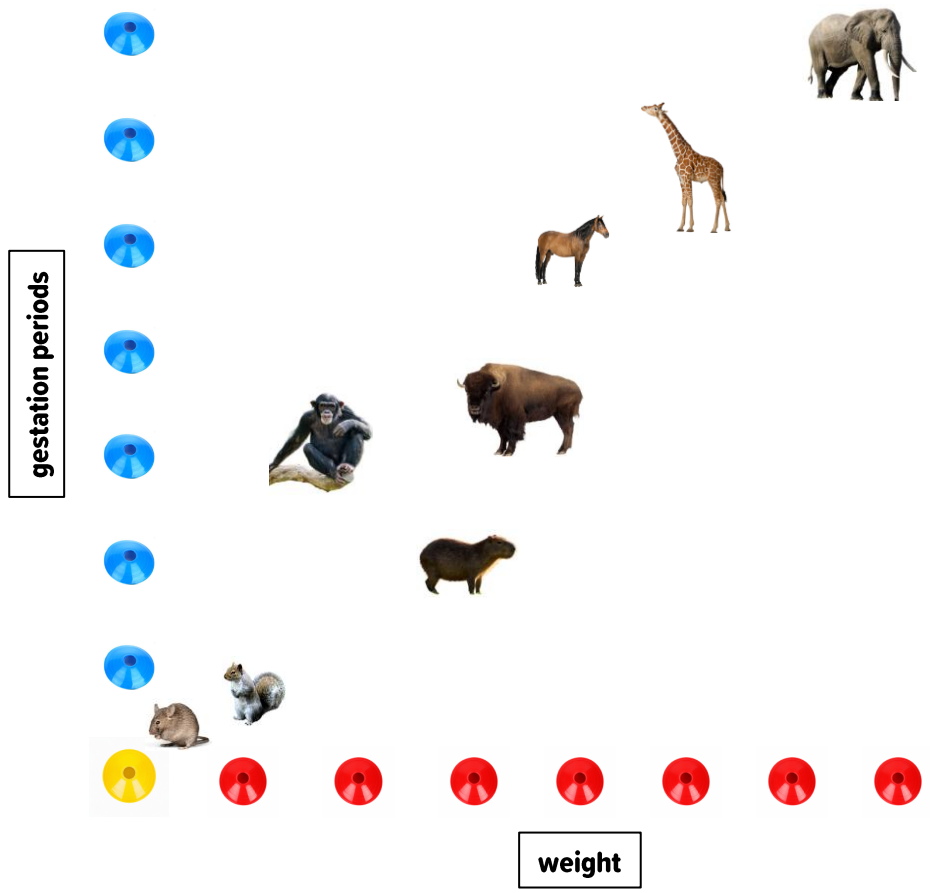
N.C. statement: describe the changes as humans develop to old age (Year 5)

Animal gestation periods continued

Use cones to create a large grid on the playground for a human scatter graph. Use the X-axis to represent weight and the Y-axis to plot gestation periods.

Get pupils to research the average weight and gestation period of an animal or use the cards available on our site. Pupils then have to find or estimate the correct coordinate on the grid to stand by.

Once everyone is positioned, take a photo or get pupils to leave their animal cards in place and step back to consider what the data shows. Is there an observable trend? Can a general conclusion be drawn? What about any outliers?



Animal gestation and weight information cards available here

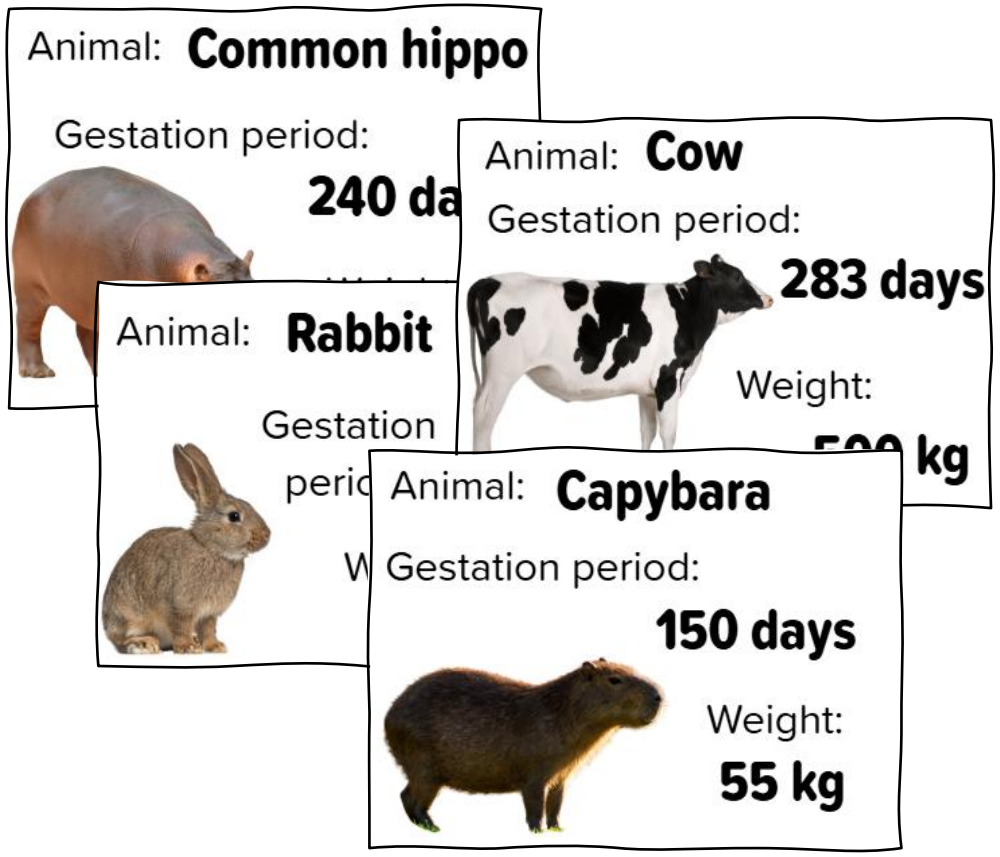
N.C. statement: describe the changes as humans develop to old age (Year 5)

Animal gestation hunt

Place animal cards around your outdoor area with information about animals' weights and gestation periods.

Pupils collect the information and use it to answer questions such as:

- ★ Which animal has the longest gestation period?
- ★ Which animals have similar weights but different gestation periods (or vice versa)?
- ★ Which animal weighs over 1,000 kg and has a gestation period of more than 500 days?
- ★ What is the gestation period of a giraffe in months?



Animal gestation and weight information cards available here

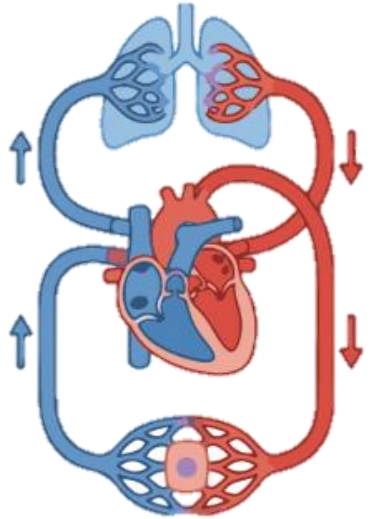
N.C. statement: describe the changes as humans develop to old age (Year 5)

Circulatory system roleplay

Split an area outside into four parts – you could use chalk or hoops – to represent the four chambers of the heart. Label these as the right and left atria and ventricles.

One group of pupils act as the lungs and hold red cones to represent oxygenated blood. Other groups act as different parts of the body, such as stomach, brain, arms, legs, and hold blue cones to represent deoxygenated blood. The remaining pupils act as the bloodstream.

A pupil from the bloodstream group moves to collect a blue cone from one of the body parts, then heads to the heart. Here, they move from the right atrium into the right ventricle before heading back out to the lungs. When they reach the lungs, they swap their blue cone for a red cone and head towards the left atrium and down into the left ventricle. They then return to one of the body parts to swap their cone and begin the cycle again.



Once pupils are familiar with the routine, you could have lots of 'bloodstream' pupils flowing through the system at the same time. Make sure all pupils get a chance to act out the path of the bloodstream.

N.C. statement: identify and name the main parts of the human circulatory system, and describe the functions of the heart, blood vessels and blood (Year 6)

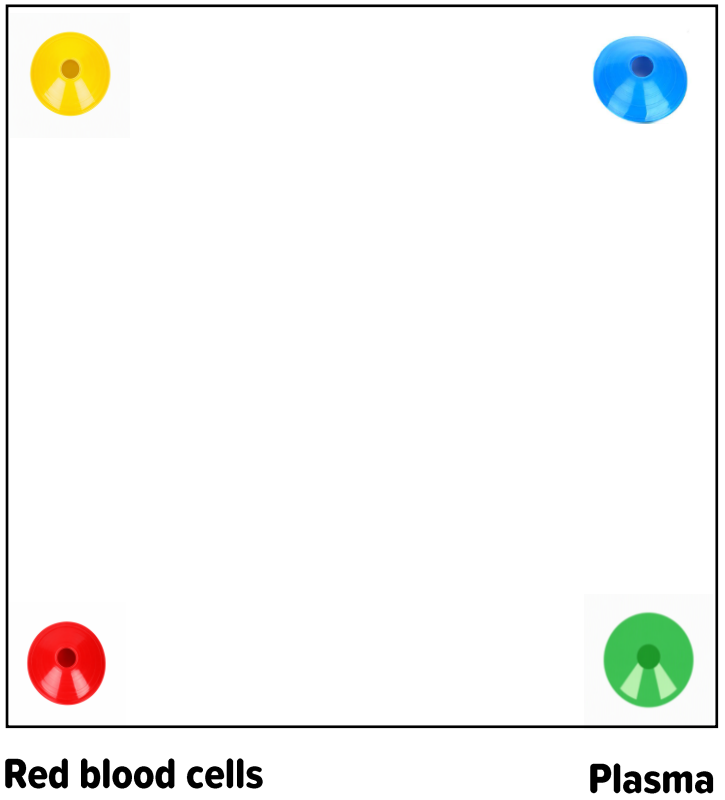
Blood components revision

This activity will help pupils to revise their understanding of the different components of blood and the functions of these.

Place cones in four corners of the playground to represent the four blood components: red blood cells, white blood cells, platelets and plasma.

Read out facts about the different components and task pupils with moving to the corner that they think is the component related to each fact.

Blood components facts and functions information available here



N.C. statement: identify and name the main parts of the human circulatory system, and describe the functions of the heart, blood vessels and blood (Year 6)

Heart/pulse rate investigation

Show pupils how to take their pulse, then ask them to record their heart rate at rest.

Repeat this task after completing some moderate exercise (e.g. walking around the playground or field), and again after vigorous exercise (e.g. running).

Ask pupils to explain why their heart rates have changed depending on the activity. They could also compare results with each other. How does heart rate vary from person to person? Can they give a possible reason for this?



As an extended maths challenge, pupils could try to calculate how much blood might be being pumped through their heart every minute (roughly 55 ml per minute), by multiplying this with their resting heart rate.

N.C. statement: identify and name the main parts of the human circulatory system, and describe the functions of the heart, blood vessels and blood (Year 6)

Recovery time

Guide pupils through an investigation into the time it takes their heart rate to return to normal after exercise.



Start by showing pupils how to measure their resting heart rates and ask them to record these. Then lead the class through an activity for 3 – 5 minutes, e.g. skipping, jumping, jogging, dancing or any other energetic movements they enjoy.

As soon as they have finished the activity, pupils should re-measure their heart rate and record this. Then instruct everyone to sit calmly to give their heart rate the best chance to return to rest. Every minute post-activity, pupils should retake and record their heart rate until it has returned to or is close to their original resting heart rate.

Resting heart rate	83 bpm
Heart rate after exercise	119 bpm
1 minute after exercise	105 bpm
2 minutes after exercise	96 bpm
3 minutes after exercise	84 bpm

Take this as an opportunity to explain that being physically active on a regular basis helps to improve recovery time after exercise as well as benefitting overall health. What do pupils predict the recovery time might be for professional athletes? Why?

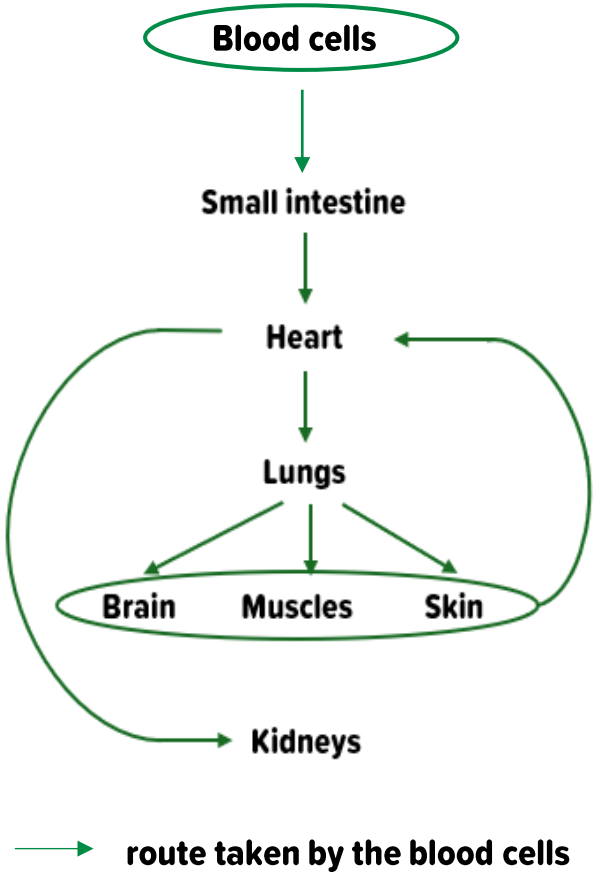
N.C. statement: recognise the impact of diet, exercise, drugs and lifestyle on the way their bodies function (Year 6)

Transporting nutrients roleplay

Set up:

Your class will take on the role of a giant ‘body’, split into the following groups and starting with the suggested resources:

- Small intestine – tennis balls to represent food/nutrients
- Heart
- Lungs – red beanbags to represent oxygen
- Brain – blue beanbags to represent waste products
- Muscles – blue beanbags to represent waste products
- Skin – blue beanbags to represent waste products
- Kidneys
- Blood cells



N.C. statement: describe the ways in which nutrients and water are transported within animals, including humans (Year 6)

Transporting nutrients roleplay

Action:

The blood cells start by passing through the small intestines group, gathering food/nutrients (tennis balls) and transporting these to the heart.

As the blood cells pass through the heart group, the heart group shouts “Pump!” to send the blood onward to the lungs.

At the lungs, the nutrient-rich blood collects oxygen (red bean bags). The blood cells at this point are now carrying red beanbags and tennis balls.

The blood cells then carry the oxygen onto the other cells in the body, represented here by the brain, the muscles and the skin. At these points, the blood cells swap their nutrients and oxygen (tennis balls and red beanbags) for the other cells’ waste products (blue beanbags).

The blood cells then travel back to the heart carrying these waste products. Some blood cells can leave their blue beanbags with the heart at this point.

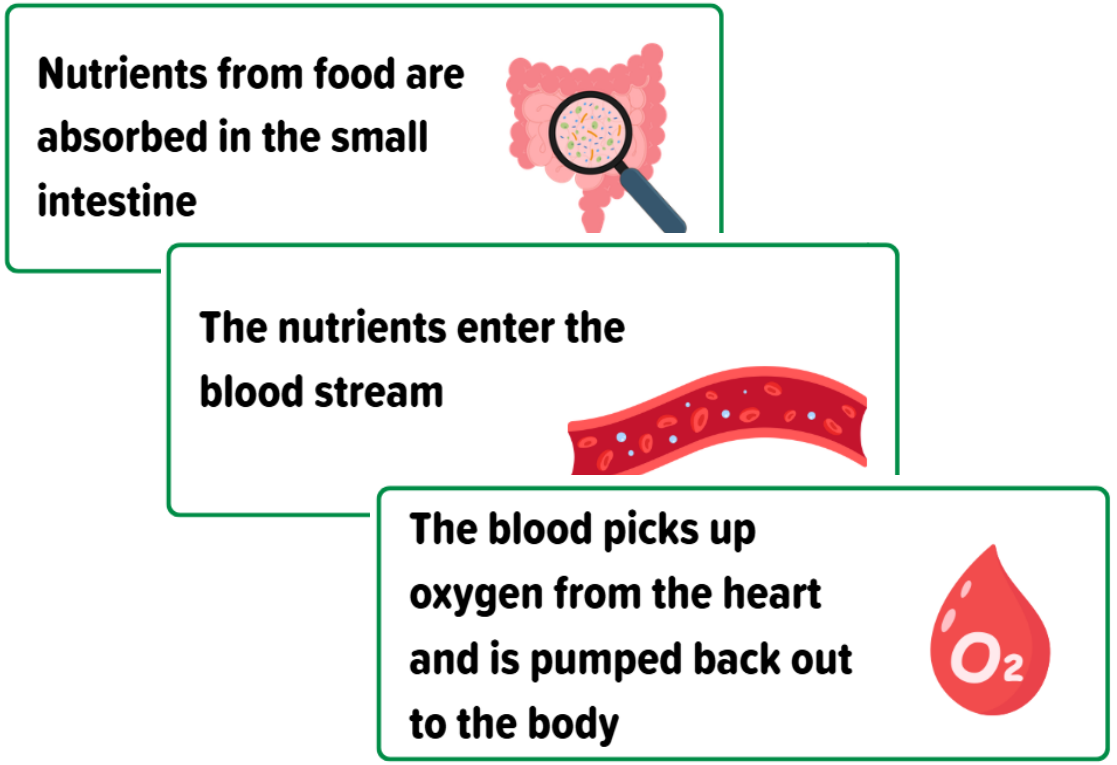
The blood cells then make a final stop at the kidneys where excess water (the remaining blue beanbags) are dropped off and carried away as urine.

N.C. statement: describe the ways in which nutrients and water are transported within animals, including humans (Year 6)

Transporting nutrients relay

Split the class into teams and challenge them to collect cards explaining the process of transporting nutrients and water around the human body.

The cards must be collected in the correct order – if someone brings back the wrong card, the next person in the relay has to return the card before another person can collect the correct stage in the sequence!



Sequencing cards available here

N.C. statement: describe the ways in which nutrients and water are transported within animals, including humans (Year 6)

Materials and States of Matter

- Year 4
- Year 5

Identifying solids, liquids and gases

As part of their learning about solids, liquids and gases, take pupils outside to investigate which materials could be sorted into each category.

As well as identifying the more obvious solid objects around your school site, encourage pupils to consider where liquids and gases could be found.

Being outside is also a good opportunity to explore some materials that pupils might be less sure of how to classify (and that can be messy), such as shaving foam, toothpaste, sand and blowing bubbles.



N.C. statement: compare and group materials together, according to whether they are solids, liquids or gases (Year 4)

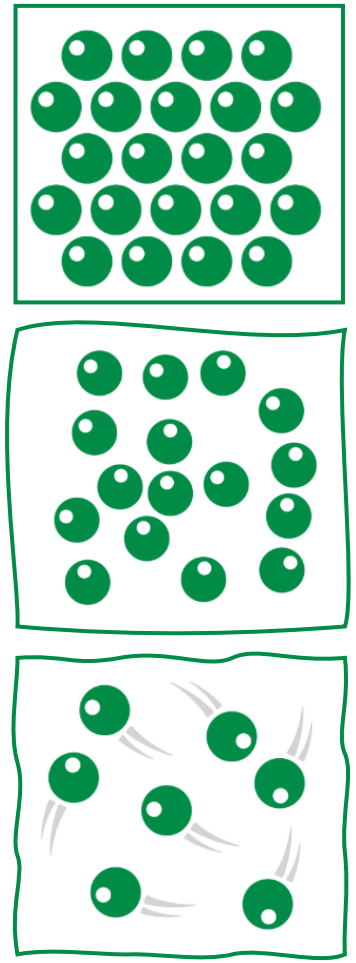
Particle roleplay

Explain to pupils that when you call out “Solid”, they must huddle tightly together forming neat rows without much movement, as these particles do not have a lot of energy.

When you call out “Liquid”, pupils should spread further apart as their particles gain more energy, starting to move around within touching distance of one another. You could even call out shapes for the ‘liquid particles’ to take on, representing how liquids do not keep a consistent form but take on the shape of their container.

When you call out “Gas”, pupils should move freely and with more speed as they gain energy. Encourage them to spread out into the atmosphere and take up as much space as possible!

You could take this activity further once pupils are familiar with the meanings of ‘melt’, ‘freeze’, ‘evaporate’ and ‘condense’. This will test understanding of what is happening during these processes. For example, you could call out “Gas” so that pupils are moving around freely, then call out “Condense” to see whether they understand that their particles should move into a liquid state.



N.C. statement: compare and group materials together, according to whether they are solids, liquids or gases (Year 4)

Investigating melting points

Give pupils the chance investigate the melting points of different materials such as cheese, butter, ice, candle wax, chocolate and/or ice cream.

Ask them to predict which might have the lowest and highest melting temperatures and their reasoning for this.

Place samples of your chosen materials in foil containers and leave these in direct sunlight. Take the temperature at timed intervals and observe what is happening to the different materials. At which temperature does each start to melt – if at all?

Has everything melted by the end of the experiment? What does this show?



N.C. statement: observe that some materials change state when they are heated or cooled, and measure or research the temperature at which this happens in degrees Celsius (°C) (Year 4)

Investigating evaporation with puddles

Ask pupils what they think happens to puddles. Why don't they stay on the ground forever?

Explain that even though water vapour is invisible, we can observe that the change from a liquid to a gas has occurred by measuring the size of puddles.



After rainfall, use chalk to outline the edge of a puddle on your playground. Depending on when you do this, return to the puddle either at the end of the day or the following day and retrace its outline. Once the water has completely evaporated, pupils could measure the width of both outlines and calculate the difference.

Was the investigation conducted on a warm day or a cold day? Ask your pupils to consider what effect this might have had on the rate of evaporation. How could you go on to investigate the effect of temperature on evaporation?

N.C. statement: identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature (Year 4)

Investigating temperature and evaporation

To investigate the effect of temperature on the rate of evaporation, choose three to five locations around your school site that experience different levels of heat/warmth/shade/cool (these do not all have to be outside).

Ask pupils to place beakers, each filled with the same amount of water, at the different locations. Back in class, show pupils how to prepare tables to record the capacity of each container over the coming days.

Set the experiment up to run for a minimum of 1 week, but 2 weeks is ideal for pupils to be able to observe more noticeable change.



A table to show the amount of water left in 3 different beakers after 14 days:

Day	Location 1 (warm)	Location 2 (shaded)	Location 3 (cool)
1	100 ml	100 ml	100 ml
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			

N.C. statement: identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature (Year 4)

Investigating temperature and evaporation

An alternative, shorter-term investigation into the effect of temperature on evaporation:

Place samples of wet material in various suitable places around the school and outdoor area (ideally on a warm day) to find out which will dry first.

Which location do they predict the material will dry quickest? Which factors might speed up the rate of evaporation?

Ask pupils if they can explain what will happen as the material starts to dry. Where has the water gone?



Decide on timed intervals to check on the material throughout the investigation. Pupils can make notes of their observations regarding any changes that take place and the length of time it takes the various samples to dry.

N.C. statement: identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature (Year 4)

Recreating the water cycle

You will need a warm sunny day for this activity, which will demonstrate how water from a larger body evaporates, condenses and rains down… then begins the cycle again.

Place a cup in the centre of a plastic container that has a well-fitting lid. Pour warm water into the plastic container but not into the cup. Put the lid on the plastic container and place it outside in a location with high sun exposure.

Gradually, the warm water will start to evaporate and condense on the lid. Point out to pupils that the lid is acting like a cloud. Encourage them to try to observe droplets falling. Some will land in the cup, demonstrating how water can be collected in different places and bodies, but the cycle will continue!



You can vary the activity by investigating the effect of temperature on the rate of evaporation, either by using cooler and hotter water or leaving the container in sunny and shady spaces.

N.C. statement: identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature (Year 4)

Precipitation collection

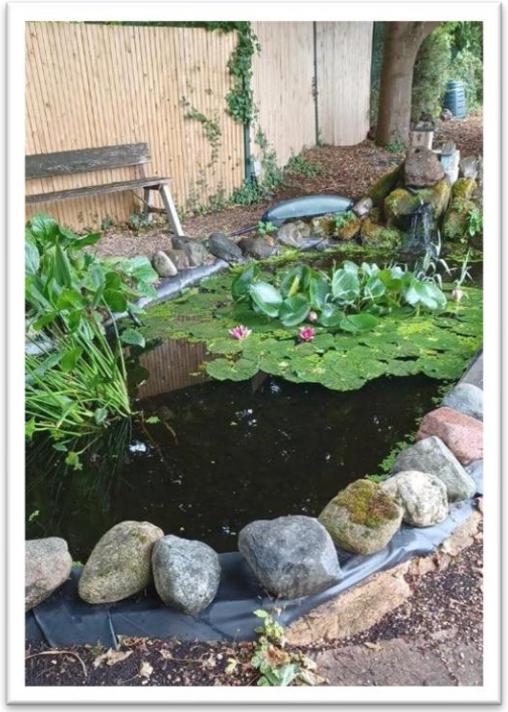
Possibilities for investigating how water levels change after rainfall:

Method 1: If you have a pond onsite and can safely do so, take a baseline water level measurement. This could be done by tying something weighted to a piece of string and lowering it until it reaches the bottom of the pond. Mark the string at the water surface, then use a tape measure to establish the depth.

Remeasure the water level after significant rainfall and/or a prolonged dry period. Encourage pupils to share their observations of any other changes they notice.

If you don't have a pond, you could create a mini version with a water tray or other large container. Measure the water level at different times, as above.

Pupils may also be able to observe changes to the appearance of the water over time. What factors could be influencing this change?



N.C. statement: identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature (Year 4)

Precipitation collection

Method 2: Set up a simple rain gauge somewhere likely to collect precipitation – i.e. away from trees and buildings – and where it isn't in danger of being knocked over. If you don't have access to a rain gauge, **this article** explains how to make one using a plastic bottle.

Check your gauge at roughly the same time each day to take a daily reading. Run the investigation for at least 7 days; longer if possible.

Pupils can use their data to create graphs and answer related questions, such as, 'How many days did it take to collect 10 cm of water?'

You could encourage them to make further predications about what they expect their graphs would look like across different months or seasons.



N.C. statement: identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature (Year 4)

Properties of materials

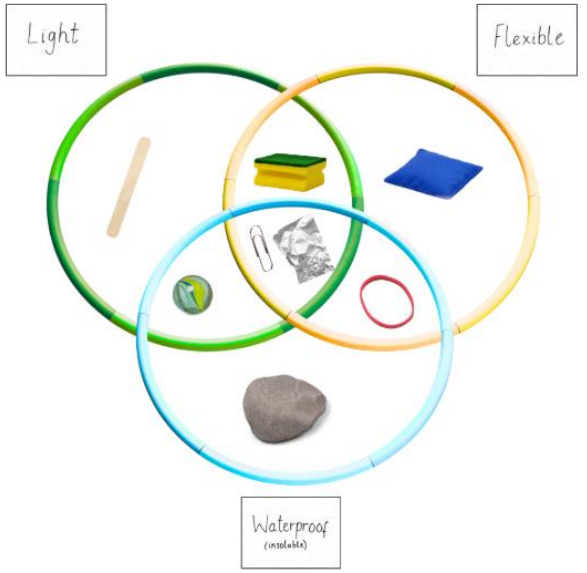
To assess pupils' prior knowledge and understanding of this topic, allow them to investigate materials around your classroom and outdoor area. Provide them with a table (see example below) that encourages them to consider the properties of the materials they find and why this has been used. Hand out magnets, if possible, to allow pupils to test whether a material is magnetic or not.

Object	Material	Properties	Rigidity rating /5	Transparency rating /5	Magnetic?
Climbing equipment	Wood	Hard, smooth, absorbent, strong	5	0	✗
Window	Glass	Hard, fragile, smooth, waterproof	5	5	✗
Bike racks	Metal	Hard, strong, flexible (when heated)	4	0	✓
Basketball hoop	Metal, plastic and nylon	Hard, strong, heavy (hoop and backboard) Stretchy, soft (nylon)	3	3	✓ - the metal hoop ✗ - the nylon and backboard

N.C. statement: compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets (Year 5)

Properties of materials

Working in groups, provide pupils with a selection of different materials and ask them to sort these in different ways. Allow them to choose two or three hoops and decide whether to create separate categories or Venn diagrams.



Give groups time to then run their materials through four tests to ascertain the rigidity, transparency, electrical conductivity and magnetism of each. They should decide how to record and/or rate their results. (You may need to return inside to conduct the electrical conductivity tests if it is difficult to move the necessary equipment outside.)

How would pupils group their materials now, based on their results? Do they notice any patterns? For example, are all electrical conductors magnetic?



N.C. statement: compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets (Year 5)

Thermal insulation investigation



Explain to pupils that by understanding thermal conductivity they will be able to make suggestions for which materials are best for keeping things either hot or cold. Therefore, you could run this investigation to test which materials will help to keep drinks either warmer or cooler for longer.

If testing how to keep drinks cool, run the investigation outside to make use of the natural heat of a warm day. Add cold water (and ice cubes, if possible) to cups made from different materials, e.g. plastic, metal, glass, cardboard/paper, Styrofoam, ceramic.

Record the baseline temperature for each cup, then take repeat measurements at regular intervals. Pupils could use their data to calculate the difference between the start and end temperatures of the water in each cup.

What can they conclude about the best material for keeping drinks cool? Why do they think some materials are better insulators than others?

N.C. statement: compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets (Year 5)

Uses of everyday materials

Ask pupils to focus on objects made from metal, wood and plastic and identify the different uses of these materials in your classroom and outdoor area. Remind pupils that these materials can take on different properties depending on their form.



Following their observations, discuss as a class whether any of the objects they found could be made from a different material. What would be the pros and cons of switching the material? For example, the playground bench is made from wood but could be made from plastic. This would make it waterproof, but it might not be as strong.



Ask pupils to design either a bug hotel or a bird box/feeder for your outdoor area. Which materials would they use and which properties would make each material suitable? (This could include materials investigated in previous activities.)

This could create a link with a D&T project – can pupils create prototypes of their designs and test whether the materials fulfil their design criteria?

N.C. statement: give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic (Year 5)

Recovering a dissolved substance

Ask pupils to suggest a method you could use to recover salt or sugar from water.

Explain that the process of evaporation should leave the salt or sugar behind and, in doing so, prove that the dissolved material doesn't "disappear" when mixed with water.

Place water with dissolved salt or sugar in a shallow tray and leave this out in an exposed sunny area. Depending on how warm the day is, you could leave the tray out in the morning and return to it at the end of the school day, or you may have to leave it out for a slightly longer period until all or most of the water has evaporated.



Pupils should be able to observe salt or sugar crystals left behind once the water has evaporated. Recap learning on the water cycle from Year 4 – has the water disappeared? Why can't we see it anymore?

(You could put out several salt-water trays in different locations to investigate where the water evaporates quickest, if pupils haven't already done a similar investigation in Year 4.)

N.C. statement: know that some materials will dissolve in liquid to form a solution, and describe how to recover a substance from a solution (Year 5)

Cleaning dirty water

Ask each group to fill up a cup with water and then take their cups outside to add some stones, soil and sand to the water. Do they think it will be possible to get the water back to how it was? This investigation will allow pupils to test different materials' effectiveness at filtering water.



Start by cutting the top off a plastic bottle. Place this upside down into the lower half of the bottle so that it looks like a funnel. If the bottle has a screw-cap lid, carefully pierce a hole through this and re-attach it. If the bottle has a pop-top lid, ensure it is open. This will allow water to drain through while stopping your filtration materials from falling down the bottle neck.

Provide pupils with materials to put into the funnel, for example: sponge, sand, cotton wool, activated charcoal, pebbles, larger stones, cloth/fabric, and anything else you have access to. Pour the dirty water into the bottle funnels and assess how well each material you have chosen filters out various sediments. Remember to keep some dirty water to compare with post-filtration. Which option(s) work best?

N.C. statement: use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating (Year 5)

Revising reversible and irreversible changes

This activity can be used for end-of-topic revision, once pupils have had experience learning about/experimenting with reversible and irreversible changes.

Sort pupils into groups and provide them with cards that describe a change in state.

Set out two hoops for each group labelled “Reversible changes” and “Irreversible changes”.

Go through the answers once each group has finished and ask pupils to prove how they know that something is an example of a reversible change. Can they explain how to reverse the process?



Reversible and irreversible change cards available here

N.C. statement: • demonstrate that dissolving, mixing and changes of state are reversible changes
• explain that some changes result in the formation of new materials, and that this kind of change is not usually reversible, including changes associated with burning and the action of acid on bicarbonate of soda (Year 5)

Living Things and their Habitats

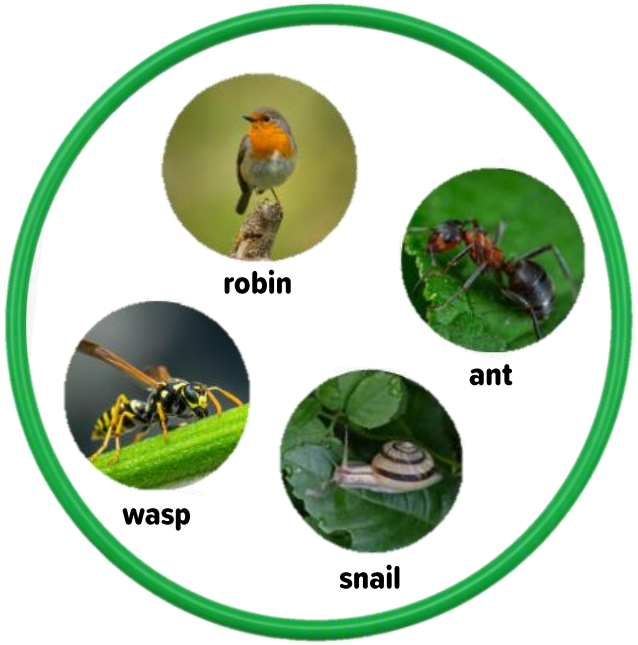
- Year 4
- Year 5
- Year 6

Classifying organisms

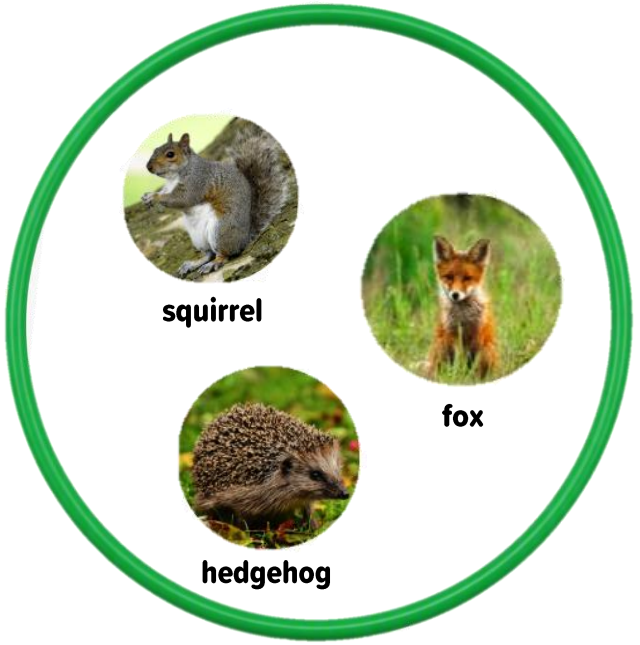
Ask pupils to identify living things in your outdoor area; plants or wildlife.

Working individually or in small groups, ask pupils to classify the organisms they have spotted.

Once they have sorted these, they should share their groupings with a partner or another group and see if the other person/group can identify the classifications they have chosen.



How do you think these animals have been classified?



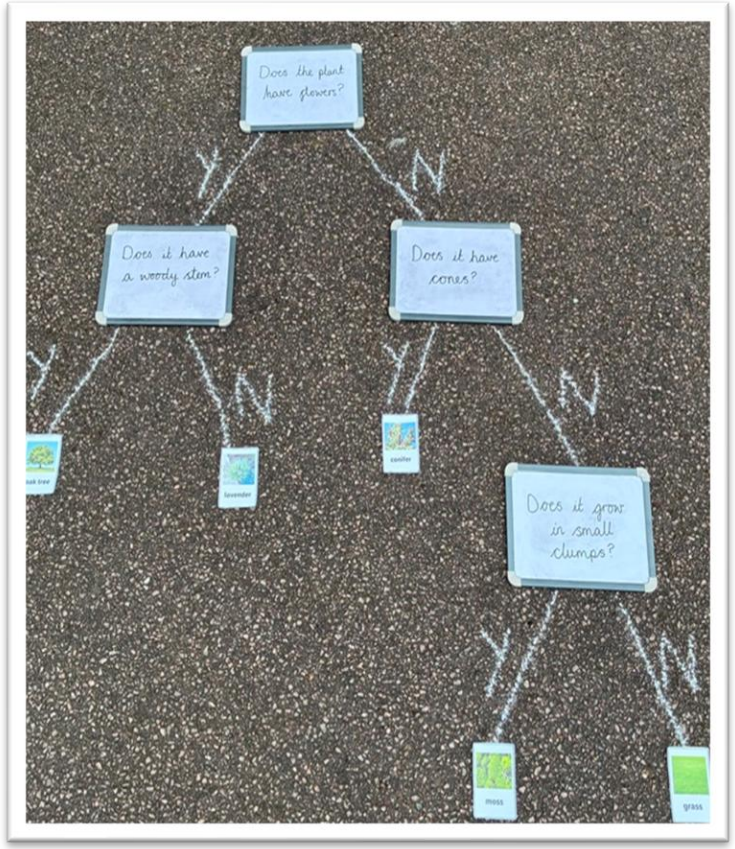
N.C. statement: recognise that living things can be grouped in a variety of ways (Year 4)

Classifying observable characteristics

Using examples of living things from your school grounds or a selection of provided/chosen examples, ask pupils to begin by sorting their organisms simply between two hoops. They can then use these sorting decisions to start building a branching classification key.

Pupils could use string or chalk to create the structure of their classification keys and write their questions on whiteboards.

They then hand over their selection of living things and ask another person or group to see if they can sort each object to the correct endpoint.



Depending on the stage you are at in your topic, you could ask pupils to sort organisms based on the following classifications:

- Vertebrate/Invertebrate
- Flowering/Non-flowering plants
- Habitat type

N.C. statement: recognise that living things can be grouped in a variety of ways (Year 4)

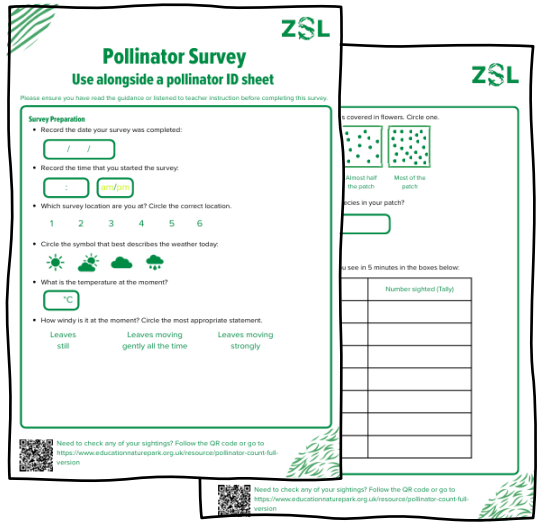
Surveying school grounds for biodiversity

If your school is embarking on a site transformation – planting trees, vegetable gardens or wildflower patches – you may wish to measure the impact of these changes and involve your students in taking measurements before, during and after the changes have been put in place.

We have resources on our **Nature-Based Curriculum Resources** webpage, which rely on 6 locations being set up as the 'sample locations' around your school site. These could be in a woodland area, by a flower patch, alongside a hedge or even on the edge of the playground. Schools we have worked with directly have used numbered log disks to mark these locations; however, paving slabs would also work well.

Using our resources, students will be supported to survey birds, either by song or sight, ground invertebrates, butterflies and pollinators. There are supporting teacher guides, along with data collection and identification sheets.





N.C. statement: explore and use classification keys to help group, identify and name a variety of living things in their local and wider environment (Year 4)

Sample plant diversity



Create a simple quadrat using string, sticks or a hoop to demarcate the area(s) you are going to survey.

Instruct pupils to identify and count:

- The number of plant species
- The abundance of each plant

If you are surveying different locations, consider areas that will provide the most diverse results and ask pupils to consider what might be responsible for these differences: is it a space that is frequently walked across? Is the make-up of the soil different?

Pupils can use their data to create totals and charts once back in class.

Field Studies Council ID guides available here
Useful ID apps: PictureThis
Plant.id
iNaturalist

N.C. statement: explore and use classification keys to help group, identify and name a variety of living things in their local and wider environment (Year 4)

Wildlife guides

Give pupils time to get familiar with local plants and animals either in your school grounds or wider area. This could include using simple guides, making notes, taking photographs, creating sketches and recording noises.

Pupils can then use the information they have gathered, plus any further necessary research, to create their own guides or keys to local living things. This could form a cross-curricular writing unit.



N.C. statement: explore and use classification keys to help group, identify and name a variety of living things in their local and wider environment (Year 4)

Changing environments

Use photos of your school site/local area to compare with historical photographs. Pupils can then discuss their observations about how the environment has changed over time and whether they think these changes might have helped or harmed local wildlife (including plants).



Bison Hill; 1931 and 2021

Take pupils out around your school grounds or an accessible green space and provide them with a simple map of the area. Using different coloured markers or sticky notes, ask pupils to map on changes that are safe and helpful and changes that might be dangerous to living things. For example, excessive mowing would mean fewer habitats for insects; litter found could be a danger to wildlife; a wildflower area will help to support pollinators; bird houses can provide shelter.

Following this investigation, give pupils time to consider and share their mappings. Are there any areas where they can identify room for improvement? What practical actions could they take as a group to reduce any dangers they have spotted or to improve the space for living things? This could be the basis for an extended and/or cross-curricular project, where pupils put their suggestions into action.

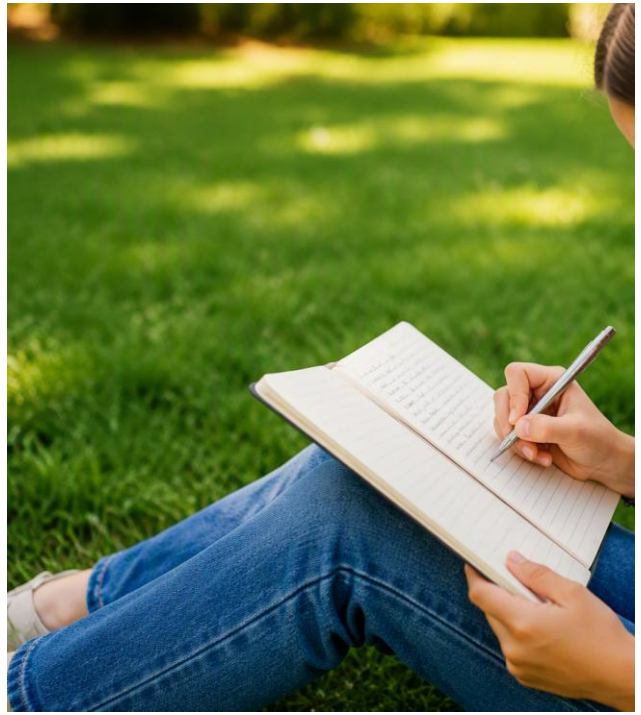
N.C. statement: recognise that environments can change and that this can sometimes pose dangers to living things (Year 4)

Life cycle changes

Provide opportunities throughout the year for pupils to observe life cycle changes in your local school environment, both animals and plants.

Consider and discuss the weather, any seasonal changes to the environment, and what is on offer in terms of food, water and shelter.

When learning about the work of naturalists and animal behaviourists, show pupils examples of how these scientists recorded their work and observations. This could inspire how pupils make their own recordings, mapping the changes they observe throughout the year.



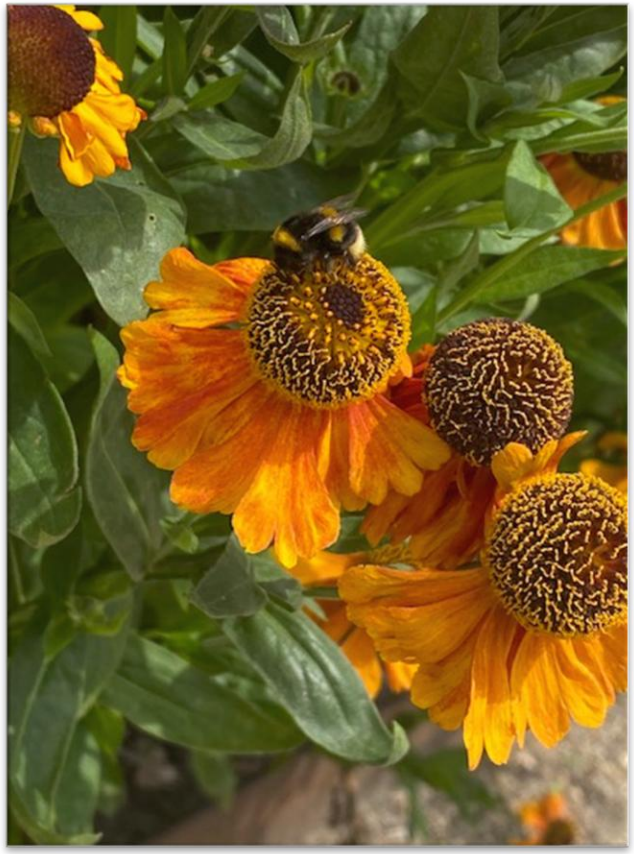
N.C. statement: describe the differences in the life cycles of a mammal, an amphibian, an insect and a bird (Year 5)

Investigating pollinators

To investigate the reproduction of flowering plants, take pupils outside to observe flowering plants and watch pollinators visiting these.

Ask pupils to keep a record of the types of insects observed, which flowers are most visited and the frequency of visits. This data could then be used to create charts and see if any patterns can be found.

You could also take magnifying glasses with you to look at flower structures or use our **sorting mat** to dissect the different parts of the plant and examine these more closely.



N.C. statement: describe the life process of reproduction in some plants and animals (Year 5)

Flowering plant reproduction

Challenge pupils to find examples of flower buds; open flowers; pollination in action; developing fruits and seed heads in your outdoor area.

They should take photos of their findings and use these to create their own visual timeline of the plant reproductive process.

These can then be used back in class as visual prompts for pupils to write explanations for each of the different stages.











N.C. statement: describe the life process of reproduction in some plants and animals (Year 5)

Plant cuttings

Show pupils how to take cuttings from parent plants. Once the cuttings have started to grow roots, take pupils out to a suitable place in your outdoor area to plant these.

You could also plant packets seeds of the same plant alongside your cuttings to demonstrate how growing from a cutting can be quicker and more efficient than germinating and growing from seeds.

Encourage pupils to keep recordings of their cuttings changing over time: this could be done by recording the number of roots, leaves and length of the stem; creating labelled diagrams and explanations; recording a video diary; or annotating photographs.



N.C. statement: describe the life process of reproduction in some plants and animals (Year 5)

Classifying organisms

Take pupils on a living things hunt. They should make note of both animals and plants that they find; you may want to provide ID sheets or access to ID apps to support pupils with this.

Initially, ask groups to classify their findings in any way of their choosing with no limit on the number of groupings. Encourage pupils to think scientifically and draw on prior learning to support this.

Once they have had an opportunity to consider different groupings, ask pupils to classify their animals into their distinct vertebrate and invertebrate groups (our **invertebrate ID mat** and/or **classification key** can support with this).

This activity can also be used when learning about Carl Linnaeus, and how Robert Whittaker built on his system of sorting to create the Five Animal Kingdom Classification System.











N.C. statement: describe how living things are classified into broad groups according to common observable characteristics and based on similarities and differences, including micro-organisms, plants and animals (Year 6)

Odd one out

Using examples of organisms that exist in your outdoor area, ask pupils (either individually or in groups) to choose three or four specimens and consider the observable characteristics of each living thing. They could also think about habitats, diet, seasonality and offspring.

How many similarities and differences can they find between each? Ask pupils to present their ideas to the rest of the class (or another group) and explain which organism they ultimately think is the odd one out.

Can they convince the rest of the class with their reasoning?

Odd one out?







N.C. statement: describe how living things are classified into broad groups according to common observable characteristics and based on similarities and differences, including micro-organisms, plants and animals (Year 6)

Habitat comparisons

Choose two or more contrasting habitats on your school site for pupils to observe and compare.

Using magnifying glasses and ID sheets, pupils should record a sample of the organisms found in the different habitats and tally of the number of species.

Once the data has been collected, pupils can create graphs to present their results and classify their findings.

Where in your outside area has the greatest abundance of living things? Can pupils explain why?



N.C. statement: describe how living things are classified into broad groups according to common observable characteristics and based on similarities and differences, including micro-organisms, plants and animals (Year 6)

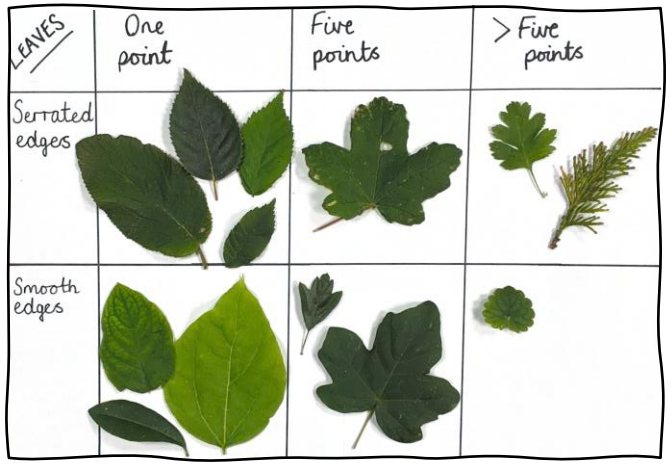
Leaf classification

As a class, collect as many leaf specimens from different trees as possible. On whiteboards, pupils could create annotations around their leaf samples to ensure they have noticed specific characteristics. These can be photographed for reference.



Pupils can then use their leaves to create a classification key – encourage them to consider redrafting their questions to ensure their key flows well, particularly the initial question to split the leaves into two groups. Before finalising, swap with another person or group to trial the keys.

Alternatively, pupils could create Carroll diagrams from their leaf selection, which would encourage careful consideration of the leaves' particular features in order to group appropriately.



N.C. statement: give reasons for classifying plants and animals based on specific characteristics (Year 6)

Rocks, Soils and Fossils

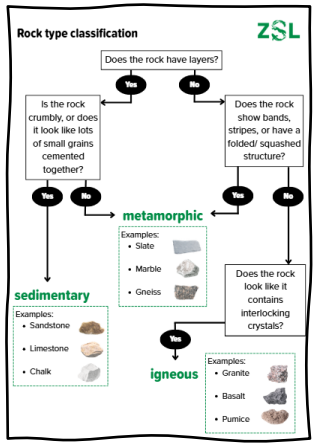
- Year 3

Identify local rock types

Once pupils have had a chance to explore examples of a range of rock types, head outside to find out which type of rock (igneous, sedimentary or metamorphic) is most abundant in your outdoor area. This includes rocks found on the ground and any that have been used for building purposes. If possible, you could also explore spaces such as parks and churches.



Rock types classification key available here

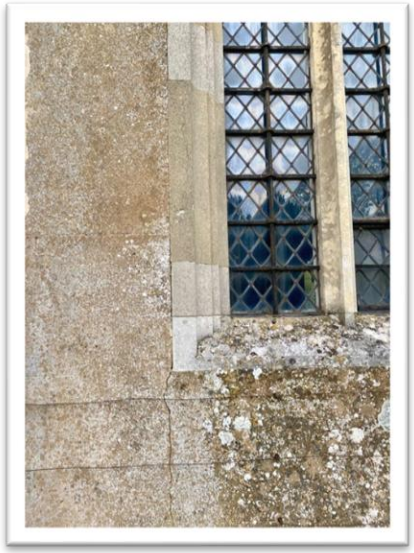


N.C. statement: compare and group together different kinds of rocks on the basis of their appearance and simple physical properties (Year 3)

Physical properties of rocks

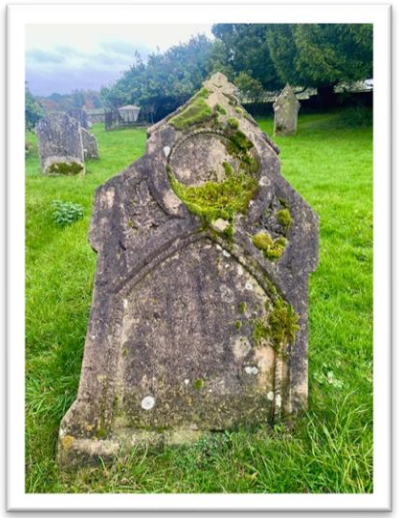
As a class, take a rock-hunting walk to discover which objects around your school (and, if possible, wider area) are made from rock. Use classification keys to find out which type of rock has been used in each instance.

For each example you come across, discuss why rock has been chosen as the most appropriate material (over other materials like wood, glass, metal, etc.). If pupils are already familiar with the physical properties of different types of rocks, you could ask why one type has been chosen for a job over another, for example, why is slate used for roof tiles rather than chalk?









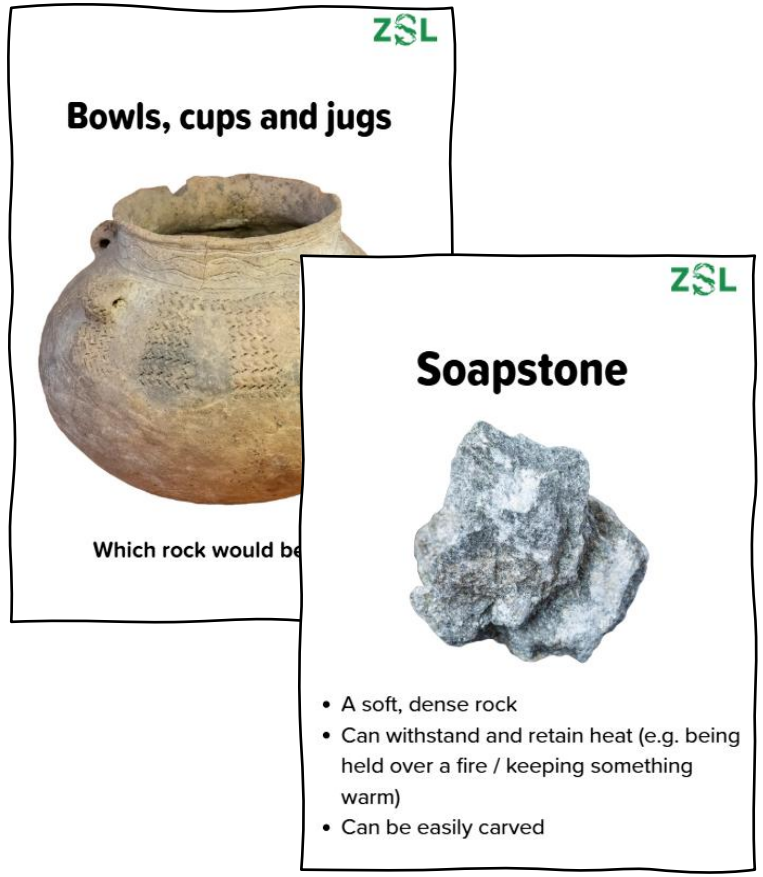
N.C. statement: compare and group together different kinds of rocks on the basis of their appearance and simple physical properties (Year 3)

Historical uses of rocks

As a cross-curricular link if your class is covering the Stone Age, remind pupils that in this period of history humans only had natural materials like rocks to build and make things from.

The type of rocks these people had access to would have depended on where they lived. Consider which sort of rocks you can find in your outdoor area. What sort of objects could be made using the examples you find? Are there any flint stones that could be used for a spear, chalk that could be used for drawing on cave walls or heavy stones that could be used for grinding?

You could set up a match-up hunt around your outdoor area using our cards that require pupils to match the most suitable rock to an object based on its physical properties.



Match-up cards available here

N.C. statement: compare and group together different kinds of rocks on the basis of their appearance and simple physical properties (Year 3)

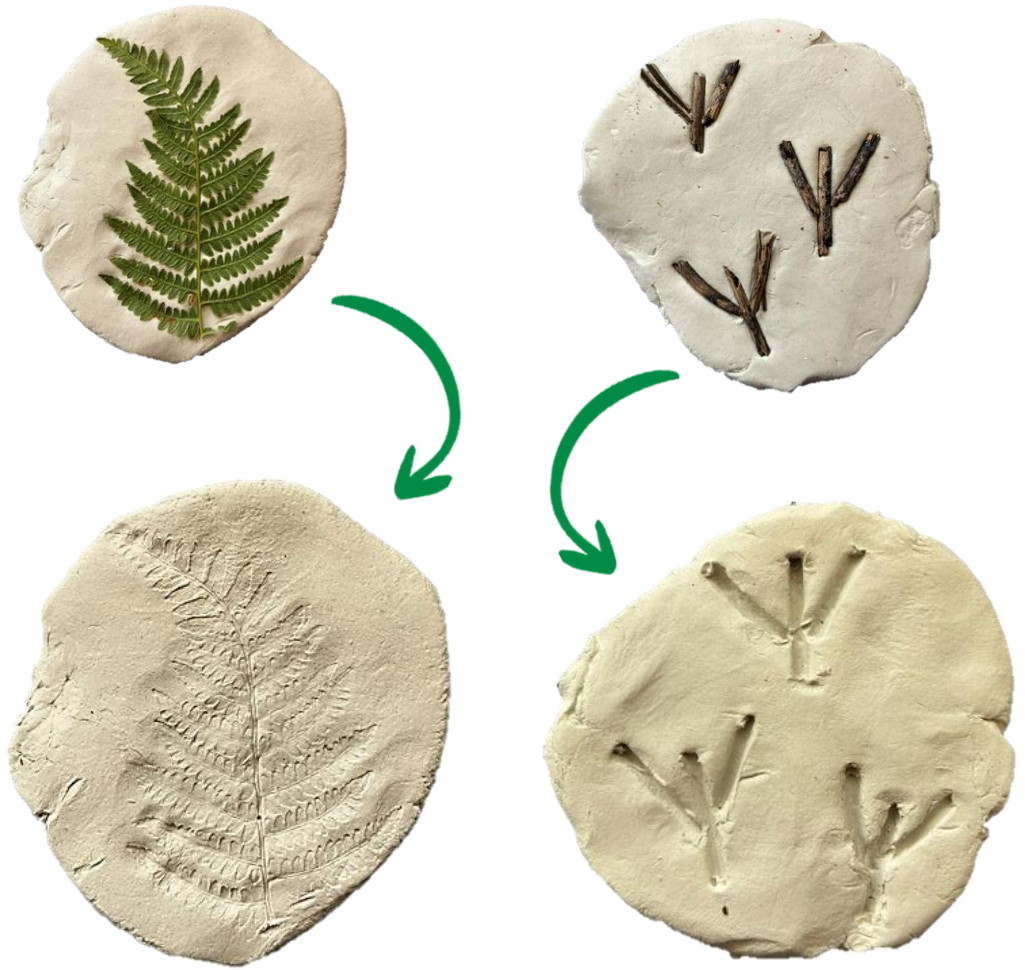
Clay fossils

Create models of imprint fossils using clay and natural objects from your outdoor area. Pupils could collect leaves, seeds, sticks, feathers, plus any other items that would leave a distinct shape in the clay.

Explain to pupils that the clay represents the layer of sediment that your object is to be pressed into firmly enough to leave an imprint.

The period it takes for the clay imprints to dry out represents the many years it takes for the sediments to become compacted and turn into hard rock.

Take a photo of pupils' creations once they have dried and ask them to write an accompanying explanation of how imprint fossils are created.



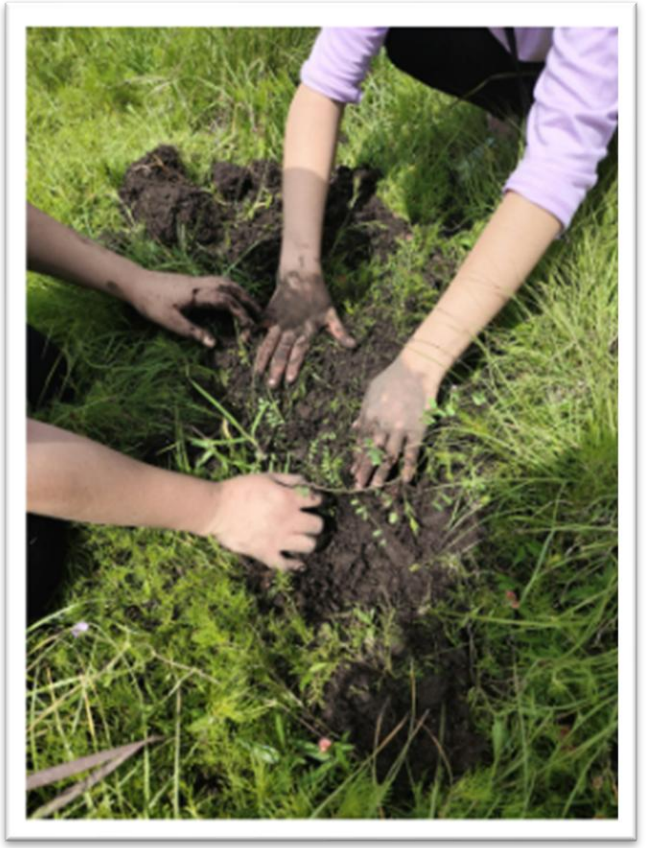
N.C. statement: describe in simple terms how fossils are formed when things that have lived are trapped within rock (Year 3)

Investigating soil

Collect soil samples from three different locations; these do not all have to be from your school site. Share the samples onto labelled paper plates so that all pupils have something to look at.

With the help of magnifying glasses, ask pupils to inspect their soil samples closely and make notes on their observations of colour, smell, texture, contents (e.g. presence of any living things or sticks, leaves, etc.) and water retention. They might also find evidence of decomposing material.

You could conduct further enquiries into the soil on your school grounds to find out which area has the healthiest soil; which soil holds the most water; which soil has the most organic matter, for example.



N.C. statement: recognise that soils are made from rocks and organic matter (Year 3)

Investigating soil continued

Take jars to sample sites around your school grounds and add a few tablespoons of soil to each.

Fill the rest of the jar with water and then give the mixture a good stir.

Leave the soil to settle over the course of a lesson and investigate the different layers that it has separated into.

Gravel and any heavier sediments will have settled at the bottom of the jar, followed by a layer of sand, a layer of silt and a layer of clay or clay particles in the water. Organic matter will float at the top of the jar.

Ask pupils to compare the proportion of sand, silt and clay between the different samples. What does each jar show? Can pupils reason about any differences, considering the locations where each sample was retrieved from?



Location 1



Location 2

N.C. statement: recognise that soils are made from rocks and organic matter (Year 3)

Soil and plant growth



For this activity, collect different types of soil to investigate which is best for flowering plant growth. Options for soil types include sandy soil, clay soil, loamy soil, chalky soil, garden soil, potting compost, sand-rich soil and woodland soil. Choose three or four to compare.

Fill pots with the different soil types and plant a seedling in each pot. Ensure the pots are labelled, then find a safe place in your outdoor area for these. After potting and having had the opportunity to experience the soil tactilely, ask pupils to predict which soil they think will help the plant grow best and why.

Decide how best to measure and record plant growth. Pupils could measure the height of the plant each week, count the number of leaves or flowers, or make observations on the overall health of the plant.

At the end of the investigation, ask pupils which soil they would recommend for a school garden. Which soil produced the tallest/most/healthiest flowers?

N.C. statement: recognise that soils are made from rocks and organic matter (Year 3)

Light

- Year 3
- Year 6

Outdoor reflective materials

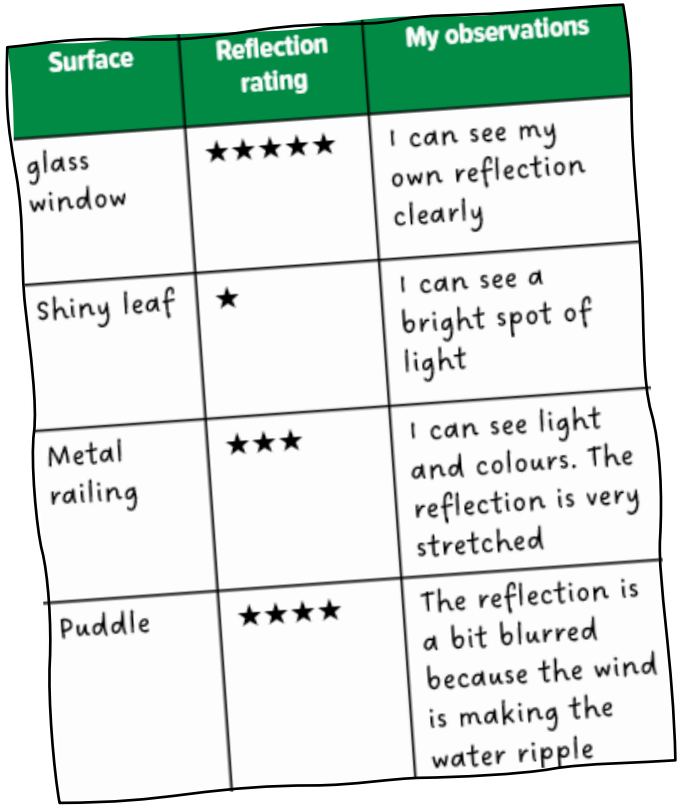
On a sunny day, investigate places around your school grounds that reflect light.

Tell pupils to look particularly carefully at windows, metal railings, car bodywork, puddles, painted surfaces, waxy leaves and any other examples you might find.

Pupils should record the surface they have found, the amount of light reflected (using their own rating scale) and what they observed.

This data can then be used to answer the enquiry question, 'Which outdoor surfaces reflect the most light?' Pupils can rank the surfaces from most to least reflective.

As part of your concluding discussions, you could ask pupils to consider whether rough or smooth surfaces make for better reflections and why, for example, glass is a better reflector than a brick wall.



Surface	Reflection rating	My observations
glass window	★★★★★	I can see my own reflection clearly
Shiny leaf	★	I can see a bright spot of light
Metal railing	★★★	I can see light and colours. The reflection is very stretched
Puddle	★★★★	The reflection is a bit blurred because the wind is making the water ripple

N.C. statement: notice that light is reflected from surfaces (Year 3)

Investigating UV light

Use UV beads to demonstrate for pupils the strength of the sun's UV rays (despite its distance from earth) and the importance of sunglasses.

Observe the UV beads before taking them out into sunlight and record/photograph this.

Put some beads in petri dishes (or another small container) and use a range of glasses to test the effectiveness of different lenses on blocking UV exposure. Options could include sunglasses (including one pair with labelled UV protection and one pair without), swimming goggles, reading glasses, blue light blocking glasses, sports eyewear, or any similar options you have available.

Leave one set of UV beads completely exposed to sunlight, while shielding the others with your chosen lenses. After an agreed period, quickly take photos of each set of beads, then display these so that pupils can make conclusions about the results of the investigation. Which lenses provided the best protection?



N.C. statement: recognise that light from the sun can be dangerous and that there are ways to protect their eyes (Year 3)

Investigating UV light continued

A similar investigation can be conducted to demonstrate the effectiveness of suncream versus other liquids, or to compare different factors of suncream.

Place UV beads in petri dishes and put different factors of suncream in the lids of each. Alternatively, use suncream and a range of other liquids, for example, oil, moisturiser, water, shower gel, hand sanitiser.

Place the lids wrong side up over the bottom half of the petri dishes. Remember to leave one set of beads uncovered completely. Leave the dishes exposed to sunlight for an agreed amount of time, then photograph each set of beads to make comparisons and draw conclusions about the effectiveness of each suncream factor or suncream in comparison with other liquids.



N.C. statement: recognise that light from the sun can be dangerous and that there are ways to protect their eyes (Year 3)

Blocking light with different objects

On a sunny day, take a range of objects outside made from a different materials (e.g. a plastic bottle, book, wooden block, plastic sheet, colander) and ask pupils to predict which ones they think will make a shadow and what shape the shadow will take on.



Pupils place the objects in sunlight and observe:

- Which objects create clear shadows?
- Which objects create faint shadows?
- Which objects allow light through?

This can support learning about opaque, translucent and transparent materials.

Ask pupils to explain why some objects made darker shadows than others. Could these shadows exist if it was an overcast day?

N.C. statement: recognise that shadows are formed when the light from a light source is blocked by an opaque object (Year 3)

Studying shadows

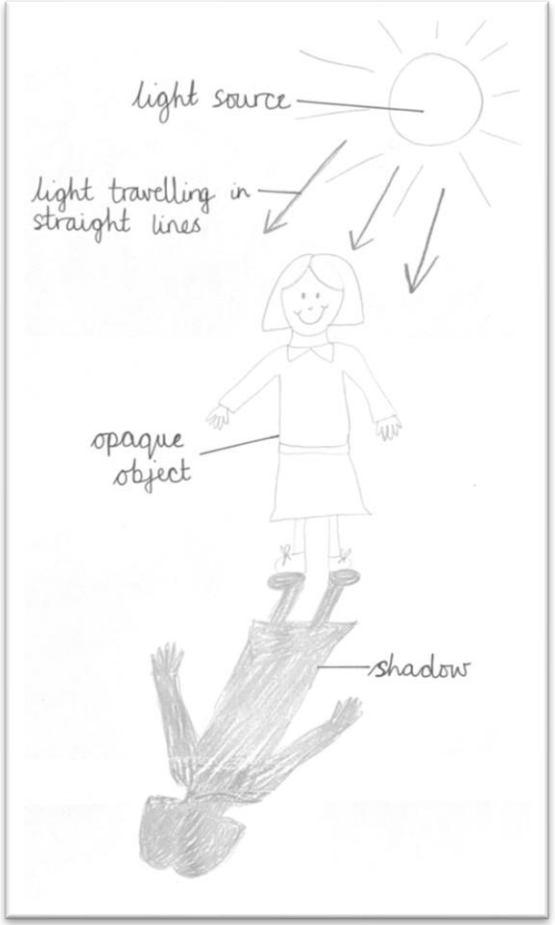
Ask pupils to study a partner's shadow closely on a sunny day.

Can they draw a diagram recreating the positioning of the light source, the opaque object and the shadow formed accurately?

Discuss how their partner's shadow should be drawn facing the opposite direction of the light source, that the shadow should be the same shape as the object, and that it should start from the base of their partner (i.e. their feet).

How accurate can they make their diagrams?

Top tip: turning the paper around when drawing the shadow helps!



N.C. statement: recognise that shadows are formed when the light from a light source is blocked by an opaque object (Year 3)

Shadow measurements

Head outside at various times on a sunny day to investigate what patterns pupils can find between the time of day and the length of their shadows.



Ask pupils to work in partners or groups to support each other with measuring the length of their shadow. The first time they do this, they should also draw around their feet and initial these so that they can return to the same spot each time.

At another two or three points during the day, take pupils back outside so they can re-measure and record their shadow length.

What patterns can pupils identify in their results? Can they explain why their shadows changed size?

Pupils could use their measurements to create a simple line graph showing shadow length against time. Can they use this to make predictions about future shadow lengths: for example, what might happen to the length later in the afternoon?

N.C. statement: find patterns in the way that the size of shadows change (Year 3)

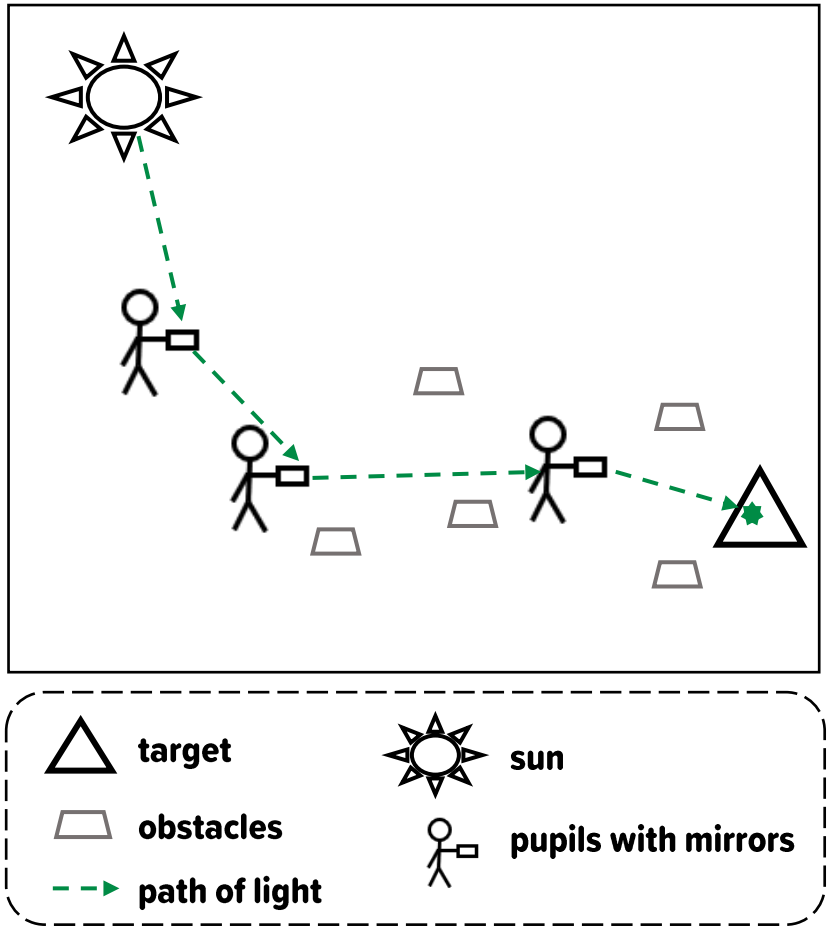
Directing sunlight

Set up ‘targets’ around the playground, for example, large cones or buckets, and then create obstacles (e.g. smaller cones) so that pupils cannot stand directly between the sun and the target.

Provide each group with enough small mirrors for one per child. Pupils must then work in teams to arrange themselves in a way that allows them to ‘direct the sunlight’ onto the target, using the mirrors’ reflections.

Once each group has managed to direct light onto their target, ask them to also investigate what happens to the direction of light if they move their mirror slightly. After some experimentation with different angles, are they able to predict which route the reflected light will take?

You could create further challenge by asking groups to see if they can direct the light around corners.



Healthy and safety: Remind pupils not to look directly into sunlight and take care when reflecting beams in their mirrors.

N.C. statement: recognise that light appears to travel in straight lines (Year 6)

Light's pathway to the eye

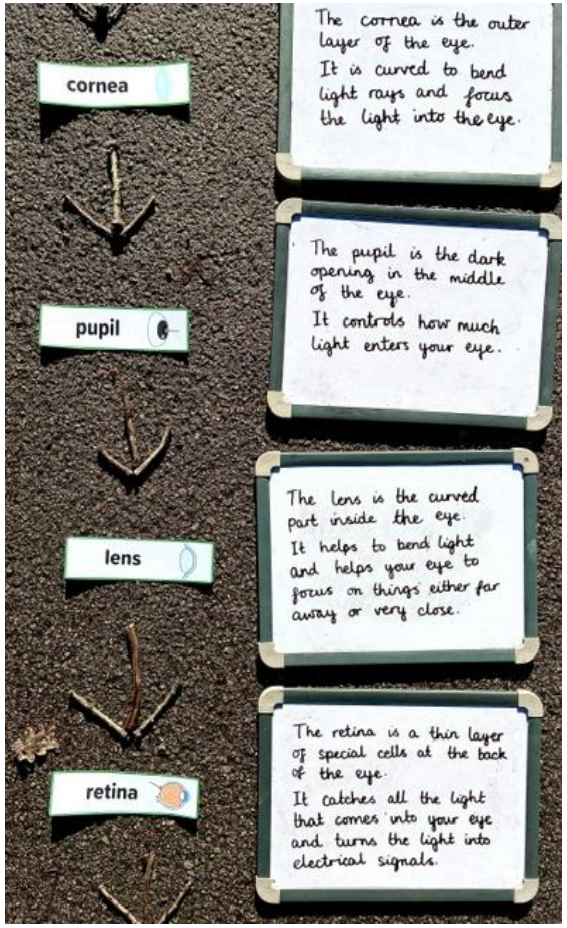
Provide pupils with word cards and sticks, and challenge them to create a pathway showing how light travels:

Light source | **Cornea** | **Pupil** | **Lens** | **Retina** | **Optic nerve** | **Brain**

In groups, pupils will need to put the word cards in the correct order and use sticks to create arrows showing the direction the light travels between each.

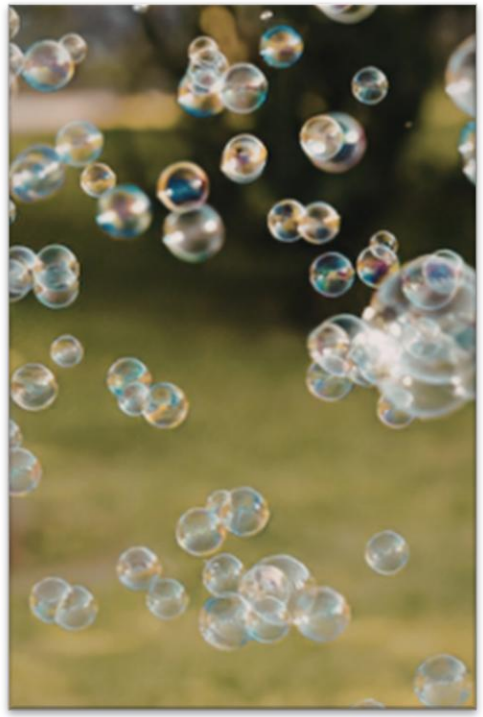
Once they have decided on the order, they then explain the light's journey and the function of each part. They could do this verbally and record one another on a tablet or write short explanations on whiteboards.

Extend pupils with questions about specific parts of the eye, such as 'What would happen if the pupil could not get larger?' and 'Why is the retina at the back of the eye?'



N.C. statement: use the idea that light travels in straight lines to explain that objects are seen because they give out or reflect light into the eye (Year 6)

Light phenomena



Blowing soap bubbles is a fun way for pupils to observe the colours and patterns in the light spectrum. Explain to pupils that it is not the soap producing the colours but is in fact light waves reflecting off both the inner and outer surfaces of the bubble's wall.

The bubble walls are incredibly thin, though there will be different thicknesses across the surface which is why we see the different colours. The thin film of the bubble wall separates the colours by reinforcing certain wavelengths while cancelling others.

Tell pupils to observe 'older' bubbles closely: the longer a bubble lasts, the more liquid will be pulled downward by gravity. As the top becomes thinner, it will display different colours.

If you have access to light prisms you could also use these to explore colour separation, or coloured filters to demonstrate how a filter of a certain colour will transmit that colour wavelength while other colours are absorbed or reflected.

N.C. statement: explain that we see things because light travels from light sources to our eyes or from light sources to objects and then to our eyes (Year 6)

Experimenting with shadows

This activity could be a short starter to recap prior learning about shadow formation and size.

Challenge pupils/groups to make:

- The shortest shadow,
- The longest shadow,
- And the widest shadow they possible can.

Ask pupils to think where the shadow forms in relation to the object (i.e. themselves). Is it in front or behind them? What is stopping the light from reaching the ground and why can it not get past the blockage?

Pupils could also take the opportunity to hold natural objects up in sunlight and compare the object with its shadow. What does a shadow show? What does it not show – for example – when compared with the **reflection** of an object?



N.C. statement: use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them (Year 6)

Sound

- Year 4

Outdoor vibrations

Ask pupils if they think it is possible to make a sound without something moving. Explain that sound is created through vibrations, and that sometimes we can see and/or feel these.



Have pupils work in partners to place an elastic band around two twigs and pull the twigs taught. When they pluck the elastic band, they should both listen to the sound it produces and watch for visible vibrations. They may also feel these. Once they have had opportunity to do this a few times, tell them to pluck the elastic band then still it with their fingers. What happens to the sound when the vibration is stopped?

After this, allow pupils to investigate what other noises they can make using outdoor materials, e.g. tapping two sticks together, rustling leaves, scraping sticks along a fence or wall, dropping pebbles onto different surfaces, tapping on tree trunks. For each sound made, ask pupils to explain or record what was making the sound and the object vibrating. Were they able to feel the vibrations produced during any of their tests?

N.C. statement: identify how sounds are made, associating some of them with something vibrating (Year 4)

Insulating sound

To look after the ears of staff on playground duty, task pupils with testing different materials to find out which is best at insulating sound.



Provide groups with a range of materials to choose from, for example: tin foil, cotton wool, felt, bubble wrap, paper/newspaper, packing polystyrene, fabric, sponge, etc.

Pupils could hold these materials to their ears or put them in containers such as plastic cups. They must try to keep things fair by using the same amount of material each time.

Out on the playground, have the rest of their group use their “outside voices”, both close to the person with the material and further away. (Alternatively, you could make use of another class’ outdoor PE lesson as your noise provider.)

Which materials muffled the sound best? Can they explain why? How would they describe the materials that were best at insulating the sound?

N.C. statement: recognise that vibrations from sounds travel through a medium to the ear (Year 4)

Outdoor pitch

Outdoor objects can be used to investigate how shorter, tighter, thinner or smaller objects will produce higher pitches and those that are longer, looser, thicker or larger will produce lower pitches:

- Use different lengths and widths of stick to tap against a log, fence or another stick
- Blow across different lengths of bamboo stick
- Stretch different types of elastic bands around sticks: thinner and thicker bands, plus bands stretched tightly and more loosely
- Drop or tap small pebbles and larger stones on the ground

Each time, pupils should record the length/width/size/tightness of the object and whether a low, medium or high pitch is produced. A pattern should emerge as they collate their results.



N.C. statement: find patterns between the pitch of a sound and features of the object that produced it (Year 4)

Investigating volume

To demonstrate that sound is a form of energy, have pupils complete a task that requires different levels of their own energetic input to investigate what effect this has on the volume of the sound produced.



Have pupils stand fairly close to one another on the playground and start by walking/marching on the spot. Use a decibel metre or an app reader to measure the volume produced by this activity, positioning this close to or on the ground. Next, ask pupils to start jogging on the spot; again, record the decibel reading produced. Finally, ask them to sprint as fast as they can and record the decibel reading.

Ask pupils to reflect on why they think their footfall got louder as they increased their speed. This purpose of this activity is to show that the more energy we put into making a sound, the louder the sound will be.

Discuss that the size of an object will also affect volume: do they think Reception class would produce the same decibel readings as theirs if those pupils undertook the same activity?

N.C. statement: find patterns between the volume of a sound and the strength of the vibrations that produced it (Year 4)

Sound and distance

Ask pupils to think of examples of things sounding louder when they are closer and quieter as they move further away; for example, a train approaching a station and moving off again.

To demonstrate how sound waves lose energy the further they travel (and therefore sound quieter by the time the vibrations reach the ear drum), download a decibel reading app. You could use one device as a whole class or, if you have access to multiple devices, let pupils work in groups.

Mark distances on the playground to move between, for example at two- or five-metre intervals. Have someone stand at the point marked zero metres and use an instrument or something similar to make a clear noise.

The class or groups move between the marked intervals, though the person with the instrument should remain at zero metres throughout. Record each decibel reading. What do pupils notice happening as they move further away from the object making a noise?



Distance (metres)	Sound (decibels)
0	55
2	52
4	50
6	47
8	45

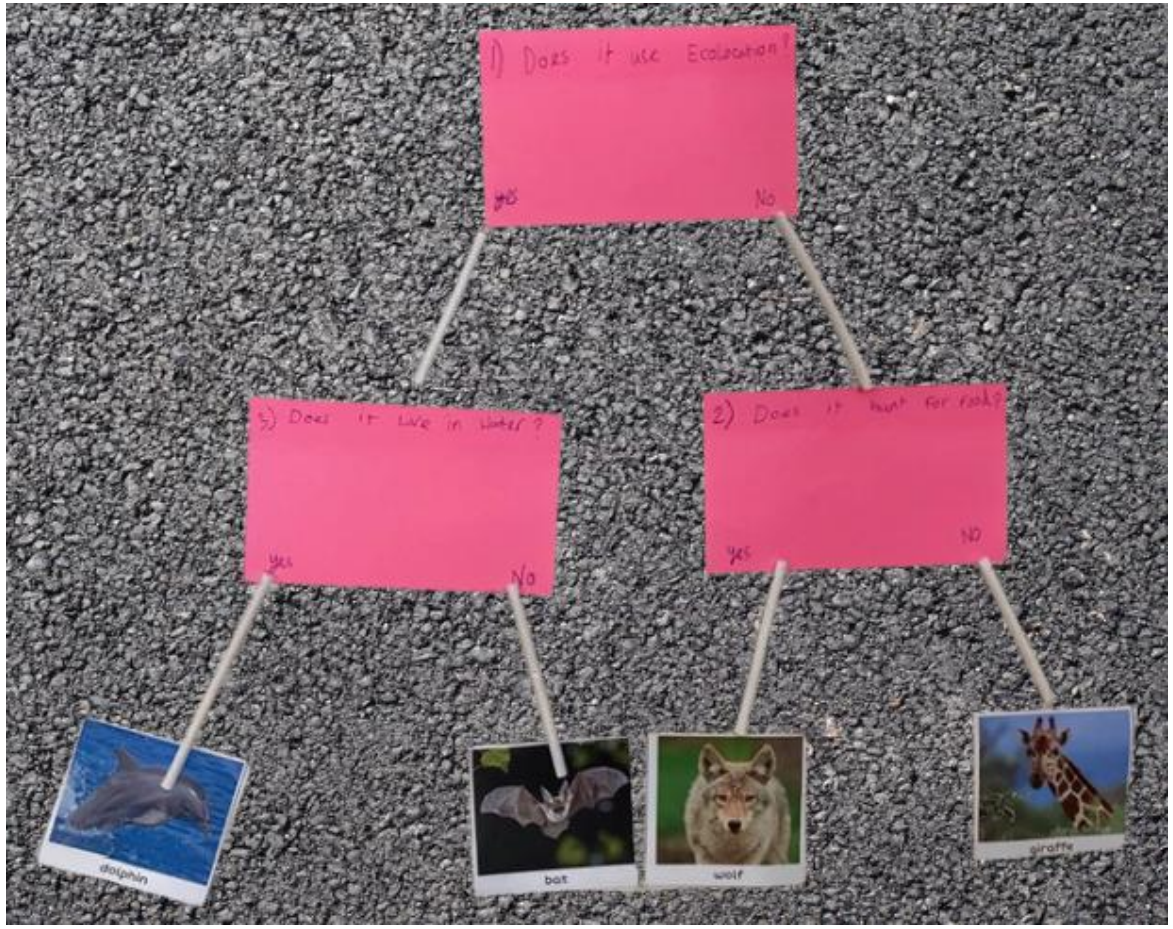
N.C. statement: recognise that sounds get fainter as the distance from the sound source increases (Year 4)

Animal hearing adaptations

Look at pictures of predatory animals and consider how their ears are shaped and positioned, and how these adaptations support their lifestyle. Make comparisons with pictures of herbivorous animals that have large, cup-shaped ears, such as deer, red squirrels and hares. Why is hearing such an important feature for these animals?

Provide pupils with pictures of a range of animals and ask them to create classification webs using largely hearing/ear-related questions to group their creatures.

Pupils could use post its or whiteboards to record their questions and create their keys using chalk or art straws.



Electricity

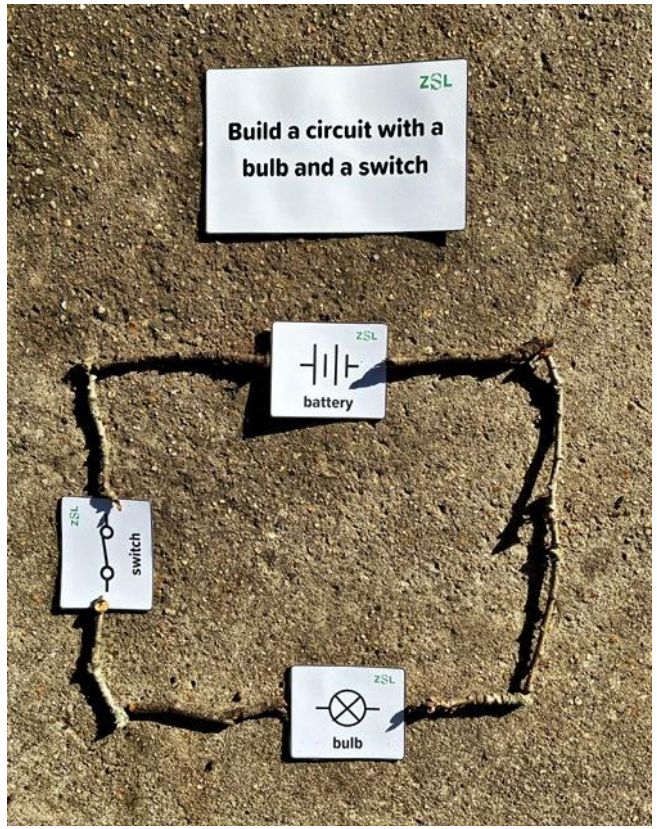
- Year 4
- Year 6

Circuit relay

Pupils collect cards of electrical circuit components from around the playground or in a relay formation to build working circuits as specified by a series of challenge cards.

Pupils must ensure they only select the required components and that they have placed these in an order that will produce a working circuit.

If you want to save on printing, pupils can collect sticks to take the place of wires to connect the components.



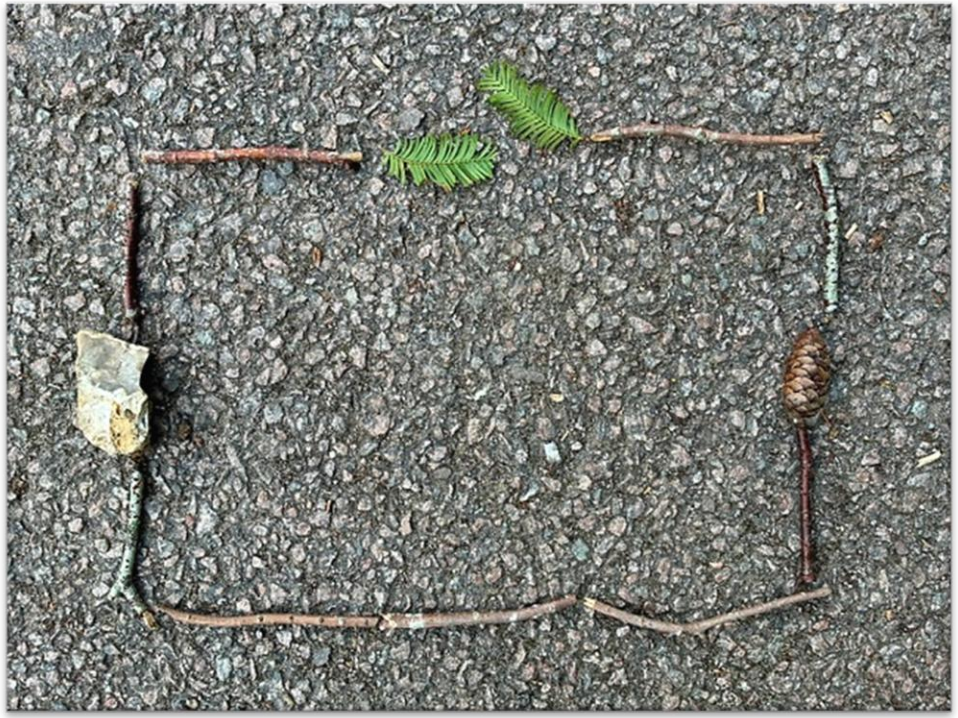
Circuit symbol and challenge cards available here

N.C. statement: construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers (Year 4)

Natural diagrams of electrical circuits

To test pupils' understanding of complete electrical circuits, challenge them to build these out of natural materials. Discuss as a group beforehand which objects will represent each part of the circuit or see if pupils can identify in each other's diagrams how each part has been represented.

Pupils should also make examples of circuits where the lamp will not light. Can someone else explain why it won't?



N.C. statement: identify whether or not a lamp will light in a simple series circuit, based on whether or not the lamp is part of a complete loop with a battery (Year 4)

Circuit roleplay

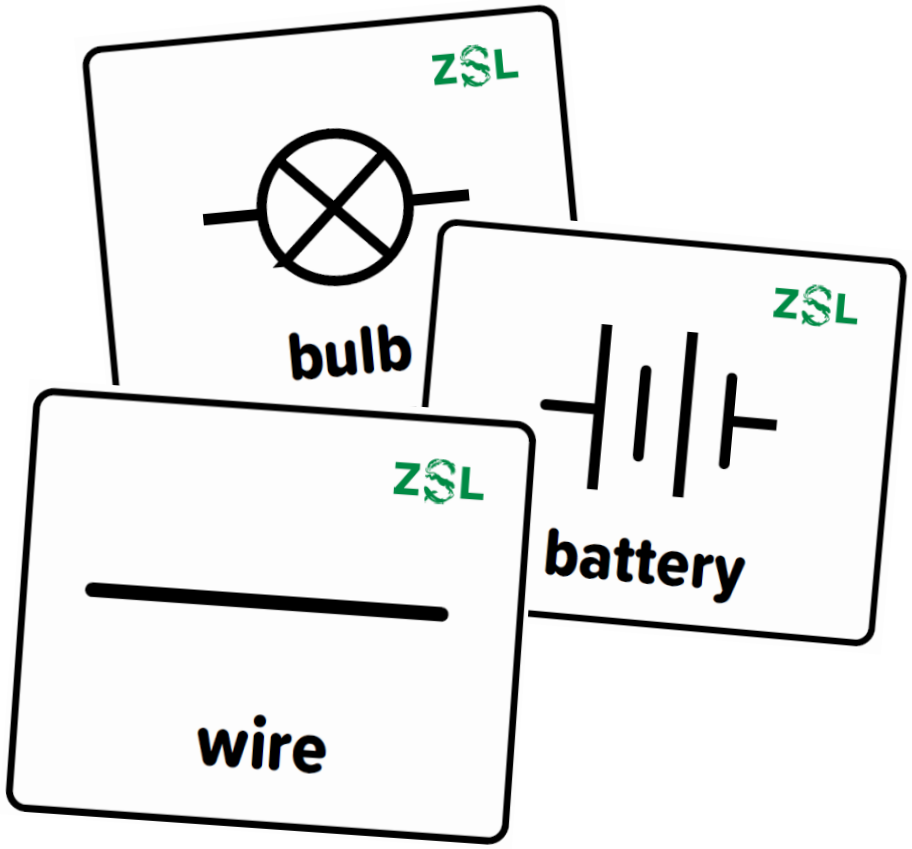
Put pupils into groups of five or more and hand each a card specifying their role in the circuit (e.g. a group could consist of three wires, one battery and one bulb).

Pupils should organise and connect themselves so that the ‘bulb’ or ‘buzzer’ in the group is able to turn on. When everyone is connected, pupils should all raise their arms and shout, “The bulb is on!”

What would happen if a wire was missing?

Introduce a switch pupil to the circuit, who can break the circuit by letting go of hands.

What happens when the switch is open?



Circuit symbol cards available here

N.C. statement: recognise that a switch opens and closes a circuit and associate this with whether or not a lamp lights in a simple series circuit (Year 4)

Investigating outdoor materials

Equipped with magnets, ask pupils to search the outdoor area for objects made from metal, wood, plastic, brick, rubber and/or any other materials present.

While outside or once back in the classroom, predict which materials would allow electricity to flow. Pupils could sort their findings into ‘Likely conductors’ and ‘Likely insulators’.

If pupils have recorded the objects they have identified as well as the materials these are made from, you could have further discussions around what potential issues there would be if certain objects in your outdoor area were made from metals that conduct electricity.



N.C. statement: recognise some common conductors and insulators, and associate metals with being good conductors (Year 4)

Natural material conductors

Ask pupils if they think there are any natural materials in your outdoor area that could complete a circuit, for example: twigs, stones, grass, leaves, wet soil, dry soil, sand, puddle water.

Collect samples in pots and allow pupils to investigate adding these components into circuits by attaching them to wires. Ensure that when pupils are investigating puddle water or wet soil that an adult is supervising.

Pupils will have likely predicted that twigs and stones will be insulators of electricity, but may be surprised to find that wet materials can conduct electricity due to the presence of minerals and salts.

This helps to reinforce why electricity and water need careful handling. Ensure you have risk assessed this activity before carrying it out with your class.



Material	Bulb Lit?
Dry soil	No
Wet soil	Dimly
Puddle water	Dimly
Twig	No
Leaf	No

N.C. statement: recognise some common conductors and insulators, and associate metals with being good conductors (Year 4)

Birds and electricity



If there are cables or wires near your school, take pupils out to look at these and ask (if there aren't already any birds perched up there!) if they have seen birds sitting on these sorts of wires before.

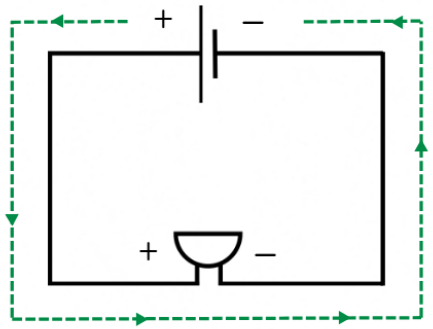
Why do they think birds are able to safely sit on power lines?

This can be investigated back in the classroom by connecting a simple circuit between wires, battery and a bulb. Then, introduce a 'bird': this could be a small peg or pupils' fingers. The 'bird' should touch two points on the same wire (to replicate the bird's feet perching). Has anything changed? No – the bird is touching the same wire in two places, so the circuit isn't broken and electricity is able to keep travelling along the wire.

However, if you insert a paperclip into the circuit to connect one of the wires to the bulb, then the paperclip is connecting two places with different electrical energy. If the bird were to perch with one foot on the wire and one on the paperclip, then it would be in danger as it would become part of the electrical path.

N.C. statement: recognise some common conductors and insulators, and associate metals with being good conductors (Year 4)

The flow of electricity



To revise simple circuits from Year 4, pupils work in groups to model the flow of electricity through a circuit: one person is the cell, one person is a buzzer, and everyone else is wires. Each person should start with a tennis ball or another small ball. The people acting as the cell and buzzer should also have something to distinguish their positive and negative terminals, such as a '+' and '—' symbol on a post it note or coloured bands.

All the components stand in a circle, with the buzzer and the cell both standing with their positive terminals connected via the wires.

The circuit "starts" when the cell passes their tennis ball in the direction of their positive symbol. Everyone else starts to pass on their tennis balls in the same direction to show the flow of electricity around the circuit. While the tennis balls are being passed round, the buzzer should be buzzing. As soon as the cell decides to stop passing on its tennis ball, everyone else also stops passing, and the buzzer goes silent.

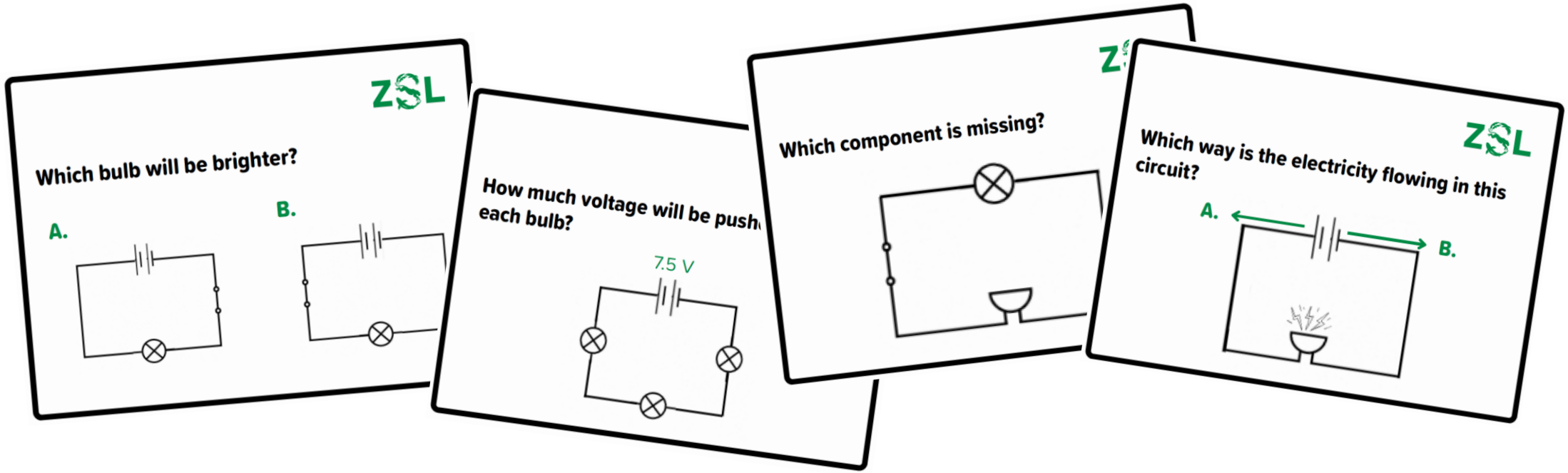
Now move the buzzer so that its negative terminal is connected to the cell's positive terminal. Do pupils think the buzzer will buzz with the terminals connected this way round? Why or why not?

N.C. statement: associate the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in a circuit (Year 6)

Electricity orienteering

As a form of assessing pupils' learning during the topic, place questions and diagrams around the school grounds for pupils to solve in partners or small groups.

Question cards available here

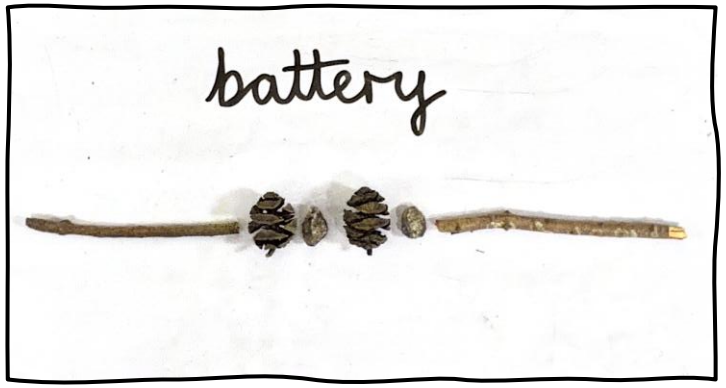


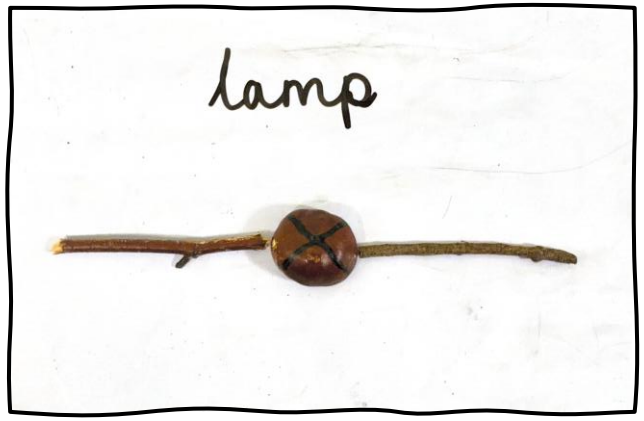
N.C. statement: compare and give reasons for variations in how components function, including the brightness of bulbs, the loudness of buzzers and the on/off position of switches (Year 6)

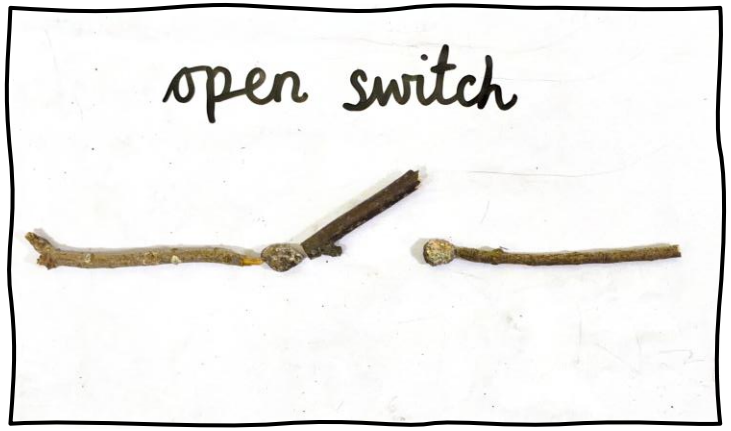
Natural symbols

Challenge pupils to create the electrical symbols that they have learnt using natural materials.

They could label these themselves using post it notes or whiteboards or ask a partner/different group to identify the symbols they have created.









N.C. statement: use recognised symbols when representing a simple circuit in a diagram (Year 6)

Forces and Magnets

- Year 3
- Year 5

Investigating friction

To test the amount of friction created by different materials, provide pupils with toy cars and objects to build ramps with. (Reception class' outdoor provision is often helpful in this instance!)

At the end of each ramp, place a different material and measure how far the car travels along each. These materials could include bubble wrap, thinner and thicker types of fabric, felt, tin foil, paper, wash cloths.

Alternatively, you could test different surfaces already present around your school, including wooden floors, carpet, grass and tarmac.

Ask pupils which materials helped their cars to travel furthest and why they think this is. What instances can they think of in their lives when knowing about the friction of a surface is important?





N.C. statement: compare how things move on different surfaces (Year 3)

Exploring contact forces

Provide pupils with a selection of PE equipment to allow them to explore contact forces. Which actions are enacted by a push or pull? Can any of the objects bend or twist?

For example: kicking a football, catching a ball, hitting a tennis ball with a racket, moving and jumping over a skipping rope, using a hula hoop, throwing foam javelins, using beanbags, running up and down rope ladders. Encourage pupils to be creative with how they manipulate the equipment!

Leave post it notes and large pieces of sugar paper near the equipment for pupils to record their observations and the forces they have identified during their explorations.







N.C. statement: notice that some forces need contact between two objects, but magnetic forces can act at a distance (Year 3)

Investigating magnetic materials

As well as investigating objects around your classroom that are attracted to magnets, make sure to explore your outdoor area, too. Pupils should identify the materials each object is made of to see if they can spot any patterns.

Object	Material	Magnetic?
Desk	plastic top metal legs	× ✓
Window	glass	×
Water bottle	metal lid plastic coating	✓ ×
Water fountain	metal	×
Bench	wood	×

Pupils may come across some objects made of metal that are not magnetic. Use this as an opportunity to discuss which types of metals are magnetic and those which are non-magnetic. Explain how this knowledge is used in recycling centres: large magnets are used to separate magnetic from non-magnetic materials before recycling.

As a class, you could set up a mini recycling plant: head out on a litter pick around your school site. Separate the objects you find into those made from metals and those made from other materials. Pupils can then use magnets to find out which of the metallic objects are made from magnetic metal and those which aren't.



N.C. statement: compare and group together a variety of everyday materials on the basis of whether they are attracted to a magnet, and identify some magnetic materials (Year 3)

Outdoor ‘magnetic’ games

You could play several games outside with pupils where they take on the role of a magnet’s north or south pole to embed their understanding of magnets attracting and repelling.



- **Game 1:** Assign half the class as north poles and half the class as south poles. Provide coloured bibs or other visible markers to distinguish the different poles.
  Pupils spread out in the designated area. When you call out, “Opposites attract!” north pupils must find a south pupil (and vice versa) and link arms or stand shoulder to shoulder.
  When you call, “Same poles repel!” north pupils must ensure they move away from any nearby fellow north pupils and the same for south pupils. The aim is to create as much distance as they can between themselves and any matching poles.

  Reinforce the learning by questioning pupils why they have moved away or towards another person at various points during the game.

N.C. statement: • describe magnets as having two poles (Year 3)
• predict whether two magnets will attract or repel each other, depending on which poles are facing (Year 3)

Outdoor ‘magnetic’ games

- **Game 2:** As in Game 1, separate the class into north and south poles and provide bibs to distinguish this. Choose two north pupils and two south pupils to be magnet catchers. The catchers can only tag people who would be attracted to their pole, i.e. north catchers can only tag south runners. Once tagged, the pupils must freeze until they are ‘repelled’ into action by a tap from a fellow pole.



- **Game 3:** Tell pupils to write down “North” or “South” on a post it note. They should keep the post it note in their hand and take care not to reveal to anyone else what they have written. Outside, tell pupils to move freely around the designated area until you blow a whistle. At this point they must stop and find the nearest person. Each pair reveals to their partner what is written on their post it note. If they are a pair of north and south poles, they should link arms or stand shoulder to shoulder. If they are a pair of matching poles, they should take three large steps away from one another. Repeat several times.



N.C. statement: • describe magnets as having two poles (Year 3)
• predict whether two magnets will attract or repel each other, depending on which poles are facing (Year 3)

Investigating gravity

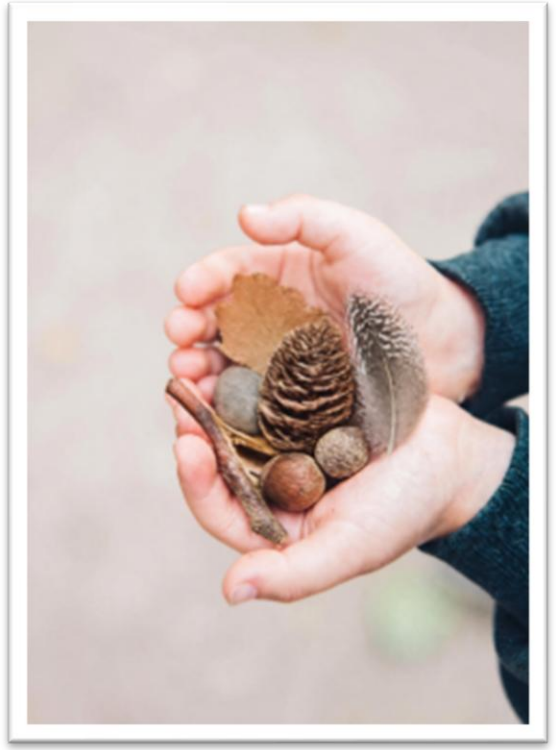
Ask groups to gather 5 to 10 natural objects from your outdoor area. This could include leaves of different shapes and sizes, twigs, seeds (e.g. sycamore “helicopters”), pinecones, pebbles, feathers.

Pupils should predict which object will reach the ground first when dropped from the same height, before dropping pairs of objects simultaneously from a fixed height.

As well as observing and recording which object lands first, ask pupils to make a note of how it falls: does it fall straight down, or does it spin, glide, flutter or other?

If you have time, repeat each drop a few times for reliability.

You might also want to compare how these objects fall inside versus outside to allow pupils to investigate the effect of air resistance on lighter objects like feathers, especially if it is a breezy day.



N.C. statement: explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object (Year 5)

Investigating gravity extension

As an alternative or extension to the previous investigation, groups collect just one object, but the variable is the size, mass, length or shape of each. For example, leaves of different sizes, pebbles of different masses, twigs of different lengths, etc.

Pupils can then use these to investigate whether heavier or larger objects always fall faster, what effect air resistance has on the fall, and if there are any patterns they can identify in their results.

Completing these experiments outside means you can address how air resistance affects the speed at which objects appear to fall. What if there was no air resistance at all? Do pupils think that gravity acts differently on heavier, longer or larger objects compared to those that are lighter, shorter or smaller?



N.C. statement: explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object (Year 5)

Parachute design

Provide pupils with a selection of materials (e.g. fabric, bubble wrap, plastic bags, muffin cases) and string with which to make parachutes of their own design. The aim is to see which group can make a parachute that will stay in the air the longest.

Factors to consider other than the material used will be the size of the canopy, the length of the string and the number of strings used to attach a small mass: for example, you could use yoghurt pots with marbles inside.

Having learnt that gravity will apply equal force on all the parachutes, pupils will be able to observe on how the effect of air resistance differs across their designs.



N.C. statement: identify the effects of air resistance, water resistance and friction, that act between moving surfaces (Year 5)

Experiencing air resistance

To allow pupils to feel the effect of air resistance for themselves, get them to run across the playground in these different scenarios:

- ⇒ Unencumbered, as fast as they can
- ⇒ Wearing a large, unfastened jacket
- ⇒ Holding a large piece of cardboard in front of them
- ⇒ Wearing a resistance training parachute or holding a large piece of material behind them

Ask pupils to discuss the differences in air resistance they experienced and what pattern they noticed between the size of surface area and the force of resistance.



N.C. statement: identify the effects of air resistance, water resistance and friction, that act between moving surfaces (Year 5)

Sinking objects

To demonstrate that water resistance can work against objects moving downwards through water – not just across – use natural objects to investigate which will sink fastest.

Drop the objects into a clear container and time how long it takes for each to reach the bottom. It may also be useful to set up a tablet to record a video in slow motion to more closely observe how each objects moves.

This investigation allows pupils to compare the effects of gravity and buoyancy alongside water resistance.



N.C. statement: identify the effects of air resistance, water resistance and friction, that act between moving surfaces (Year 5)

Investigating friction

Tell pupils that their task is to identify the best surface around your school site to prevent people slipping over.

Using a Newton metre and a weighted shoe, pupils should measure the force required to move across a range of surfaces, including those in your outdoor space.

Which surface provided the greatest amount of friction? Which would pupils recommend for a non-slip surface? Do they think the types of shoe/shoes they investigated with had a significant impact on the results?



N.C. statement: identify the effects of air resistance, water resistance and friction, that act between moving surfaces (Year 5)

Creating outdoor mechanisms



Use objects in your outdoor area to create a range of mechanisms for pupils to investigate:

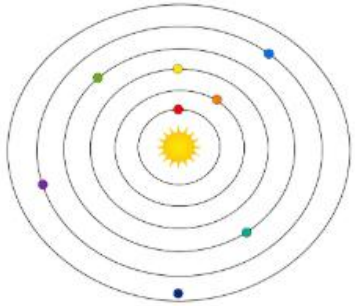
- Create a pulley system by hanging a rope over a strong tree branch. Pupils can compare directly lifting a heavy bucket (e.g. filled with beanbags or similar) to lifting the bucket using the pulley system.
- Use a long plank and a log or another cylindrical object to create a lever. Pupils can test different fulcrum positions and/or different load positions to see what effect this has on the ease of leverage.
- Roleplay how gears transfer movement by having pupils stand in groups holding hoops around their middles. When one of the ‘gears’ turns clockwise, the touching hoops start to rotate in the opposite direction, and this continues throughout the group like a ripple effect.
- If any pupils have cycled to school, they could demonstrate how different gears affect the effort and speed required to move the bike by changing up and down through the gears, while others in the class observe the wheel rotations.

N.C. statement: recognise that some mechanisms, including levers, pulleys and gears, allow a smaller force to have a greater effect (Year 5)

Earth and Space

- Year 5

Orbit walk



Place a large ball or hoop in the centre of your playground to represent the Sun, then draw concentric circles around this in chalk to represent planetary orbits.

Assign pupils as different planets – to represent size difference you could have larger and smaller groups of pupils depending on which planet they represent.

Position pupils on their orbit paths around the Sun. Which are closest and which are furthest away? Will the Sun move around the planets or vice versa?

Pupils can then start rotating around the Sun, moving at different speeds. For example, Mercury will move quickly, Earth at a more medium pace, and Neptune will move very slowly.

After a minute, pause the planets. Ask which have managed to complete a whole orbit, and which have only travelled part of the way. Why do some planets move faster than others?

You may want to photograph pupils in a ‘freeze frame’ pose. If you are able to take an image from above, pupils can use this to sketch and label their own diagrams, including the Sun, planets and their individual orbital paths.

N.C. statement: describe the movement of the Earth, and other planets, relative to the sun in the solar system (Year 5)

Moon phases

As a class or in groups, draw eight circles on the playground using chalk to represent the Moon at different points during the month. Fill each circle using darker and lighter natural materials to represent the different phases. Alternatively, if you have enough stones, pupils could use these and shade in the phases with marker pen.



waxing crescent

Once the sequence is complete, as pupils to explain which phase is brightest and when we can only see a small part. Can they identify a pattern to the Moon's phases? Does the Moon actually change shape over the course of a month?

To reinforce that the Moon orbits the Earth as the Earth orbits the Sun, have one pupil stand with a torch to represent the sun, while another pupil slowly spins and rotates around them. Another pupil also spins and rotates around the Earth pupil at the same time.

Get the groups to pause at various points: does this help them to see when the Moon would appear more or less illuminated to one side of the Earth?

N.C. statement: describe the movement of the Moon relative to the Earth (Year 5)

Investigating the Sun's position



Pupils can create a sundial out of natural resources to observe the Sun's apparent movement across the sky and consider how these were used to tell the time in the past before the invention of clocks.

Start by pushing a large stick into the ground so that it stands up right, in a sunny location.

Observe the first shadow made by the stick and place a stone at the tip of the shadow. Record the time on a whiteboard or a post it note. (Be sure to tuck paper recordings under the stone!) Alternatively, you may be able to write on the stones in permanent marker.

If possible, return to the sundial every hour throughout the day and place stones at the new shadow tip, labelling the new time.

By the end of the school day, pupils will have created a natural sundial following the movement of the stick's shadow and had the opportunity to observe the different lengths cast. What was causing these changes?

N.C. statement: use the idea of the Earth's rotation to explain day and night and the apparent movement of the sun across the sky (Year 5)

Size and distance in the Solar System

To help pupils gain perspective of the comparative sizes of the Sun, the Earth and the Moon, provide them with the diameter of each:

- Sun = 1,400,000 km
- Earth = 12,800 km
- Moon = 3,500 km

Explain to pupils that if we were to try to create scale models in centimetres (e.g. 1,400 cm, 12.8 cm and 3.5 cm), the Sun would be too large to create for most playgrounds.

Instead, ask pupils to use scale factors to calculate how big the Sun and Moon should be if we represent the Earth with a 5 cm diameter. The Sun is approximately 109 times larger than Earth, and the Moon is roughly 27% of the Earth's diameter.

Pupils can then draw chalk circles on the playground using the scaled diameters and compare the relative sizes of each. To help them draw the large circle for the Sun, pupils could use string equal to the scaled radius. One pupil secures the string at a central point, while another attaches chalk to the opposite end. This can act like a large-scale compass.

You could also scale down the distances between the Moon and the Earth and the Earth and the Sun to a measurement that would be manageable for pupils to walk or plot.



Evolution and Inheritance

- Year 6

Create a prehistoric timeline

Create a long timeline across your playground or field, creating a scale based on how far back you want pupils to go. You could start by revisiting pupils' prior history learning about the Stone and Iron Ages, then introduce geological prehistory such as the Palaeozoic, Mesozoic and Cenozoic periods (where 1 metre could be equal to 50 million years).

Ask pupils to place fossil cards at different points along the timeline, such as trilobites, ammonites, dinosaur footprints, fern fossils, mammoth teeth.

Being able to 'walk back in time' this way will help to provide pupils with a sense of Earth's vast history, while also addressing any misconceptions about whether certain creatures or plants lived alongside one another or whether they were separated by millions of years.











N.C. statement: recognise that living things have changed over time and that fossils provide information about living things that inhabited the Earth millions of years ago (Year 6)

Create a prehistoric timeline



Ask pupils to collect objects from your outdoor area and, using clay or damp soil, create impressions of the objects they have found.

After removing, ask them to compare the object and its imprint.

- What information is preserved?
- What information is lost?
- Could a scientist identify the organism in question from its imprint alone?

As well as demonstrating how imprint fossils form, this activity also helps pupils to appreciate the difficulties scientists have if faced with incomplete evidence.

It is also worth giving pupils the following statement:

“Without fossils, scientists would know much less about organisms that existed millions of years ago.”

Identify one side of the playground as ‘agree’ and one as ‘disagree’ and ask pupils to stand somewhere along the spectrum of this line, providing justification for their chosen position.

N.C. statement: recognise that living things have changed over time and that fossils provide information about living things that inhabited the Earth millions of years ago (Year 6)

Spotting similarities and differences



Start by showing pupils two leaves from the same tree that are different in size, colour or shape. Ask pupils to explain that, if they came from the same tree, why aren't they exactly the same? If it hasn't come up already, introduce the term **variation**.

Then, give pupils the opportunity to explore the school grounds and either collect or observe their own examples of variation within the same species. This could include leaves from the same tree, daisies from the same patch, conkers, acorns, sycamore seeds and feathers.

With their sets, pupils should discuss or record the similarities and differences they can find. Encourage them to look closely at the structures, colour shades, shapes, number of petals, markings, etc.

This activity allows pupils to investigate for themselves how individuals across all species show variation.

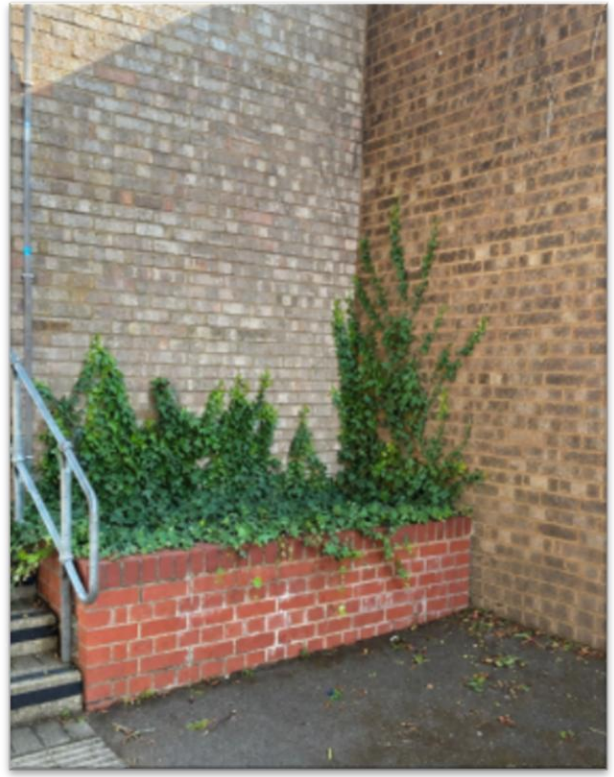
N.C. statement: recognise that living things produce offspring of the same kind, but normally offspring vary and are not identical to their parents (Year 6)

Adaptation and evolution

In your outdoor area, ask pupils to consider what desirable features and adaptations various organisms display. How do they survive different seasons and in various locations? Which parts of the organism might have changed over time to meet the needs of today?

Then, using examples of leaves and/or seed pods from your outdoor area, lay these out and ask pupils which they think might survive best if the weather became much drier. What makes them think this? This allows for a discussion about natural selection and how variation helps some individuals survive changing conditions.

You could take this further by looking at **Kew's 'Planting for the Future' report**, which recommends that "planting for resilience is essential nationally" due to our changing climate. Pupils could research which sorts of species they would recommend for better survival in future years around your school's outdoor area.



Climbing stems help ivy plants reach sunlight

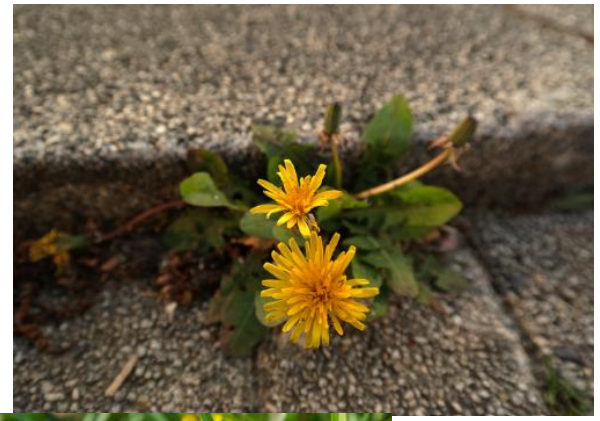
N.C. statement: identify how animals and plants are adapted to suit their environment in different ways and that adaptation may lead to evolution (Year 6)

Plant survival study

Investigate plants growing in different locations around your school. As well as purposely planted foliage like flower planters and hedges, also look for plants emerging from cracks in pavements.

Compare factors such as leaf size, stem length, flower abundance and plant height. What reasoning can pupils provide for any differences observed between the same or similar plants in different locations?

Then, consider the challenges presented by each location. What adaptations can pupils observe or suggest the plant must have in order to survive there?





N.C. statement: identify how animals and plants are adapted to suit their environment in different ways and that adaptation may lead to evolution (Year 6)

School grounds over time

Choose a habitat on your school grounds. Allow pupils time to observe the organisms that live in this area, plus any they have seen on other occasions, e.g. squirrels or types of birds.

Gather in this location and ask pupils to consider what would happen to the area given the following scenarios (you could split pupils into groups to discuss these):

- The climate becomes much hotter
- The climate becomes much wetter
- New predators arrive
- There is less vegetation available

What would happen to particular organisms in each scenario? Which would survive and which would struggle? What adaptations would be advantageous? How might the population of different organisms change over many generations?



N.C. statement: identify how animals and plants are adapted to suit their environment in different ways and that adaptation may lead to evolution (Year 6)

The information and guidance provided by ZSL are intended for educational purposes only. Responsibility for the safety and supervision of pupils remains with the school and its staff at all times. Teachers should only undertake activities that are appropriate to their setting and must ensure that all activities are planned, risk assessed, and carried out in accordance with their school's policies, procedures, and safeguarding requirements.