RISING STARS

SWITCHED ON Science

Second Edition

Teacher's Guide

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Contents

How to use Switched on Science, Second Edition

In England, the primary science curriculum has been written to indicate the basic entitlement for children at Key Stages 1 and 2. *Switched on Science, Second Edition* ensures full coverage of the content for this year group, and more, so that children are given access to ideas and ways of working scientifically in a range of contexts thus providing appropriate repetition and reinforcement which helps to ensure retention.

What is included in the printed and online resources?

At the beginning of each topic, learning outcomes for working scientifically are listed as well as the subject knowledge concept statements.

The introduction to each topic also lists the pupil videos, which can be used to introduce new concepts and consolidate learning, and CPD videos to build confidence in teaching science. These can be accessed via our *My Rising Stars* platform. Also online are editable versions of the Activity Resources, teaching PowerPoints, interactive activities and visual resources to engage your pupils, as well as PDF versions of the Teacher's Guide.

Teacher's Guide

This Teacher's Guide contains six topics covering the primary science programme of study, and more. The first five topics, each designed to cover a half-term (although they can be planned flexibly depending on how science is delivered in your school), are linked directly to the programme of study. The sixth topic in each pack is our 'Science in Action' topic. This off-curricular topic reinforces key working scientifically skills linked to the curriculum. It is an opportunity for children to apply their science skills in a wider context.

Each topic contains:

- Cross-curricular and STEAM links
- Background knowledge for teachers
- Essential scientific language
- Big questions for discussion
- Health and safety guidance

Get started guidance

At regular points, where a new area of the topic is being introduced, there is a Get Started activity which provides a suggestion on how to 'hook' children's interest.

Activities

Each activity begins with the key learning objectives from the subject knowledge element of the curriculum and working scientifically where appropriate.

At the end of each activity, guidance is given for assessment purposes suggesting what responses could be used to differentiate children who are (Em.) emerging, (Exp.) expected and (Exc.) exceeding in their (SK) subject knowledge and (WS) working scientifically understanding. Of course, this is guidance only and other responses from children can be used.

Activity Resources

The Activity Resources section contains photocopiable resources for children to use. Here you will find investigation scaffolds, diagrams for labelling, tables and timelines.

Pupil videos

Every *Switched on Science, Second Edition* customer receives free access to amazing science videos linked to the resource on *My Rising Stars* (36 science videos in total for Key Stage 1 and Key Stage 2). You will see the videos clearly linked throughout this Teacher's Guide.

My Rising Stars

On *My Rising Stars* you will find all teaching notes, editable Activity Resource sheets and six stimulating interactive activities, covering all topics. There are also half-termly editable plans and an assessment overview. The suggested plans cover one topic per half-term and two activities per week. The plans are fully editable so that you can change them to suit your class and school schedule. Please see the inside front cover for details of how to log in.

Testing

For those schools that want to use end-of-topic tests, these can be found online and downloaded, photocopied and given to children.

TOPIC 1

Rocks, soils and fossils

About this topic

Curriculum link: Year 3, Rocks

SUMMARY:

In this topic children work scientifically on a variety of quick investigations and longer tasks to learn about rocks. This topic covers the properties and uses of rocks, the rock family, soils and finally fossils.

UNITS:

1.1: Rocks
1.2: Soils
1.3: Fossils

ACTIVITY RESOURCES:

- 1.1: Testing rocks
- 1.2: The rock family
- 1.3: Soil investigation
- 1.4: Fantastic fossils

ONLINE RESOURCES:

Teaching slides (PowerPoint): Rocks, soils and fossils
Interactive activity: Rocks, soils and fossils
CPD video: Rocks, soils and fossils
Pupil video: Rocks, soils and fossils
Word mat: Rocks, soils and fossils
Editable Planning: Rocks, soils and fossils
Topic Test: Rocks, soils and fossils

Learning objectives

This topic covers the following learning objectives:

- Compare and group together different kinds of rocks on the basis of their appearance and simple physical properties.
- Describe in simple terms how fossils are formed when things that have lived are trapped within rock.
- Recognise that soils are made from rocks and organic matter.

Working scientifically skills

This topic develops the following working scientifically skills:

- Ask relevant questions and use different types of scientific enquiries to answer them.
- Set up simple practical enquiries, comparative and fair tests.
- Make systematic and careful observations and, where appropriate, take accurate measurements using standard units, using a range of equipment.
- Gather, record, classify and present data in a variety of ways to help in answering questions.
- Report on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions.

CROSS-CURRICULAR LINKS

This topic offers the following cross-curricular opportunities:

Mathematics

- Sort rocks.
- Compare weight to size.

English

- Create verbal and written descriptions of rocks.
- Use new technical vocabulary.
- Read non-fiction texts about rocks and soils.
- Use a scientific dictionary to find and check words.
- Research and retrieve information.
- Comprehend key facts.
- Write newspaper reports about events, e.g. a volcanic eruption and new fossil finds.
- Write rock poems.

Geography

- Describe and understand key aspects of physical geography, e.g. rocks, soils and volcanoes.
- Locate active volcanoes using a world map or globe.
- Locate famous rocks across the UK, e.g. The Needles, Stonehenge and Durdle Door.
- Research local industry past and present, e.g. coal, lead and tin mining.
- Locate local quarries, what they mine and uses of the rocks.

- Areas famous for fossils such as the Jurassic Coastline of Dorset.
- Famous rocks from around the world, e.g. Ayr's Rock (Uluru), Immortal Bridge Mountain in China and the Grand Canyon.

Art

- Cave art, e.g. The Chauvet-Pont-d'Arc Cave, France and the Caves in the district of Maros, Indonesia.
- Draw rocks using a hand lens or computer microscope.
- Patterns in rocks and fossils, e.g. ammonites.

Computing / ICT

- Use a digital microscope to view rocks.
- Use branching databases to identify different rocks and fossils.
- Watch an animated video to show how fossils are formed.
- Photographing rocks and fossils.
- Using interactive classification Apps on rocks and fossils.

History

- Rock Art.
- The Stone Age.
- Mary Anning and other palaeontologists.
- Geological time scales.

Drama

- Role play and hot seating about relevant people, e.g. Mary Anning, a palaeontologist.
- Participating in a dig and discovering fossils.

HEALTH AND SAFETY

Use of plaster of paris when making fossils: the advice from CLEAPSS Health and Safety organisation is that it is safe to make a plaster cast of a fossil. A small amount of mixture should be made up, e.g. in a yoghurt pot, and poured into the mould. A few splashes on the hand could be washed off with no injury. Injury only results when the plaster cannot be removed quickly. For further information see http://www.cleapss.org.uk/attachments/article/0/PS74.pdf?Primary/Resources/Guidance%20Leaflets/

STEAM (SCIENCE TECHNOLOGY ENGINEERING ART AND MATHS) OPPORTUNITIES

Invite into class

- Geologists from local universities or mining companies.
- Palaeontologists from local universities or historical sites.
- Artists to use rocks, soils and fossils to create a range of artwork.
- Actors to role play Mary Anning.

Visit

- Museums, such as the Natural History Museum or local museums.
- Quarries offering supervised visits.
- Archaeological digs.
- Safe coastal areas for fossil hunting.

SUBJECT KNOWLEDGE

The Earth can be divided into three main layers: the core, mantle and crust. Rock is a natural material that is found in the Earth's crust. The Earth is at least 4800 million years old and the oldest rock is about 4000 million years old. The age of a rock can be judged by radioactive decay and nearby fossil types. Younger rocks are usually on top of older ones.

Rocks

There are three main types of rock formation: sedimentary, igneous and metamorphic.

Sedimentary rocks are formed when sediment / rock is deposited from air, ice, wind or water (where the sediments are suspended in the water). These build up in layers. This is called sedimentation; hence the name. As the layers build up, water is squeezed out and the sediments are 'cemented' together. Chalk, shale, limestone and sandstone are all examples of sedimentary rock. Sedimentary rock contains fossils.

Igneous rocks begin as molten magma (liquid rock) from inside the Earth. As the magma moves towards the surface it cools; the faster it cools the smaller the crystals (e.g. if it flows into water). Obsidian, which looks glassy, is an example of this. If the lava cools slowly the crystals are larger, e.g. granite. Igneous rocks do not contain fossils because the heat would have melted them.

Metamorphic rocks are rocks that have been changed by heat or pressure; the word *morph* means change. The rocks are heated (but not melted like igneous) or changed during great earth movements where rocks are squeezed and put under enormous pressure. Both sedimentary and igneous rocks can be changed in this way and that is why metamorphic rocks usually do not contain fossils.

Different rocks can be identified by their properties, e.g. colour, texture, hardness and permeability. The study of rocks is geology and people studying rocks are called geologists.

Rocks come in different sizes and there are lots of everyday words used for them, e.g. boulder, stones, pebbles, gravel and sand. Rocks can be weathered by the effect of: temperature, e.g. freezing and thawing; wind blowing tiny grains of rock (sand) against rock wearing it away; rain and waves.

Many rocks have different uses such as slate for roofs, marble as floor tiles, chalk in schools, toothpaste and polish and granite for buildings, paving stones and bridges.

Minerals from rocks are found in breakfast cereals (iron and zinc), bread (limestone), ice creams and cheese (gypsum). Salt is dissolved from rocks and even water contains minerals from rocks.

Soils

Soil is formed by weathering, which breaks the rocks into small particles of rock / mineral that are then mixed with dead and decaying plants and animals (humus) as well as water and air.

Soil helps to support plant life by providing plants with nutrients, water and air. It keeps plant roots in the ground.

The characteristics of the soil depend on the rock it is formed from. There are different kinds of soil, e.g. clay, sandy soil, loam. Clay soil has very small particles which can hold water. It is sticky to the touch when wet, but smooth when dry. Sandy soil has the largest particles. It feels dry and gritty and water drains through it quickly. Loam is a soil that is a mix of different soils and it is high in humus (decaying plants and animals) so it is popular with gardeners. Different plants grow better in different types of soil.

Fossils

Fossils are the prehistoric remains of plants or animals that have been preserved, usually by being buried under layers of mud or sand which are then changed into sedimentary rock. Fossils can also be made when animals and plants are frozen in ice or become stuck in tree resin that hardens to form amber.

A palaeontologist studies fossils and palaeontology is the study of fossils. By studying fossils palaeontologists can learn a lot about the environment in which the plant or animal lived and their relationships with other living things. They can also see how living things have evolved, which is why children return to fossils in Year 6.

CHILDREN'S MISCONCEPTIONS

Children might think…

- that all rocks are large, heavy and jagged.
- that rocks are made of one substance: in fact, some rocks contain crystals and are made of more than one mineral.
- that concrete is a rock.
- that fossils are actual animals and plants.
- that only bones can be fossils.
- that humans can make rocks: in fact, rocks are naturally occurring.
- that rocks form when pebbles stick together: in fact, pebbles are fragments of rock.
- that all sedimentary rocks form under water: in fact, they can be formed on land, e.g. desert sandstone.

Children already know...

- how to identify everyday materials including rock (Year 1).
- how to identify and compare everyday materials including rock (Year 2)

Fossils are not met in Key Stage 1 at all: however, a lot of children will already have an interest in, and may know quite a lot about, fossils.

SCIENTIFIC VOCABULARY: ROCKS, SOILS AND FOSSILS

You can download a Word mat of essential vocabulary for this topic from *My Rising Stars*.

mineral: a natural substance that makes up rock

rock: made from one or more minerals

permeable: allows water to pass through

impermeable: does not allow water to pass through

crystals: rock that has formed into a pattern of three-dimensional shapes, e.g. cubes

magma: hot liquid rock

sediment: small bits of rock

sedimentary: rock made from sediment

humus: part of soil made from dead plants and animals – gives soil a dark colour

fossil: the prehistoric remains of a plant or animal

extinct: when there are no more of a particular animal or plant species alive anywhere in the world – they have died out

palaeontology: the study of plants and animals that lived millions of years ago

palaeontologists: scientists who study the remains of plants and animals that lived millions of years ago

granite: a kind of igneous rock which is very hard and light-coloured

igneous: rock formed from magma

metamorphic: rock that has been changed by heat or pressure

soil: small particles of rock mixed with decayed plant and animal material

Key words: names of some rocks: granite / marble / sand / clay / limestone

Mohs scale of hardness

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1 

2 

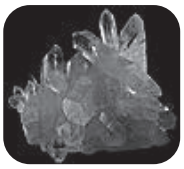
3 

4 

5 

Mohs scale of hardness	Rock / Mineral	This is the rock
1	Talc	
2	Gypsum	
3	Calcite	
4	Fluorite	
5	Apatite	
6	Feldspar	
7	Quartz	
8	Topaz	
9	Corundum	
10	Diamond	

6 

7 

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1.1 Rocks

COMPARING AND GROUPING ROCKS

GET STARTED

Use PowerPoint Slides 1 to 4 to introduce this topic. Many schools do not have a collection of the same kind of rocks so it can be difficult to teach children their irgeological properties. A great way to do this is to use a collection of sweets which, if stored in small plastic containers, can be kept and used another year. The sweets should show properties found in rocks, e.g. crystals, hard, soft, layers, holes, crumbly. Include in the sweet mix: sweets covered in sugar, Polo Mints, boiled sweets in transparent wrappers, lips, shrimps, laces, flumps / marshmallows, Love Hearts, Liquorice Allsorts and Mint Imperials.

LET'S THINK LIKE SCIENTISTS

Use these questions to develop research skills and speaking and listening:

- How are rocks formed?
- Are all rocks the same?
- What rocks can be found where you live?

ACTIVITIES

In these activities, the term *rock* is used rather than *mineral*. A rock is usually composed of a number of different minerals.

1 SORTING ROCKS

L.O. Gather, record, classify and present data in a variety of ways to help in answering questions.

- Give each pair a set of 'Sweetie Rocks' (see Get Started), and explain that they are going to use them to learn about the properties of rocks, that is what rocks are like. Remind children that they are going to work like scientists and therefore should not eat the rocks for health and safety reasons.
- Ask children to find out as much as possible by sorting (classifying) their 'Sweetie Rocks' into as many different groups as possible, e.g. hard, soft. Tell them to write their classification down and then begin a new sort. Give children a target, e.g. beat ten sorts. When a group gets to ten, stop everyone and share the language that they have used, which might include *shape, size, colour, texture, writing on it, squash, stretch, melt, bounce*.
- This initial sort is useful to find out the language that children remember and use from Year 2 and how comfortable children are carrying out independent sorting activities.

YOU WILL NEED

- A collection of different sweets that can be used to represent different types of rock (see Get started)
- Hand lenses / magnifying glasses
- Bowls or pots for sorting 'Sweetie Rocks'

ASSESSMENT

Working Scientifically

- Em. Children sort their 'Sweetie Rocks' into a limited number of categories, e.g. colour.
- Exp. Children sort their 'Sweetie Rocks' into a wide range of groups according to obvious characteristics.
- Exc. Children group according to scientific properties, e.g. melt, dissolve, crystals.

2 BEING A GEOLOGIST

L.O. Compare and group together different kinds of rocks on the basis of their appearance and simple physical properties.

Gather, record, classify and present data in a variety of ways to help in answering questions.

- Sometimes, in science, a whole-class lesson where children are taught basic understanding is a useful approach. In this activity, the whole class is engaged in learning how geologists identify, group and classify rocks. The first part of the pupil video for this topic shows children investigating rocks with hand lenses.
- Remind or introduce children to the word *property* (characteristic): a way of describing how something looks, e.g. rocks. Again, explain to children that they will use the 'Sweetie Rocks' so everyone has the same kind and new words are learned together.
- Teach children each geological term (see below), then ask them to find and show you a sweet with that property. Children then sort their collection of 'Sweetie Rocks' by that property, e.g. hard, not hard.
- This activity introduces children to basic geological terms (use PowerPoint Slide 5), which can be more interesting for children and more challenging for the more able. The aim is not to assess children on these terms but on their ability to compare and group.
  - *Hardness*: some rocks are harder than others; granite is a hard rock, while chalk is soft. Hardness is easily spotted amongst 'Sweetie Rocks'; harder rocks do not wear away easily, soft rocks do.
  - *Colour*: e.g. chalk is white, coal is black. 'Sweetie Rocks' come in all different colours.
  - *Cleavage*: is how a rock breaks along a layer, e.g. how easily the rock splits, such as slate and shale. Try Liquorice Allsorts sandwiches.
  - *Streak*: the colour a rock makes when it is scratched on the back of a plain tile; it can also work on paper or card, e.g. chalk and gypsum will leave a white streak, haematic is a reddish brown. Many 'Sweetie Rocks' will leave a colour mark on paper.
  - *Lustre*: how the rock reflects light, e.g. glassy (obsidian), shiny like metal / metallic (galena, pyrite). If it does not reflect and is dull, this is called earthy. Boiled 'Sweetie Rocks' will reflect light well.
  - *Crystalline*: has crystals, e.g. any 'Sweetie Rocks' coated in sugar.
  - *Friable*: any rock that easily crumbles, e.g. sandstone, chalk. Ask children to make a hand sign to help them remember this word; some children will look like they are crumbling something or frying in a pan.
- With children, create a working wall of the key properties. Children can also create their own 'Geological Dictionary' page to use in later activities.
- In groups, children take turns to test each other with someone stating a property and the rest of the group sorting the 'Sweetie Rocks'.
- At the end of this lesson, all children will have had experience of sorting 'Sweetie Rocks' according to their geological properties.

YOU WILL NEED

- PowerPoint Slide 5
- Collection of 'Sweetie Rocks' that can be used to represent different types of rock
- Hand lenses / magnifying glasses
- Torches or light sources
- Paper

ASSESSMENT

Subject Knowledge

- Em. With support, children sort according to appearance.
- Exp. Children are able to classify according to each property.
- Exc. Children apply some properties to rocks that have one or more of the properties, e.g. diamond is shiny and very hard.

Working Scientifically

- Em. Children, with support, classify according to given criteria.
- Exp. Children can classify using given criteria.
- Exc. Children use both given and their own criteria.

3 MOHS' SCALE OF HARDNESS

L.O. Compare and group together different kinds of rocks on the basis of their appearance and simple physical properties.

Gather, record, classify and present data in a variety of ways to help in answering questions.

- This activity also benefits from children using the 'Sweetie Rocks' because this can be taught to the whole class and then they can apply this way of identifying and classifying to rock samples. Friedrich Mohs (Born: 1773) developed a 'Scratch test', which is quite simple and is based on the idea that a harder material will scratch a softer one. His scale goes from talc at 1, which is the softest material, to diamond the hardest at 10. Show children PowerPoint Slide 6. The second part of the pupil video for this topic shows children investigating hardness using this activity.
  - Children choose five or six 'Sweetie Rocks' and sort them in order of hardness, softest to hardest. The softest rock can be scratched by all the other rocks; the hardest one cannot be scratched. This is an activity that will be rich in discussion as children debate if one can scratch or be scratched by another rock.
  - Once they have sorted their 'Sweetie Rocks' according to Mohs' Scale, ask them to swap tables with another group to test the order of rocks: do they agree or disagree? Why? They could leave a comment on a sticky note as peer assessment.
  - As a home–school activity, challenge children to find out some more information about Friedrich Mohs and create a fact file card or poster for the working wall on rocks.

YOU WILL NEED

- PowerPoint Slide 6
- Collection of 'Sweetie Rocks' to represent different types of rock
- Sticky notes for each group

ASSESSMENT

Subject Knowledge

- Em. With support, children order a limited number of rocks, e.g. three or four.
- Exp. Children are able to use Mohs' Scale of Hardness to order a set of 'Sweetie Rocks'.
- Exc. Children use Mohs' Scale of Hardness and talk about rocks they know, e.g. diamonds, chalk, coal.

Working Scientifically

- Em. Children require support to classify.
- Exp. Children classify a set of 'Sweetie Rocks'.
- Exc. Children explain their reasons for how they have classified.

4 COMPARING ROCKS

L.O. Compare and group together different kinds of rocks on the basis of their appearance and simple physical properties.

- Having compared and grouped 'Sweetie Rocks', the whole class can work with rocks because they know about properties or have a geology word list to remind them, so it does not matter if children have some rocks that do not have the same properties.
- Working in pairs, children closely observe rocks and sort them into different groups based on their properties.
- Encourage children to use a hand lens or a digital microscope to enhance their observations.
- Go around and ask different pairs how they have grouped their rocks to assess their ability to compare and group rocks.

YOU WILL NEED

- Collection of rocks with different appearance and properties – you could ask children to bring in their own examples
- Hand lens / magnifying glass
- Digital microscope (optional)

ASSESSMENT

Working Scientifically

- Em. With support, children sort according to appearance, e.g. colour.
- Exp. Children are able to classify according to one property.
- Exc. Children classify according to more than one property, e.g. hardness and lustre.

5 PERMEABLE OR IMPERMEABLE?

L.O. Compare and group together different kinds of rocks on the basis of their appearance and simple physical properties.

Set up simple practical enquiries, comparative and fair tests.

- Some rocks such as sandstone and chalk can be *permeable*; they let water soak through them. Rocks that do not let water through are called *impermeable*, e.g. slate and marble. Ask children to think of ways they could test and group the rocks in their collection into permeable and impermeable.
- Children might decide to drip water onto the rock and observe whether or not it soaks into the rock.
- An alternative approach is to place different pieces of rock into water in a plastic transparent container. If bubbles come from the top of the rock, it means that water is getting into it and it is permeable as there are spaces inside the rock with air in and water can travel through. If there are no bubbles from the rock, it shows that the rock is tightly packed with no air inside and so water cannot get through; therefore it is impermeable (although there might be some air trapped on the surface, so let the rock settle).

YOU WILL NEED

- Collection of rocks with different appearance and properties – you could ask children to bring in their own examples
- Water
- Transparent containers for observing rocks in water

ASSESSMENT

Subject Knowledge

- Em. With support, children notice bubbles and can compare two rocks.
- Exp. Children are able to classify rocks into permeable and impermeable.
- Exc. Children offer reasons why bubbles appear and why a rock is permeable.

Working Scientifically

- Em. Children, with support, are able to carry out a simple comparative test.
- Exp. Children test their own ideas.
- Exc. Children are able to carry out a simple test and use observations to draw conclusions.

6 ADOPT A ROCK

L.O. Compare and group together different kinds of rocks on the basis of their appearance and simple physical properties.

Ask relevant questions and use different types of scientific enquiries to answer them.

- Children will enjoy adopting their own rock, especially if you have some fun and allow children to stick on some craft 'goggle eyes'.
- Give children a range of rocks from which they can choose their own.
- Explain that they are going to find out as much as they can about their rock and record what they find out in an interesting way, e.g. fact file, rock passport, poster. They begin by observing their rock, then using sticky notes to ask questions using question stems (these were used in the Key Stage 1 units and include: How…? What…? Does…? Which…? Has…? Could…? Where…? What if…? How does…? Who…? When…? Why…?). Use PowerPoint Slide 7.

YOU WILL NEED

- PowerPoint Slide 7
- A range of rocks for children to adopt
- Equipment for testing rocks, e.g. magnifying glasses
- Sticky notes
- Research materials, e.g. non-fiction books
- Activity Resource 1.1

ASSESSMENT

Subject Knowledge

- Em. Children are able to talk about what their rock looks like.
- Exp. Children are able to talk about the appearance and properties of their rock.
- Exc. Children apply their knowledge of the appearance and properties of their rock and research further information.

- Give children time to explore their rock and ask a range of questions such as: How hard is my rock? Is it permeable? What kind of rock is it? Can this rock be used for anything?
- They then decide how to answer their own questions using different types of scientific enquiries, e.g. test, classify, observation, research. At this stage, most children will need some support in deciding what kind of scientific enquiry to use to answer their questions. They could use research to find out, e.g. which rocks do people use? How are rocks used? What are rocks used for?
- Children use Activity Resource 1.1 to record their tests.

Working Scientifically

- Em. With support, children ask questions about their rocks and answer them.
- Exp. Children are able to ask questions about the properties of their rocks and, with some support, decide how to answer them.
- Exc. Children are able to ask a range of questions and decide the best way to answer them.

HOW ARE ROCKS MADE?

GET STARTED

The activities in this section model how rocks are formed and are extensions to the statutory curriculum requirements. Start by explaining to children they are going to watch a video clip showing how different rocks are formed (see Useful website links on *My Rising Stars*) and, when it has finished, in their groups they are going to talk about what they learned under the headings sedimentary, igneous and metamorphic. For some children this helps to both make it interesting but also more accessible.

Tell children some geologists like to explain how rocks are formed using food and that they are going to try out this idea to see if it helps them understand about rocks. Use PowerPoint Slide 8 to start a discussion to find out how children think rocks are made.

ACTIVITIES

1 SEDIMENTARY SANDWICHES

L.O. Compare and group together different kinds of rocks on the basis of appearance and simple physical properties.

- Sedimentary rocks are laid down in layers; often these rocks have been worn away by the sea or rivers to create sand, shells and the remains of tiny animals as well as plants. An easy way to illustrate this is for children to make a sedimentary sandwich. Show children a sedimentary sandwich you have made and explain what each part represents:
  - White bread = sand
  - Chocolate spread = bones of animals
  - Brown bread = dust
  - Lettuce = plants
  - Granary bread = mud with stones and rocks

YOU WILL NEED

- PowerPoint Slide 9
- Ingredients for a sandwich, e.g. different types of bread, chocolate spread, lettuce or other ingredients
- Plates and blunt knives

Over time, as more and more layers are created, the bottom layers get squashed and become rock. Show this by placing a plate on top of the sandwich and exerting pressure.

You can also show how the layers can be changed if they are squashed (pressure applied) from below, the sides or in the centre. Show how this works by gently pressing down and upwards on the middle of the sandwich and pushing gently from the sides.

This model is used to help children to visualise how this happens. It is hard for young children to understand that this happens on a massive scale and over incredibly long periods of time.

- Now let children make their own sandwiches. They could create a short video to explain what they are doing or take and annotate a photograph.
- Give children sedimentary rocks to handle and compare so that they are given the opportunity to link the model with rocks.
- Use PowerPoint Slide 9 to show children an example of a sedimentary rock.

ASSESSMENT

Subject Knowledge

- Em. Children, with support, make a sedimentary sandwich and describe what they did.
- Exp. Children are able to state that their sedimentary sandwich shows how rocks are made.
- Exc. Children apply what they know and decide on the composition of their rock (as opposed to a 'sandwich').

2 CHOCOLATE METAMORPHIC ROCKS

L.O. Compare and group together different kinds of rocks on the basis of appearance and simple physical properties.

- In this activity, children use chocolate firstly to model sedimentary rocks and then to model how metamorphic rocks are made. This is a safe activity for children; the water does not have to be boiling, just very hot but not scalding.
- Use small foil cake tins and scrape pieces of milk and white chocolate with a knife so that they form three or four layers (milk, white, milk, white). Use some cling film to press the layers firmly together so the chocolate joins together.
- Children try this part to see how the different layers form a sedimentary rock when pressed together. Ask children to compare this with the sedimentary sandwich: how is it the same?
- Show children how to place a piece of their sedimentary rock into a piece of cling film and make sure that it is sealed so it does not leak. Use your hands to show how to massage the rock and how it changes because of the pressure and heat from your hands. Try not to melt the rock completely, but roughly keep its shape.
- Leave it to cool and explain that heat and pressure (force) can change rocks. These are called *metamorphic rocks*, e.g. slate and marble. Show children PowerPoint Slide 10, which shows a metamorphic rock.

YOU WILL NEED

- PowerPoint Slide 10
- Milk chocolate
- White chocolate
- Foil tins
- Knife
- Cling film

ASSESSMENT

Subject Knowledge

- Em. Children, with support, make their metamorphic rock and describe what they did.
- Exp. Children are able to say that heating and squashing the sedimentary chocolate rock shows how metamorphic rocks are made.
- Exc. Children apply what they know and use scientific / geological language to describe how to make a metamorphic rock.

3 CHOCOLATE IGNEOUS ROCKS

L.O. Compare and group together different kinds of rocks on the basis of appearance and simple physical properties.

- In this activity, you model how to use chocolate chips to make igneous rocks. Use hot but not scalding water so that children can try out this activity for themselves.
- Place some white and milk / dark chocolate chips in a transparent plastic bowl so that children can see what is happening. Point out that the individual pieces (chocolate chips) are just like the rock in the ground. Place the bowl in a larger bowl of very warm water, explain that this is like rocks being melted by the high heat at the centre of the Earth: the Earth's core.
- Mix well until all signs of individual chips are gone and the colours are completely blended. Show children the bowl again so they see the individual chips are no longer visible and the minerals (rocks) they started with have melted. This is similar to the liquid rock, called *magma*, in the Earth's core.
- Pour the melted rock (chocolate) onto a tray and explain that this is molten rock coming from the inside of the Earth. When it gets to the Earth's surface (the tray), the molten rock *solidifies* (hardens) and forms a new rock, which is called *igneous rock*. Pumice, obsidian and basalt are all examples.
- Children use Activity Resource 1.2 to reinforce their knowledge about rocks.
- Show children PowerPoint Slide 11 on igneous rocks.

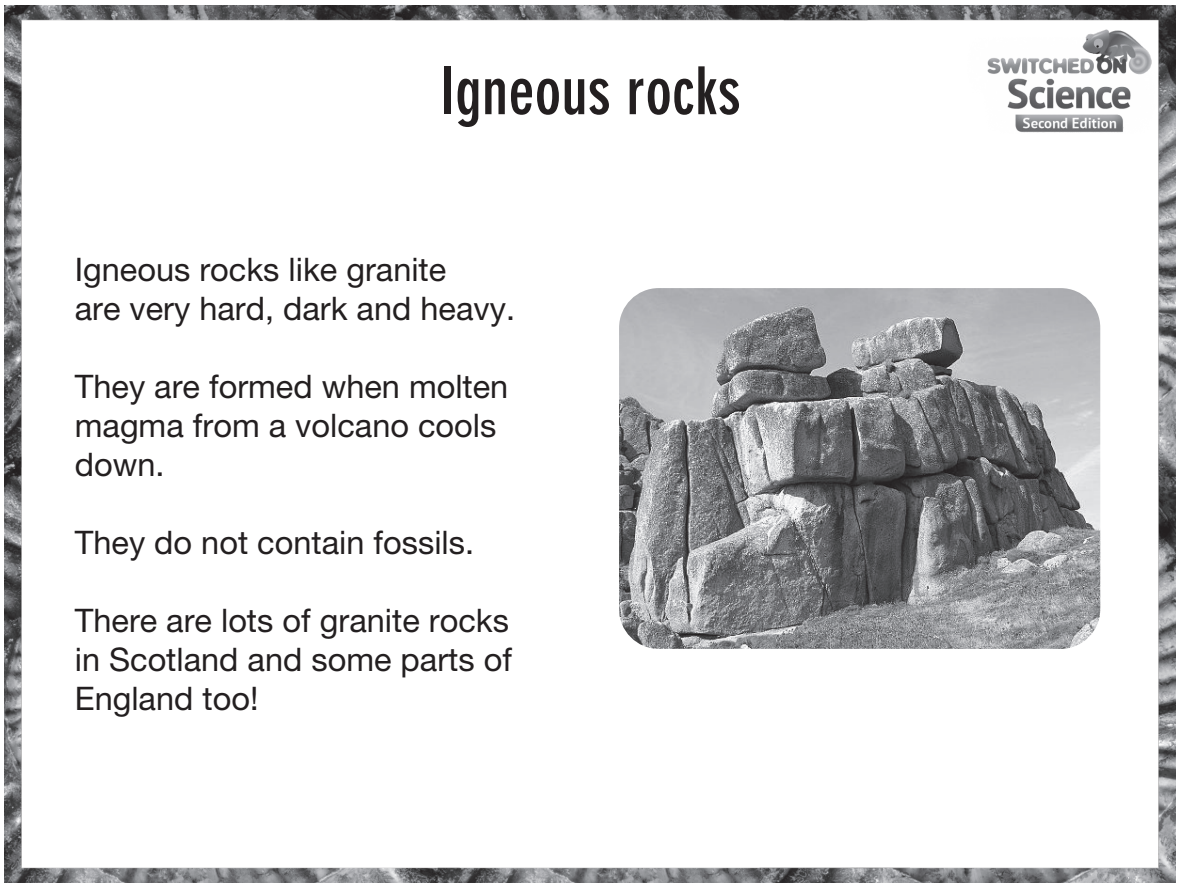
YOU WILL NEED

- PowerPoint Slide 11
- White and dark chocolate chips
- Bowls
- Tray
- Warm water
- Activity Resource 1.2

ASSESSMENT

Subject Knowledge

- Em. Children, with support, make their igneous rock and describe what they did.
- Exp. Children are able to say that heating the chocolate rock and then cooling it shows how igneous rocks are made.
- Exc. Children apply what they know and use scientific / geological language to describe how to make igneous rock.



1.2 Soils

GET STARTED

Take children outside where there is a safe (uncontaminated) source of soil to dig up a handful to place in a container. Then use this soil in the next few activities. You could either get children to work on a table outside or in the classroom. Wherever you work, share the facts about soil from PowerPoint Slide 12 with children. Ask them to think about the statements and whether or not they believe them.

LET'S THINK LIKE SCIENTISTS

Use these questions to develop research skills and speaking and listening:

- What do you think soil is made from?
- What would the world be like without soil?
- How would plants grow without soil?
- Do you think that there is soil on other planets in our Solar System?

ACTIVITIES

1 WHAT IS SOIL?

L.O. Recognise that soils are made from rock and organic matter.
Ask relevant questions and use different types of scientific enquiries to answer them.

- In this activity, children use the soil that they have collected (or, if unavailable, soil given to them: not compost) to find out what soil is made up of. They use a hand lens or digital microscope along with a paintbrush to sweep bits to one side and tweezers to pick bits out on a large sheet of paper. Children could use clear tape to stick pieces down and annotate to say what they are. Children should find pieces of rock, plants (e.g. stems, leaves, twigs) and dead animals. They might also find live animals and evidence of humans, e.g. plastic.
- As you go around each pair or small group, talk with them about what they have found and, through careful questioning, support them in using the evidence to decide what each piece is. Ask children to count how many different things they have found in their soil. Children could create a long list as part of a working wall on soil.
- Some children could use Activity Resource 1.3 to record their observations and try sieving soil. The pupil video for this topic has information for children on soil and how it is created.

YOU WILL NEED

- Activity Resource 1.3
- Soil
- Hand lens and / or digital microscope
- Paintbrush
- Tweezers
- Paper
- Sticky tape

ASSESSMENT

Subject Knowledge

- Em. With support, children sort and label the soil into groups.
- Exp. Children sort and begin to classify their soil and are able to say that soil is made up of bits of rock and plants.
- Exc. Children recognise that soil is made up of many things; mainly rock and dead / decaying animals and plants.

Working Scientifically

- Em. Children use question stems and are supported in using them to ask questions about the soil.
- Exp. Children use question stems to ask questions and are able to suggest ways to answer them.
- Exc. Children are able to say which scientific enquiry activities they could use to answer their questions.

2 SHAKING SOIL

L.O. Recognise that soils are made from rock and organic matter.

Set up simple practical enquiries, comparative and fair tests.

- This activity helps consolidate the idea that soil is made up from different things. Children collect a new sample of soil, about a large handful. They place their soil in a jar three-quarters full with water, put the lid on top and then give it all a good shake.
- This is an observation over time activity, since children will need to leave their soil sample observing what happens for one or two days.
- When the soil has settled, ask children to draw an annotated diagram to show what has happened. They should notice layers in the water with heavier rock particles having sunk to the bottom of the jar and lighter plant material floating towards the top of the water. The water itself will probably be discoloured and this is usually due to plant material that is dissolved in the water. Ask children to think about what they have learned about soil from this activity and how it links with what they learned from Activity 1. Some children could use Activity Resource 1.3 to record their work.
- This activity could then lead onto asking children to work out how much of the jar is soil, e.g. half, an eighth (this is easily done using a marker pen to draw divisions down the side of the jar).

YOU WILL NEED

- Soil
- Jars with lids
- Activity Resource 1.3
- Marker pen

ASSESSMENT

Working Scientifically

- Em. With support, children say what has happened to the soil.
- Exp. Children recognise that the soil is in layers and is made up of bits of rock and plants.
- Exc. Children know what soil is made up of and explain why the soil is in layers.

3 HOW MUCH SOIL IS AIR AND WATER?

L.O. Recognise that soils are made from rock and organic matter.

Set up simple practical enquiries, comparative and fair tests.

Make systematic and careful observations and, where appropriate, take accurate measurements using standard units, using a range of equipment.

- In Activities 1 and 2, children will have found out that soil is made up of many different things. Here children carry out activities to help them understand that soil also contains air and water. Discuss soil using PowerPoint Slide 12. Take a handful of soil and ask the question 'How much of this soil is air and how much water?'. Challenge children to think about how they can answer this question by choosing an appropriate enquiry: should they do a test, observe, classify or perhaps research information? Give children time to discuss this question in their groups and then ask them to share ideas. There are a number of ways children might suggest to answer this, e.g.:
  - Leave the soil out so that it dries and the water evaporates; they could weigh the soil before and after.
  - Pour water into the soil to see if air bubbles come out.
- Give children the opportunity to try out their ideas; encourage them to think about and make measurements when drying out the soil.
- When children have carried out their practical activities, ask them to think about why it is important that there is water and air in soil. Help children to make links with the needs of living things, e.g. animals living in soil needing air and water.

YOU WILL NEED

- Soil
- PowerPoint Slide 12

ASSESSMENT

Subject Knowledge

- Em. With support, children say what is in the soil.
- Exp. Children recognise that the soil is in layers and is made up of bits of rock and plants.
- Exc. Children know what soil is made up of and explain why the soil is in layers.

Working Scientifically

- Em. With support, children describe what they did and what happened.
- Exp. Children carry out a comparative test, measure weight using standard measures and answer the question.
- Exc. Children use their results (standard measurements and observations) to answer the questions.

4 ARE ALL SOILS THE SAME?

L.O. Ask relevant questions and use different types of scientific enquiries to answer them.

Gather, record, classify and present data in a variety of ways to help in answering questions.

- Give children a selection of the three different kinds of soil: clay, silty loam and peat. Always make sure that soil is from a safe source: local garden centres might offer some samples for your class. Ask them 'Are all these soils the same?' and then guide them to observe the soil using their senses (what does it look like? smell and texture?). Give them the opportunity to explore and compare what the different soils look like.
- After children have explored the soil, use Activity Resource 1.3 to guide them through the investigation.
- From their activity, children should be able to say that not all soils are the same and that they have different characteristics, e.g. sticky, grainy.

YOU WILL NEED

- Samples of different types of soil
- Activity Resource 1.3

ASSESSMENT

Working Scientifically

- Em. Children require support to understand the question and decide which scientific enquiry to use to answer it.
- Exp. Children decide how to answer the question but not necessarily classification.
- Exc. Children decide to classify soils and use a key to answer the question.

5 ARE WORMS GOOD FOR THE SOIL?

L.O. Ask relevant questions and, using different types of scientific enquiry, answer them.

Report on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions.

- Use PowerPoint Slide 12, which asks children whether they believe that worms are good for the soil. Challenge children to think about how they can answer this question choosing an appropriate enquiry: should they do a test, observe, classify or perhaps research information? This is an activity where children will need to research information so make sure that they have access to appropriate books, websites, posters and leaflets. Link their recording to approaches to writing in literacy such as reading non-fiction texts about worms, retrieving information and key facts to create, e.g. a poster, presentation, fact file or leaflet.

YOU WILL NEED

- PowerPoint Slide 12
- Books and websites about worms and soil

ASSESSMENT

Working Scientifically

- Em. Children require support to understand the question and decide which scientific enquiry to use to answer it.
- Exp. Children decide how to answer the question and can report their findings.
- Exc. Children answer the question through research and decide how to communicate their findings.

6 IS SOIL AN IMPORTANT RESOURCE?

L.O. Ask relevant questions and, using different types of scientific enquiry, answer them.

Report on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions.

- Set this question as a home–school activity where children can research the answer by asking other people for their responses and reasons (a simple survey). In groups, ask children to share what they have found out, decide what their answer is and justify their answer to the rest of the class. The data could be represented as a graph for children to use and answer the question.
- This activity could form part of a working wall with children communicating their answers and research as posters, comments, fact files, etc. Children might say that soil is important for farming, forestry and the countryside. They may recognise that buildings are built on soil, water supply drains through water and soil helps to retain water. Soil is home to animals and plants, and enables us to plant flowers and vegetables.

YOU WILL NEED

- Materials for working wall and resources

ASSESSMENT

Working Scientifically

- Em. With support, children take a question card home and bring back one or more answers.
- Exp. Children collect responses from home and use them to suggest answers to the question.
- Exc. Children carry out a survey at home, record their data and use it to answer the question; they might also carry out online research.

A handful of soil

SWITCHED ON Science Second Edition

Soil cleans water

There are more living things in a handful of soil than there are people on earth.

Do you believe it?

Soil is a habitat for animals such as mice and moles.

Soil is a precious resource we should look after it.

Half of soil is air and water the other half is made of broken rocks, tiny animals, decaying plants and animals.

Are worms good for soil?

1.3 Fossils

GET STARTED

Take children back into history and begin this section on fossils by introducing them to the story of Mary Anning and her amazing fossil finds. Show children the BBC video on Mary Anning (see Useful website links on *My Rising Stars*), a story that children can relate to since it tells of the life of Mary from childhood and links well with the history topic, 'The Victorians'.

Some children may think that there are only fossils of dinosaurs and need experience of fossils that are shells, plants or even faeces. They may also think that fossils are always bones or skeletons, so you may want to show them examples of other types of fossils, e.g. leaves, footprints, eggs or animal droppings. Use PowerPoint Slide 13 as a starter for discussion to find out what children know about fossils.

LET'S THINK LIKE SCIENTISTS

Use these questions to develop research skills and speaking and listening:

- Do rocks tell stories?
- Are fossils only found in rocks?
- Do fossils always show extinct plants and animals?

ACTIVITIES

1 LOOKING AT FOSSILS

L.O. Describe in simple terms how fossils are formed when things that have lived are trapped within rock.
Ask relevant questions using different types of enquiries to answer them.

- Many children will have fossil collections. Local universities and secondary schools may also be able to lend your school fossils.
- Give children a range of fossils. Tell them that these are the type of 'curiosities' that Mary Anning and her father found and ask why she called them curiosities.
- Ensure that there is time for children to observe fossils (using hand lenses) and even swap fossils from another table. Use PowerPoints Slides 14 and 15 and explain that fossils are important because they can tell us about things that lived millions of years ago. Ask them to think about what their fossil tells them and if they can work out what the object in the fossil is.
- Encourage children to think of a fossil as a rock that can tell them a story. What is the story of this rock and its fossil? What do they want to find out? Encourage children to ask and write down their questions on sticky notes, working in pairs or small groups. They could place their sticky notes on the Rocks and Fossils working wall and find ways to answer them. Introduce children to the word *palaeontology*, which is the study of fossils, and the person who

YOU WILL NEED

- Activity Resource 1.4
- PowerPoint Slides 14, 15 and 16
- Selection of fossils
- Hand lenses
- Sticky notes

ASSESSMENT

Subject Knowledge

- Em. Children observe the fossils and describe them.
- Exp. Children observe the fossils and know that they represent an animal or plant that lived millions of years ago.
- Exc. Children observe, describe and suggest how fossils are formed.

Working Scientifically

- Em. With support, children ask questions about the fossils.

studies fossils is called a *palaeontologist*. Encourage children to call themselves *palaeontologists* by using the word frequently yourself. As a follow up, use Activity Resource 1.4 to think about how old fossils are.

- Exp. Children can ask questions about their fossils and suggest ways of answering them.
- Exc. Children ask questions relating to the fossil and its habitat and decide how to answer them.

2 MAKING A MOULD FOSSIL

L.O. Describe in simple terms how fossils are formed when things that have lived are trapped within rock.

- Fossils are simply the preserved remains of an animal or plant that lived millions of years ago.
- When animals or plants die, some of them may fall into mud or soft sand and, over time, the animal or plant might leave an *imprint* (a dent in the shape of the plant or animal). Over many years, it is then covered by layers of mud or sand and gradually the body falls apart and is dissolved.
- The layers of mud or sand harden into rock (sedimentary) preserving the impression (palaeontologists call this a 'mould fossil'). If the impression is then filled with minerals, it forms a 'cast fossil'.
- Making a mould fossil is quite easy. Using clay or a salt dough (which will then harden), children make an impression using, e.g. a toy dinosaur, shell or for a modern fossil, a pen or plastic toy, as shown on PowerPoint Slide 17. They remove the object and should be able to see the detail left in the impression. To record this, children could take a photograph of the mould fossil and create a set of instructions to explain how it was made.

YOU WILL NEED

- Clay or salt dough
- Objects to make an impression, e.g. toy dinosaur
- Camera
- PowerPoint Slide 17

ASSESSMENT

Subject Knowledge

- Em. Children need support to make a link between what they have made and how fossils are formed.
- Exp. Children make and explain how mould fossils are formed.
- Exc. Children apply what they know to other fossils or explain how living things left behind today can become future fossils.

3 MAKING A CAST FOSSIL

L.O. Describe in simple terms how fossils are formed when things that have lived are trapped within rock.

- When real fossils are made, the impression made by an animal or plant is filled in by different minerals that harden and produce the fossil. Over time, more and more layers are produced, which eventually might be exposed and the fossils are found by humans, e.g. on a cliff face. Sometimes rocks with fossils are lifted up due to huge forces and the fossils can be found.
- Making a cast fossil is similar to making a mould fossil; the difference is that the impression left by the object is filled in with Plaster of Paris (see Health and safety advice on page 6). Children make a mould fossil, then pour Plaster of Paris into the mould and let it set. Make sure children are supervised making small amounts of Plaster of Paris and they do not place their fingers into the mix.

YOU WILL NEED

- As for Activity 2
- Plaster of Paris

ASSESSMENT

Subject Knowledge

- Em. Children need support to make a link between what they have made and how fossils are formed.
- Exp. Children make and explain how cast fossils are formed.
- Exc. Children can compare the two different ways that fossils are made.

4 ASKING QUESTIONS ABOUT FOSSILS

L.O. Describe in simple terms how fossils are formed when things that have lived are trapped within rock.

Ask relevant questions and, using different types of scientific enquiries, answer them.

- Most children are fascinated by fossils so, having experienced looking at fossils and then making their own, they will find it much easier to ask questions. Give children question stem cards with a variety of question words written on them, e.g. What...?, Where...?, How...?, etc. and tell them they are going to use the cards to ask questions on anything they want to know about fossils. Use of question stems encourages children to use a wide range of questions, which also leads to different ways of answering them.
- Children could put their questions on sticky notes, then sort their questions into the different scientific enquiry activities to answer them, e.g. doing something (fair or comparative test), observing fossils, researching using books, the Internet and video clips.
- Where children raise questions that need research, they could answer them in class and / or as a home–school science activity.

YOU WILL NEED

- Question stem cards
- Sticky notes

ASSESSMENT

Subject Knowledge

- Em. Children can describe how they made their fossils.
- Exp. Children can say that fossils were living things that lived millions of years ago.
- Exc. Children can relate to the idea that fossils tell us about how living things lived millions of years ago.

Working Scientifically

- Em. Children need support to use question stems to ask relevant questions and how to answer them.
- Exp. Children use the question stems to ask a wide range of questions and suggest ways to answer them.
- Exc. Children ask questions and state which scientific enquiry activity they could use to answer them.

5 OTHER KINDS OF FOSSILS

L.O. Describe in simple terms how fossils are formed when things that have lived are trapped within rock.

- Show children PowerPoint Slides 18–25.
- In pairs, children talk with their partner to explain how they think that the mammoth was fossilised in ice (PowerPoint Slide 23). Children then pair up with another group to discuss their ideas; are they the same or different?
- Tell children that they are going to see what effects freezing might have on a fossil. They are going to try freezing different plants and perhaps dead insects that they might find outdoors.
- Children can draw or photograph them before and after freezing.
- Children could be involved in making an insect trapped in tree resin. Explain that sometimes insects can get trapped in tree resin, which comes out of a tree when the bark is damaged (it is not sap). If the resin gets buried in sediment it hardens and becomes like orange glass. Show the amber fossil on PowerPoint Slide 22.
- Let children make amber fossils and compare them to real examples or the example on PowerPoint Slide 22.

YOU WILL NEED

- PowerPoint Slides 18–25
- Currants and raisins, barley sugar sweets
- Patty tins, oil, greaseproof paper
- Camera / drawing materials
- An oven that goes up to 180°C

ASSESSMENT

Subject Knowledge

- Em. Children describe how their fossil is made but are unable to link it to how animals became fossilised thousands of years ago.
- Ex. Children are able to describe how plants and animals can be fossilised in ice and amber.
- Exc. Children carry out extra research to find out more information about animals fossilised in ice and amber.

Making amber fossils is straightforward but does require adult support when using the oven. Slice raisins or currants in half and cut or shape to look like insects. Grease patty tins with oil and line with greaseproof paper. Put raisin insects in the indented parts of the tin and put two barley sugar sweets on top of each insect. Bake for 8 minutes at 180°C: this might need to be varied depending on the oven. Leave to cool and then take off the paper. Remove any paper stuck to the 'amber' with some water.

- Children could create their own fossil museum as suggested in PowerPoint Slide 25, with information about the fossils on fact cards.

6 FINDING FOSSILS ROLE PLAY

L.O. Describe in simple terms how fossils are formed when things that have lived are trapped within rock.

- Children role play finding a fossil using fossils they have made buried in safe soil or sand and role play being part of a fossil dig.
- They create a video of their dig and the excitement of finding fossils.
- They role play being palaeontologists in front of the class and participate in 'hot seating' about the fossil they have found, either their own or a real fossil that they have researched.

YOU WILL NEED

- Fossils made in previous activities
- Tools for digging fossils, e.g. trowels
- Video camera / iPad

ASSESSMENT

Subject Knowledge

- Em. Children participate in a role play about fossils.
- Exp. Children are able to communicate what they have learned about fossils through their role play.
- Exc. Children research additional information for their role play to make it more authentic.

TOPIC 2

Food and our bodies

About this topic

Curriculum link: Year 3, Animals, including humans

SUMMARY:

Children work scientifically on a variety of quick challenges and longer tasks to learn about food and their bodies. This topic looks at where animals get food from and why it is important, and skeletons, muscles and joints.

UNITS:

2.1: Food for thought
2.2: Bones and skeletons
2.3: Protecting our bones
2.4: Muscles and joints

ACTIVITY RESOURCES:

2.1: My food diary
2.2: Food groups
2.3: What I eat
2.4: Build a skeleton

ONLINE RESOURCES:

Teaching slides (PowerPoint): Food and our bodies
Interactive activity: Food and our bodies
CPD video: Food and our bodies
Pupil video: Food and our bodies
Word mat: Food and our bodies
Editable Planning: Food and our bodies
Topic Test: Food and our bodies

Learning objectives

This topic covers the following learning objectives:

- 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.
- Identify that humans and some other animals have skeletons and muscles for support, protection and movement.

Working scientifically skills

This topic develops the following working scientifically skills:

- Gather, record, classify and present data in a variety of ways to help in answering questions.
- Record findings using simple scientific language, drawings, labelled diagrams, keys, bar graphs and tables.
- Report on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions.

CROSS-CURRICULAR LINKS

This topic offers the following cross-curricular opportunities:

Mathematics

- Food preferences: collecting data using a table and transferring to bar graphs.
- Cooking: measuring using standard measures, numbers to 1000, e.g. ml, gm.
- Time: how long to cook things for.
- Read food labels.
- Understand weight of ingredients, e.g. sugar, salt.
- Fractions: sharing food, e.g. pizza.
- Addition and subtraction problems with food.
- Measure the body using metres and centimetres.
- Pattern seeking: body measurements, e.g. height and arm span.
- Mental calculations: differences in height, etc.
- Begin to work out the scale when creating a bar graph, e.g. counting in twos, fives, tens.
- Bar graphs, pictograms and tables.

English

- Increase the range of books read, e.g. cookery books.
- Read recipes.
- Write recipes, using correct grammar and punctuation.
- Read and retrieve information from food labels.
- Retrieve and record information, e.g. researching food groups.

- Create a glossary of key scientific words.
- Read and spell scientific vocabulary.
- Research information; comprehension.
- Represent researched information.
- Label and caption diagrams.
- Prepare poems and play scripts to read aloud and to perform, showing understanding through intonation, tone, volume and action.
- Read books that are structured in different ways and read for a range of purposes.
- Transfer handwriting and spelling expectations to science.
- Write stories or poems inspired by the characters in books such as *Funnybones* by Janet and Allan Ahlberg or *Skulduggery Pleasant* by Derek Landy.

Geography

- Food miles; farm to fork.
- Use maps to locate where different foods come from around the world.
- Research recipes from different countries.

History

- Foods in different periods of history, e.g. Stone Age, Romans.
- Timeline of different foods, e.g. sugar, burgers.
- What our parents, grandparents and great grandparents ate.

Design / technology

- Design recipes that are healthy and appealing, e.g. using a computer and selected from a wide range of ingredients.
- Design a healthy lunchbox meal: evaluate each other's lunchboxes.
- Cook recipes and design healthy snacks and plates of food: consider the views of others to improve their ideas.
- Reuse materials to design and make a model of the skeleton and muscles.
- Use annotated sketches to develop the design.
- Select from and use a wide range of materials and components according to their functional properties.
- Evaluate their skeleton and muscles against design criteria and consider the views of others to improve their work.

Music

- 'Danse Macabre' by Saint-Saëns: how does the music represent skeletons?
- ''Dem Bones' music and lyrics: replace the words with specific names, e.g. change knee bone to patella.

MFL

- Learn parts of the body, e.g. in French, Spanish.

Art

- Giuseppe Arcimboldo: creat portrait heads from fruit and vegetables.
- Print using fruit and vegetables.
- Still-life painting.
- Observational drawings.
- Printing techniques to create skeletons, e.g. dog bones using white paint on black paper.
- Create X-ray pictures.

P.E.

- Create a keep fit programme.
- Compare and improve own performance.
- Develop flexibility, strength, technique, control and balance.
- Locate which bones and muscles are used in different P.E. activities.
- Use specific bones and muscles to create movement sequences.
- Practise specific activities to improve skills, e.g. strengthening arm muscles to throw a ball a distance.

Computing / ICT

- Use research technology effectively, e.g. to find recipes, research information about food.
- Learn how to use a spreadsheet in science.
- Create a table and graph.
- Collect and place individual and class data, e.g. height, bones broken, on to an Excel® spreadsheet.
- Create basic stick-man skeleton out of pipe cleaners, cover it in modelling clay, then create a video using stop-motion animation.
- Write skeleton songs and record them using microphones or cameras.
- Use technology safely, respectfully and responsibly.

Subject knowledge

This unit covers two different areas of the curriculum – nutrition and skeletons and muscles – and it does so in relation to animals including humans, so it is important to make sure that activities relate to animals as well as humans.

Nutrition

The basic needs of all humans and other animals are food, water, oxygen and shelter. Unlike plants, which make their own food by photosynthesis, animals (including humans) cannot make their own food. Instead, they have to get their food by eating plants or other animals.

Humans need to eat regularly and eat different kinds of food to stay healthy. The food that humans eat can be divided up into different groups. There are various ways of doing this, but we recommend you use the following groups:

- ***Fruit and vegetables*** are a good source of vitamins and minerals and fibre that helps people to go to the toilet. They are also low in fat and calories.
- ***Starchy foods,*** e.g. bread, rice, potatoes, pasta and cereals should make up just over a third of the food we eat. They are a good source of energy, fibre, calcium, iron and B vitamins. Where possible, people should eat wholegrain bread, rice and pasta.
- ***Dairy food,*** e.g. milk, cheese and yoghurt, is a good source of protein and calcium. Our bodies need protein to work properly and to help the body repair itself. Calcium helps to keep our bones and teeth strong.
- ***Meat, fish, eggs, beans, pulses and nuts*** help the body to grow. They are rich in protein for healthy bones, zinc for hair, nails and eyes and fish is good for keeping the heart healthy.
- ***Fat and sugar*** are needed in small amounts. Fats are important as they provide the body with energy and help the skin and brain. They help the body to absorb different vitamins such as A, K and D. At the same time, fats act as insulation to help keep humans warm. Sugar is a source of energy but it should not make up more than around 5% of calorie intake because excess sugar can lead to tooth decay, type 2 diabetes and other health issues.
- ***Water*** is essential to life; without water humans and other animals would die. In humans, the body needs water to work; blood needs water. We need water to digest our food and remove waste in urine. Thirst is a sign that the body is dehydrated so we need to keep hydrated and drink water, milk and eat fruit and vegetables but avoid sugary drinks.

Skeletons

The skeleton is a strong, rigid structure inside the body made of bone. Bone is living tissue made from bone cells, collagen and minerals such as calcium phosphate. The bones of our skeleton provide us with a strong structure supporting and protecting the rest of the body.

The ribs form a protective structure around the heart and lungs; the skull protects the brain.

Inside bone is a spongy tissue called bone marrow, which is where red blood cells are made. Bone needs a blood supply, just like every other tissue in the body. Bones are joined together by strong elastic groups of fibres known as ligaments.

Cartilage is the elastic, slippery protein covering the ends of bones at joints, allowing them to move freely. Noses and ears are made from cartilage and some fish, such as sharks, have whole skeletons made of it.

We are born with around 300 bones, but as we get older some of these fuse together into large bones. So, by the time we are adults, we only have 206 bones.

Some creatures such as crabs, lobsters and insects have a tough external skeleton, or exoskeleton. However, this is often made from a protein called chitin.

Muscles and joints

Use the CPD video to check understanding about muscles and watch how model muscles can be made to help children understand how they work.

Joints are the places where bones meet. They allow the skeleton to move and allow humans and other animals to grow.

There are various types of joint, each allowing different types of movement:

- ***Sliding joints*** like the ankle and wrist allow for limited rotation at the joint.
- ***Fixed joints*** are fixed and do not allow movement, such as the joints between the various bones in the skull.
- ***Ball and socket joints*** have a rounded end that fits into a cup-like cavity on another bone, e.g. hip and shoulder joints.
- ***The elbow and knee*** are simple hinge joints, allowing basic movement in a single plane, e.g. backwards and forwards.

Bones are moved using muscles. These muscles are attached to bones by tendons – strong, inelastic strips of tissue. Muscles can contract and get shorter; this pulls on the tendon and makes the bone move. They work in pairs; one muscle contracts and pulls in one direction, then another contracts and pulls back while the original muscle relaxes. Muscles do not always attach to bone; some do things such as move the eyes. The heart is a ball of muscle, a muscular organ, which pumps blood around the body.

The smallest muscle in the human body is the stapedius; it is a tiny muscle that is less than 2 mm long located in the middle ear. The largest and strongest is the gluteus maximus, which children will enjoy learning about because it is the buttocks / bottom.

CHILDREN'S MISCONCEPTIONS

Children might think...

- that we only eat food to give us energy: in fact, food does much more, including providing the vitamins and nutrients we need to keep our bodies healthy.
- that all fats are bad for us: we need a certain amount of fat in our diet for many different reasons including building cells, helping nerves carry messages, protecting our organs and heat insulation to keep us warm.
- that bone is not living and cannot grow: in fact, it is made from living cells. That is why bone can heal itself if it is broken or fractured.
- that only arms and legs have muscles.
- that muscles are not found all over the body.
- that muscles can push: in fact, they can only pull, but our bodies can push things because of the way the muscles pull on different bones.

Children already know...

- the basic parts of the human body (Year 1).
- that animals and humans need food to survive (Year 2).
- that it is important to eat the right types of food (Year 2).

SCIENTIFIC VOCABULARY: FOOD AND OUR BODIES

You can download a Word mat of essential vocabulary for this topic from *My Rising Stars*.

balanced diet: a diet that has the right amount of nutrients

biceps: a large muscle at the front of the upper arm

carbohydrates: nutrients found in sugary foods such as sweets or starchy foods such as potatoes and pasta; these provide energy

contract: when a muscle gets shorter and pulls

relax: when a muscle stops contracting

exoskeleton: a skeleton that some animals have that is outside their bodies like a suit of armour

fats: nutrients found in foods such as butter; these give you energy and insulate your body

femur: the long bone at the top of the leg

humerus: the long bone at the top of the arm

joint: where bones meet; there are different types of joint that can move in different ways to make the body move

muscle: special organs that can contract and relax

nutrients: useful substances found in foods

protein: nutrients found in foods such as fish, used in your body for growth and repair

skeleton: supports and protects the body, allowing movement

triceps: a large muscle at the back of the upper arm

vertebrate: animal with a spinal column or backbone including mammals, birds, amphibians and fish

2.1 Food for thought

GET STARTED

Show children a video about feeding monkeys at the zoo, available from the BBC website (see Useful website links on *My Rising Stars*). Then discuss the variety of animals you would find in a zoo and the different types of food you would need to feed them. Think about what you know about carnivores (crocodiles, lions, etc.), omnivores (bears, badgers, hedgehogs, etc.) and herbivores (sheep, cows, deer, kangaroos, etc.).

Use PowerPoint Slides 1 to 4 to introduce the topic.

LET'S THINK LIKE SCIENTISTS

Use these questions to develop research skills and speaking and listening:

- Why do different animals eat different foods?
- Lettuce is supposed to be a healthy food. But what would happen to us if we ate nothing but lettuce?
- Do all the foods we eat only contain a single food group?
- Iron is a mineral. Which foods contain it? And why do we need minerals in our diet, anyway?
- Vitamin C is found in which foods? Why do we need different vitamins in our diet?

ACTIVITIES

1 WHAT DO HUMANS AND OTHER ANIMALS NEED TO LIVE?

L.O. Identify that animals, including humans, need the right types and amounts of nutrition, and that they cannot make their own food; they get nutrition from what they eat.

- Show children PowerPoint Slide 5 and ask them to discuss in their groups what all of the animals have in common (what they need to live). Go around and listen to children discussing their ideas and accept all their comments since this will give access to what children already know and understand. When their discussion seems to be slowing down, ask them to write their ideas on a large sheet of paper. Remind them that, in science, they need to write so that others can read it and also to check each other's spellings, use a dictionary, etc.
- Once ideas are written down, give children some time to go from one table to another and read their ideas. They can then use sticky notes to leave each other positive comments, e.g. one star and a wish, as well as take ideas from other groups to add to their own.
- After this, ask for a list of the key things that all animals have in common. Although at this stage the curriculum does not mention life processes, some children might offer more than the need for animals (including humans) to eat, drink water and breathe, so keep the following list in mind and introduce children to these basic ideas if they offer them:

M	Movement	All living things move
R	Respiration	Breathe (simplest term)
S	Sensitivity	Sense their surroundings
G	Growth	All living things grow
R	Reproduction	Have young
E	Excretion	Getting rid of waste
N	Nutrition	Taking in and using food

YOU WILL NEED

- PowerPoint Slide 5
- Sticky notes
- Large sheets of paper

ASSESSMENT

Subject Knowledge

- Em. Children know that they have to eat to stay alive and can link this to e.g. the needs of their own pets.
- Exp. Children can explain that humans and other animals need to find and eat food because they cannot make their own.
- Exc. Children can also explain that they need the right kinds of food to remain healthy and this applies to other animals.

The main idea that children need to take forwards is that all living things need to eat to stay alive; animals get their nutrition from what they eat because they cannot make their own food.

2 WHO EATS WHAT?

L.O. Identify that animals, including humans, need the right types and amounts of nutrition, and that they cannot make their own food; they get nutrition from what they eat.

- Give each group of children a selection of different foods for pets in plastic bowls, or create a carousel of different foods on each table so children can move around and record the food and what they think eats it. These could include dry food for dogs or cats, lettuce, carrots, sunflower seeds, loose bird seeds and fish food flakes. You could focus on pets or include grass or hay, for example, to broaden this out to other animals.
- Discuss what was on each table with children and remind them of learning from Key Stage 1 that some animals eat meat and these are called *carnivores* and some eat only plants and are called *herbivores*. Ask them to think of as many different animals as they can and group them into carnivores or herbivores. Do any animals eat both meat and plants? Can children find out what they are called?
- Show children PowerPoint Slide 6 and ask them to compare what rabbits eat and what humans eat. What are the similarities and differences?
- Use PowerPoint Slides 7 and 8 to introduce the home–school activity. Ask children to design a dinner menu for a wild animal of their choice, such as a meerkat, lion or crocodile. Children carry out research into the animal and bring their menu to share with the rest of the class.

YOU WILL NEED

- A range of foods for different pets in bowls
- PowerPoint Slides 6–8

ASSESSMENT

Subject Knowledge

- Em. With support, children can match some animals to their food.
- Exp. Children can suggest which food is eaten by which animals and why.
- Exc. Children can also explain why different food is eaten by different animals.

3 MY FOOD DIARY

L.O. Identify that animals, including humans, need the right types and amounts of nutrition, and that they cannot make their own food; they get nutrition from what they eat.

- Explain to children that they are going to keep a ‘food diary’ to help them learn about food and nutrition. Ask them to find out what the word *nutrition* means and create their own definition.
- To help them keep their diary, give them two copies of Activity Resource 2.1 and ask them to keep the food diary by recording everything they eat and drink over the next two days. Tell them to bring this diary back to school because they will use it for some work soon.
- Use this information as the basis of Activity 6, ‘Which food groups do I eat?’.

YOU WILL NEED

- Activity Resource 2.1

ASSESSMENT

Subject Knowledge

- Em. With support, children record what they have to eat and drink.
- Exp. Children complete the diary independently.
- Exc. Children can also explain why the food might be nutritious.

4 BIRD FEEDERS

L.O. Identify that animals, including humans, need the right types and amounts of nutrition, and that they cannot make their own food; they get nutrition from what they eat.

- Take in a range of bird feeders for children to observe and to think about what kind of birds would feed from them.
- Using PowerPoint Slide 9, ask children to name the birds (remind them that they might have learned these in Key Stage 1), explain that these birds are common visitors to gardens and feed from bird feeders.
- Tell them they are going to design and make a bird feeder to hang up to attract these birds. Give children access to everyday materials for them to make their feeder for the school grounds (or to take home). You can find some inspirational ideas for different types of bird feeders in the Useful website links on *My Rising Stars*.
- To broaden children's STEM experience, you could contact local RSPB representatives who might help children make bird feeders, or a friend of the school with craft or woodwork skills.

YOU WILL NEED

- A range of bird feeders
- Everyday materials for making bird feeders, e.g. cardboard, plastic, wood
- PowerPoint Slide 9

ASSESSMENT

Subject Knowledge

- Em. With support, children make a bird feeder and suggest food to put in it.
- Exp. Children design and make a bird feeder suited to the needs of the birds.
- Exc. Children research the needs of a specific garden bird and explain how their design and food is appropriate for the type of bird.

5 FOOD GROUPS

L.O. Identify that animals, including humans, need the right types and amounts of nutrition, and that they cannot make their own food; they get nutrition from what they eat.

Gather, record, classify and present data in a variety of ways to help in answering questions.

- Use PowerPoint Slide 10 and give each group of children a selection of different foods, either real or photographed. Ask children to sort these into groups. What criteria did they decide on? Could the foods be sorted in other ways? Discuss this as a class.
- Introduce the idea of food groups using PowerPoint Slides 11 and 12. Introduce children to the basic food groups, as described in the subject knowledge at the start of this topic. The curriculum does not require children to learn and be assessed on terms such as *carbohydrates* but some children enjoy learning scientific words so do offer them.
- Ask children to go back to the food or pictures that they used earlier and sort them into the groups shown on PowerPoint Slide 11. Discuss any that they find difficult to classify and why it is important that we eat some from each group.
- Give children Activity Resource 2.2 and ask them to complete the grid using the foods they have sorted. Encourage children who complete early to add new foods to the groups, checking using the Internet or dictionary if they are unsure.
- Make sure that children understand there is no such thing as unhealthy food, just an unhealthy diet, and that chocolate, crisps, etc. as treats are fine. What children should try to eat is a balanced diet, eating food from all food groups.

YOU WILL NEED

- Collection of different foods or pictures
- PowerPoint Slides 10 to 12
- Activity Resource 2.2

ASSESSMENT

Subject Knowledge

- Em. Children sort food according to what it looks like and do not make the link between food and a food group.
- Exp. Children recognise food groups and classify according to those groups.
- Exc. Children apply the food groups to classify new food that they suggest.

Working Scientifically

- Em. With support, children can complete the grid.
- Exp. Children are able to use a grid to record data and draw conclusions.
- Exc. Children use the grid to answer questions and are able to ask new questions.

6 WHICH FOOD GROUPS DO I EAT?

L.O. Identify that animals, including humans, need the right types and amounts of nutrition, and that they cannot make their own food; they get nutrition from what they eat.

Gather, record, classify and present data in a variety of ways to help in answering questions.

- Children return to the food diary that they kept for two days. You could create your own food diary and use it to model how children analyse their data and record using a tally chart. Children will know this from Key Stage 1 science and mathematics but might need reminding of how to create one. You could use PowerPoint Slide 13.
- While children create an individual tally chart, encourage them to work with their partner and help each other out if they are unsure, encouraging discussion.
- Children use their data to produce a bar graph showing how many of each food type each child has eaten. At this stage children will require support transferring their data from tally to bar chart, so use PowerPoint Slide 14 to show them what to do.
- When children have completed their bar chart, they could work as pairs and analyse each other's data to make two comments: one positive relating to what they eat, e.g. well done for eating lots of vegetables, and the second on how they can improve their diet, e.g. you could try to eat less sugar or have more starchy foods. Be careful that children do not become judgemental about each other's diet.

YOU WILL NEED

- PowerPoint Slides 13 and 14
- Food diary (from Activity 3)

ASSESSMENT

Subject Knowledge

- Em. Children can talk about the food they have recorded in their food diary.
- Exp. Children know which groups different foods belong to.
- Exc. Children apply the food groups to suggest how healthy a diet is.

Working Scientifically

- Em. Children are able to transfer data from their food diaries to a tally chart and, with support, create a bar graph.
- Exp. Children are able to create an accurate bar graph based on data in their food diaries and draw some conclusions about what they eat.
- Exc. Children use the data to draw conclusions about their diets and changes they could make.

7 SUGARY DRINKS

L.O. Identify that animals, including humans, need the right types and amounts of nutrition and that they cannot make their own food; they get nutrition from what they eat.

Gather, record, classify and present data in a variety of ways to help in answering questions.

- Children will need either bottles or cans of fizzy drinks, juices and smoothies or copies of the nutritional information on them.
- Working in groups, children find out the amount of sugar in different drinks and carry out a consumer test to find out which drink has the most sugar.
- Show children PowerPoint Slide 15, which shows information from the label of a popular fizzy drink.
- In pairs, children apply maths and calculate the amount of sugar in this drink. Some children might need support in applying maths at this point. Let them weigh and pour out the amount of sugar so that children understand what 25 g of sugar looks like; this helps them to understand how much sugar is being consumed. Give children time to think about whether this is a healthy amount of sugar and to think about, e.g. tooth decay, gaining weight, etc.

YOU WILL NEED

- A range of different drinks in containers with labels showing amounts of sugar, etc or the nutritional information from the labels.
- Sugar
- Weighing scales
- Plastic cups
- PowerPoint Slide 15 and 13

ASSESSMENT

Subject Knowledge

- Em. Children know that some drinks are unhealthy.
- Exp. Children can say why some drinks are less healthy than others.
- Exc. Children are able to explain the links between high sugar content and health; they can talk about the consequences of drinks with high sugar content.

- Once children know how to read the information on drinks bottles, tell them they will work in groups to find out the amount of sugar in different drinks such as fizzy drinks, juices and fruit smoothies. Tell them to create a group table to record their results; remind them of the table on PowerPoint Slide 13 and ask them what their table would look like (they would only need a row for sugar). Look at the labels from different bottles and then, in plastic cups, weigh out the corresponding amounts of sugar. Which drink has the most sugar? Which has the least? Discuss why too much sugar can be bad for our bodies. What problems can sugar cause?

This activity could be extended to carry out a survey of how much fat is in different snacks, using lard.

Working Scientifically

- Em. With support, children read and record the numbers from labels and use comparisons of amounts of sugar poured into bowls to say which drink has the most sugar.
- Exp. Children collect, record data and answer the question.
- Exc. Children use the data they have collected to make decisions about which drink is the healthiest.

8 SCHOOL LUNCHES

L.O. Identify that animals, including humans, need the right types and amounts of nutrition and that they cannot make their own food; they get nutrition from what they eat.

Record findings using simple scientific language, drawings, labelled diagrams, keys, bar charts and tables.

- Children complete a Activity Resource 2.3 over a week of the foods they eat for school dinner or for packed lunch. As the week progresses, ask children to think about if they are happy that their choices are healthy ones and whether they need to choose a food group next day that, so far, they have not eaten a lot of.
- Give children time each day to complete the table and discuss with their partner the choices they have made. Listen to conversations, what language are they using and whether they are using knowledge about food groups in their talk and reasoning.

YOU WILL NEED

- Activity Resource 2.3

ASSESSMENT

Subject Knowledge

- Em. With support, children complete the table and are able to talk about the foods they are eating.
- Exp. Children identify the food groups they have eaten each day.
- Exc. Children apply what they know about food groups and choose what to eat each day according to how healthy the food is.

Working Scientifically

- Em. Children complete a given table.
- Exp. Children are able to construct a table and add data.
- Exc. Children can suggest amendments to their table as data is collected.

9 MEAL PLANNER

L.O. Identify that animals, including humans, need the right types and amounts of nutrition, and that they cannot make their own food; they get nutrition from what they eat.

- Give children access to a range of food – fresh, packets, tins etc. – or pictures of foods and ask them to plan healthy meals for themselves for a day: breakfast, lunch, evening meal and supper. Ask children how they would record this, e.g. a poster, on paper plates, a table. Children might want to include food that is not in the classroom; this is often a sign that they are confident to apply their understanding to their own choices.

YOU WILL NEED

- A range of fresh foods, packets, tins

ASSESSMENT

Subject Knowledge

- Em. With support, children choose food for each meal.
- Exp. Children choose foods from the different groups for each meal.
- Exc. Children apply what they know about food groups and choose what to eat for each meal.

2.2 Bones and skeletons

GET STARTED

Which bones have children heard about before? How many of the bones in the skeleton can they name? Get them to pair up and make a list, checking their spellings using a dictionary. They could put their words inside a giant paper bone that can be displayed. Give children time to compare the list with that of another pair and add new words to their own list, making sure first that they know where the bone is in the human body.

LET'S THINK LIKE SCIENTISTS

Use these questions to develop research skills and speaking and listening:

- What would happen if we didn't have skeletons?
- How are animals with tough external skeletons able to move about?
- What are bones made from?
- Why do we need to drink milk to keep our bones healthy?
- What happens when you break a bone? How is it able to mend itself?

ACTIVITIES

1 OUR SKELETONS

L.O. Identify that humans and some other animals have skeletons and muscles for support, protection and movement.

- Children could work in groups to draw around someone from the group and then draw in the skeleton. This can be done on paper, but it is also a great activity to take outdoors where children can space out and everyone can be involved using chalk on the ground.
- As children work they can label the bones that they know and also go and visit skeletons created by other groups to check and add to their own ideas. You could provide children with a list of parts of the body and ask children to think about where they are and also what job they do, e.g. the skull protects the brain, the ribs protect the heart and lungs. If children have a vocabulary list there is no excuse for incorrect spellings; remind children that words must be spelt correctly in science just as they should be in English.
- Give each group the use of a camera to take a photograph of their skeleton, which can then be printed out and placed in the science book or class book. Ask children to add a sentence of their own about what they have learned from this activity.

YOU WILL NEED

- Large sheets of paper and marker pens (or chalk)
- Camera

ASSESSMENT

Subject Knowledge

- Em. Children are able to name some basic parts of the body and point to them, e.g. head, leg, arm.
- Exp. Children name and position a range of bones / body parts taught at Key Stage 1.
- Exc. Children are able to name, position and explain the function of some bones, e.g. ribs.

2 BONES

L.O. Identify that humans and some other animals have skeletons and muscles for support, protection and movement.

- Give children a collection of bones. These could be cleaned and sterilised chicken bones or a collection of animal bones from a local

YOU WILL NEED

- Collection of different bones

secondary school, university or museum service. Encourage children to handle the bones and examine them carefully to discuss:

- Which animal do you think the bones come from?
- What is the name of each bone?
- Which parts of the body do you think the bones come from?
- What do you notice that is special about the bone?
- Which of the bones do you also have in your body?

- If the bones are different on each table, give children the opportunity to visit other tables to observe and discuss their bones.

ASSESSMENT

Subject Knowledge

- Em. Children recognise that they are observing bones.
- Exp. Children suggest names and parts of the body they belong to.
- Exc. Children give reasons for their ideas using personal knowledge.

3 RESEARCHING BONES

L.O. Identify that humans and some other animals have skeletons and muscles for support, protection and movement.

- Show children a video clip on bones (see Useful website links on *My Rising Stars*) or provide books, leaflets and posters.
- Give them time to research five new facts about bones and add them to the Class Big Book or working wall on bones.
- The aim is for children to display their new facts and then read those from others and learn some new ideas from other groups.
- Extend this to a home – school activity by challenging children to find out interesting facts and add them to the Class Bone Facts collection.

YOU WILL NEED

- Books and websites providing information about bones

ASSESSMENT

Subject Knowledge

- Em. With support, children are able to find out some facts about bones.
- Exp. Children work independently and use different sources to find information about bones.
- Exc. Children present the results of their research and comment constructively on work of other groups using a range of scientific vocabulary.

4 BUILD A SKELETON

L.O. Identify that humans and some other animals have skeletons and muscles for support, protection and movement.

- As children build up their knowledge of bones, give them the opportunity to create a skeleton using cotton buds that they can cut down to size and glue onto black paper to represent a skeleton.
- Encourage children to research their skeleton first by using model skeletons in the classroom, books, video clips, etc.
- Children could use Activity Resource 2.4 to build a skeleton.

YOU WILL NEED

- Activity Resource 2.4
- Cotton buds and glue
- Black paper

ASSESSMENT

Subject Knowledge

- Em. Children are able to create a simple skeleton and name some bones.
- Exp. Children create a skeleton showing they have learned some new bones and checked against their playground bone photograph.
- Exc. Children create a complex skeleton and are able to talk about it with confidence.

2.3 Protecting our bones

GET STARTED

Show the image of a knight in a suit of armour on PowerPoint Slide 16. Ask children why they think he is dressed like this. What does the armour do? What would it be like to wear? And what problems would you have?

Tap your head. Why is your skull so hard? And what does it do?

What would it be like if we didn't have bones?

LET'S THINK LIKE SCIENTISTS

Use these questions to develop research skills and speaking and listening:

- What do bones protect?
- Why are bones good for protection?
- What is the ribcage for?

ACTIVITIES

1 PROTECTING THE BRAIN

L.O. Identify that humans and some other animals have skeletons and muscles for support, protection and movement.

- Ask children to pair up and discuss the vital jobs that skeletons do. Why do they think we have them? Note children's responses so that you can use these to reinforce that:
  - bones help to keep us upright: we would be floppy like jelly without them
  - they help use to move (along with muscles)
  - they protect some parts of the body, e.g. brain, heart and lungs.
- To help children understand how the skull protects the brain, show PowerPoint Slide 17 that shows what the brain looks like and ask children to think about what their brain is like, why the brain is important and why it needs a skull for protection.
- Then give them some jelly to put into a small plastic container (e.g. film canister) representing the skull and then ask them to put some on a paper plate.
- Ask children to shake the jelly on the plate and the jelly in the container. What happens to both lots of jelly?
- Ask children what the container does that the plate does not, i.e. it is like our skulls or ribs, protecting our soft, squishy bits like our brains, heart and lungs.
- Ask children to stand in different poses of their choice. For instance, they could balance on one leg with their arms outstretched. Then ask them to think about what it is that is keeping them upright, i.e. that our skeleton supports the whole body.
- Challenge children to find out what the word *vertebrate* means; this could be a home–school activity. Children should understand this word since it then helps them to understand why *invertebrates* are different.

YOU WILL NEED

- PowerPoint Slide 17
- Jelly
- Small plastic containers
- Paper plates

ASSESSMENT

Subject Knowledge

- Em. Children can say that they have a skeleton and need support to explain why.
- Exp. Children know why humans have a skeleton and can use the jelly activity in their explanation.
- Exc. Children explain using a range of scientific vocabulary, e.g. *skeleton, organs, protect, support.*

2 ANIMALS WITHOUT A SKELETON

L.O. Identify that humans and some other animals have skeletons and muscles for support, protection and movement.

- Show children pictures of animals with exoskeletons on. Explain that these animals do not have skeletons inside like we do, but do have hard shells. You could also reveal that some animals do not have skeletons at all! Then, in groups, identify and group animals with skeletons on the outside, with skeletons on the inside and without skeletons at all. At this point children could go out into the school grounds to search for invertebrates and ask children to find, identify and name the invertebrates using their knowledge from Key Stage 1.
- Use the interactive activity (on *My Rising Stars*) to help consolidate learning.

YOU WILL NEED

- Interactive activity:

ASSESSMENT

Subject Knowledge

- Em. Children state that they have a skeleton and need support to explain why.
- Exp. Children know the difference between animals that are vertebrates and invertebrates.
- Exc. Children explain using a range of scientific vocabulary, e.g. *invertebrates, vertebrates, skeleton, internal and external*.

3 BROKEN BONES SURVEY

L.O. Identify that humans and some other animals have skeletons and muscles for support, protection and movement.

Record findings using simple scientific language, drawings, labelled diagrams, keys, bar charts and tables.

Report on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions.

- Children look at how bones break and mend. Use PowerPoint Slide 19 and show children X-rays of bones that have broken. Ask them to discuss in their groups which parts of the body are being shown, identify the break and suggest how the bones could have been broken.
- Lead children to think about what they can find out about children and broken bones. Ask if anyone in the class has broken any bones and encourage children to ask their own questions to their classmate. The aim is for children to carry out a whole-school survey to collect data about children breaking bones.
- As a class create a survey tally sheet with questions such as:
  - Who has broken bones?
  - Boy / Girl?
  - Age when broken?
  - Which bone/s?
  - How?
- The data from tally charts can be transferred to a bar chart and children suggest a set of questions for other groups to answer, e.g.
  - Have boys or girls broken the most bones?
  - What is the most common age for breaking bones?
  - How do most children break their bones?

YOU WILL NEED

- X-ray images of broken bones
- PowerPoint Slide 19

ASSESSMENT

Subject Knowledge

- Em. Children know that the skeleton is made up of bones.
- Exp. Children are able to name different bones in the body.
- Exc. Children know that bones are living (tissue) and can heal.

Working Scientifically

- Em. Children are supported in collecting data and answering questions.
- Exp. Children use a tally chart, place data on a bar graph and answer questions.
- Exc. Children collect, display their data and write a set of conclusions using the data.

2.4 Muscles and joints

GET STARTED

Show children video clips of people doing different sports and of animals such as horses, dogs, cheetah, snakes moving, someone smiling or someone climbing. Ask them to think about all of the things that the pictures have in common.

Give children time to discuss this in their groups; see if any pick up on the idea of muscles. If not, show the clips again and tell them that they need to think about something that is very important that helps us move, whether running or smiling.

LET'S THINK LIKE SCIENTISTS

Use these questions to develop research skills and speaking and listening:

- Why is it so difficult for an athlete to be good at many different events, such as in a heptathlon or decathlon, rather than just one sport?
- Why is it important that tendons are very strong and do not stretch?
- What muscles are used when you kick a football? How about when you swim?
- Why is your heart the hardest working muscle in your body?

ACTIVITIES

1 MUSCLES

L.O. Identify that humans and some other animals have skeletons and muscles for support, protection and movement.

- Take advantage of cross-curricular links by combining a science and P.E. lesson and arrange for children to carry out lots of different activities, e.g. running, jumping, throwing, climbing and balancing.
- As they work, ask them to think about which parts of the body they are using, especially bones.
- Introduce the term *muscles* and discuss what they know. At this stage, children are likely to know about muscles in their arms and legs, so get children to bring their hand up to their shoulder so that they can feel and see their arm muscle. Get children to move a knee to their chest and feel the leg muscles moving.
- The key to understanding is that bones support the body and it is muscles that help bones to move. Extend understanding to include the idea that there are muscles all over the body, including in the face. Ask children to smile and tell them it takes more muscles to frown than it does to smile. Ask them to think about this and locate different muscles in the body.
- Ask children to work in pairs and think about which muscles they use when they stand, sit, hop, jump on the spot. Further develop understanding by giving children time to engage in different activities and, as they do, to think about which muscles they are using.
- Towards the end of the lesson children work individually or in pairs to make a sequence of activities where they use different muscles, e.g. arms, legs, stomach.
- As a home-school activity, children complete Activity Resource 2.4.

YOU WILL NEED

- Activity Resource 2.4

ASSESSMENT

Subject Knowledge

- Em. Children can point to muscles in the arms and legs.
- Exp. Children are able to indicate where there are different muscles in the body.
- Ex. Children apply what they know about muscles to explain that muscles are needed to make bones move.

2 HOW DO OUR ARM MUSCLES WORK?

L.O. Identify that humans and some other animals have skeletons and muscles for support, protection and movement.

- Lots of children will make 'big muscles' to show how strong they are, so take advantage of this and ask children to do this and watch what happens to their upper arm.
- Ask them to repeat it but this time observe vary carefully and make links between what happens as they raise their hand towards their shoulder and the upper arm.
- Ask children to share their observations with each other and then bring this together with the whole class.
- Repeat this but tell children to observe what happens when they lower their arm.
- Ask children to hold their right arm out straight in front of them, palm up. They then put their left hand on their upper arm. Next, they bring their arm up and feel what happens to the muscle as they do.
- Ask them to describe their observations to a partner. What do they think is making their arm move? Listen to their responses to see which children are developing an understanding of muscles making their arm move and what happens when they move their arm up and down.
- Begin to introduce the idea that muscles work in pairs and ask children to feel the muscle at the front of the arm and at the back. Use PowerPoint Slide 20 to illustrate what happens.
- Children may need a lot of exposure to this idea because, although they can feel what is happening, they cannot see under their own skin. Muscles can only pull, they cannot push.
- Ask children to once again move their hand towards their shoulder; the muscle at the front (biceps) gets shorter (contracts) as it is pulling the arm upwards. Tell them to do this again but this time feel the muscle at the back (triceps); this stretches (it relaxes). When they put their arm down the muscle at the back (triceps) contracts and the muscle at the front (biceps) is stretched (relaxes).
- Give children time to repeat this again with each child explaining what is happened to their partner. In pairs, children hold their partner's upper arm as they move it up and down and explain to each other what is happening. This might seem repetitive but it is important that children match language and experience.

YOU WILL NEED

- PowerPoint Slide 20

ASSESSMENT

Subject Knowledge

- Em. Children can show their upper arm muscles working.
- Exp. Children are able to demonstrate and describe what happens to the muscle when they move their arm.
- Ex. Children use scientific language to explain that muscles work in pairs and how the muscle in their upper arm works.

3 MAKE A MODEL OF A MUSCLE

L.O. Identify that humans and some other animals have skeletons and muscles for support, protection and movement.

Report on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions.

- Explain to children that they are going to make a model arm to show how muscles work.
- Show children PowerPoint Slide 21 and discuss how they think this model is made.
- Use two lengths of stiff card fixed at one end with a paper fastener. Then add elastic bands to act as the biceps and triceps muscles. Ask children to observe what happens when you pull on the biceps and what happens when you pull on the triceps. Explain that one muscle pulls the arm up, and the other pulls the arm down. Remind children that muscles only ever pull, they cannot push.
- Once children have completed their model, ask them to think about and jot down the scientific words they need to use to explain how their model works; their list should include:

Muscle Triceps Biceps

Contract Relax Arm

Up Down Move

Model Work

- Then ask them to demonstrate and explain to their partner how the model works, using as many of the scientific words on their list as possible. Partners listen and peer assess, offering constructive comments to their partner. Once this is complete, children could glue their model into their book and write their explanation using scientific vocabulary, paying attention to making sure they apply their literacy, e.g. full stops, correct tense, capital letters, to their writing. You can use the CPD video 'Food and our bodies' to see this activity modelled.

YOU WILL NEED

- PowerPoint Slide 21
- Stiff card
- Paper fasteners
- Elastic bands

ASSESSMENT

Subject Knowledge

- Em. Children can name basic joints, e.g. elbow, wrist, knee.
- Exp. Children know that joints allow parts of the body to move.
- Exc. Children are able to explain how different joints work.

Working Scientifically

- Em. With support, children are able to make the model and label different parts.
- Exp. Children make and label the model and are able to explain how muscles work to a partner.
- Exc. Children can give oral and written explanation using scientific vocabulary and give constructive feedback to a partner.

4 GETTING TO KNOW JOINTS

L.O. Identify that humans and some other animals have skeletons and muscles for support, protection and movement.

Report findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions.

- Show children PowerPoint Slides 22 to 24 and discuss the different joints and how they work. Then take children into the school hall or outside and ask them to bend their bodies in as many different ways as possible, such as bending over, down, bending knees at the hips, elbow, ankle, wrist. Then ask them to repeat this but in slow motion so that they can locate the joint that allows parts of the body to bend. If tablets are available, children video their partner or someone in the group bending and saying where the joint is, e.g. ankle, elbow.
- If outside, children draw round one child in their group and locate joints and put circles around them. If they know the name of these joints, e.g. knee, ankle, neck, hips, they could label these.
- For each joint they label, they write a description of the kind of movement each one allows, e.g. backwards, forwards, side to side. Do they think all joints allow each part of the body to move in the same way? Why?
- Back in the classroom, tell children that there are different kinds of joints, such as:
  - hinge
  - ball and socket
  - sliding.
- Challenge them to research information about these joints. This could be carried out as part of literacy where children read non-fiction text, e.g. books, leaflets, posters, retrieve and record appropriate information, and then choose the best way to display or present their information.

YOU WILL NEED

- PowerPoint Slides 22 to 24
- Camera / tablet

ASSESSMENT

Subject Knowledge

- Em. Children can name basic joints, e.g. elbow, wrist, knee.
- Exp. Children know that joints allow parts of the body to move.
- Exc. Children are able to explain how different joints work.

Working Scientifically

- Em. Children can show someone where their joints are.
- Exp. Children can research and choose how to tell others what they have found out.
- Exc. Children choose how to communicate their research and are able to compare different joints.

TOPIC 3 Light and shadows

About this topic

Curriculum link: Year 3, Light

SUMMARY:

Children work scientifically on a variety of quick challenges and longer tasks to learn about the wonders of light, including reflections and shadows.

UNITS:

3.1: Light and reflections
3.2: Making shadows

ACTIVITY RESOURCES:

- 3.1: Shiny or dull?
- 3.2: Reflections
- 3.3: My mirror maze
- 3.4: How dark are the shadows?
- 3.5: Dark rabbit

ONLINE RESOURCES:

Teaching slides (PowerPoint): Light and shadows
Interactive activity: Light and shadows
CPD video: Light and shadows
Pupil video: Light and shadows
Word mat: Light and shadows
Editable Planning: Light and shadows
Topic Test: Light and shadows

Learning objectives

This topic covers the following learning objectives:

- Recognise that we need light in order to see things and that dark is the absence of light.
- Notice that light is reflected from surfaces.
- Recognise that light from the Sun can be dangerous and that there are ways to protect the eyes.
- Recognise that shadows are formed when the light from a light source is blocked by a solid object.
- Find patterns in the way that the sizes of shadows change.

Working scientifically skills

This topic develops the following working scientifically skills:

- Set up simple practical enquiries, comparative and fair tests.
- Make systematic and careful observations and, where appropriate, take accurate measurements using standard units, using a range of equipment including thermometers and data loggers.
- Report on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions.
- Use results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions

CROSS-CURRICULAR LINKS

This topic offers the following cross-curricular opportunities:

English

- Read the story *Black Rabbit* by Philippa Leathers.
- Write a letter to the rabbit to explain how the Black Rabbit shadow is made.
- Write a script for a puppet show: create settings, characters and a plot.
- Retrieve and record information from non-fiction texts on light, mirrors and shadows.
- Compose and rehearse explanations on how shadows are made using correct language and grammar before writing them.
- Use a science dictionary to check spelling.
- Use headings and sub-headings in science writing.
- Assess their own and others' science writing and suggest improvements.
- Read and write poems using similes.
- Write about the reflective qualities of a variety of materials using interesting adjectives.
- Make a word wall comprising all the key vocabulary about light and shadows.

Mathematics

- Use standard measures for the length of shadows.
- Use a table to collect data.
- Transfer data from table to bar graph.

Computing / ICT

- Know how to stay safe when using the computer.
- Use the Internet to research information.
- Use the computer to present information.
- Use graphing programmes to create bar graphs.
- Use tablets or digital cameras to shoot photos and video.
- Video puppet shows.
- Photograph a variety of images formed by reflective surfaces.
- Use a drawing program to produce a diagram of how shadows are formed.
- Use digital cameras to photograph different shadows around the school grounds.

Design / technology

- Generate, develop and communicate ideas about making a shadow puppet through discussion and sketches.
- Use a range of materials to make a shadow puppet and evaluate the end product.

Art

- Use different approaches to suggest changes in light in paintings.
- Use Alberto Giacometti's 'Man Pointing' to make dough or clay models to make shadows in different positions.
- Create silhouettes and research the silhouettes of Hans Christian Anderson and Augustin Edouart.
- Use pictures of the Aurora Borealis to create chalk, wax or wash patterns.
- Create stained glass effects.
- Photograph reflections.

Drama

- Perform shadow puppet plays to an audience.
- Perform role plays about how light is reflected off mirrors.

History

- Ask questions about the history of light using them for the basis for researching answers.
- Research the history of lighting.
- Create a time line of inventions relating to light.
- Make models, e.g. of the first oil lamp.
- Research scientists, e.g. Newton, Edison, Joseph Swann and Humphry Davy.
- Engage in hot seating: answering questions about a scientist.

Geography

- Locate and learn about areas in the world that receive a lot / little sunlight.
- Investigate how the amount and intensity of sunlight affects people living in different countries, e.g. homes, farming.
- Research holidays and safety, e.g. sun cream, sunglasses, clothes.
- Solar panels, light pollution.
- Dark Sky reserves: what and where are they? The nearest one.

P.E.

- Outdoor P.E. activities, e.g. make shadows, body movement, parts of the body.
- Work in pairs or small groups to make shadow statues.
- 'Catch my shadow' games.

Music

- Watch and listen to music accompanying light shows.
- Create music and a light show.

P.S.H.E.

- Look at the relationship between light and mood.
- Investigate use of light to relax.
- Understand the need for light for health.

STEAM (SCIENCE TECHNOLOGY ENGINEERING ART AND MATHS) OPPORTUNITIES

Invite into class

- STEM Ambassadors: they might be able to find a local business involved with developing and manufacturing lights.
- An artist to show children techniques relating to using light in art.
- An animation specialist from your local secondary school or college who could show children how to create a simple animation.

Visit

- A local lighting shop to see the different varieties of lights and light bulbs.
- A local museum where they show lighting throughout the ages.
- A local theatre group that uses shadow puppets.

HEALTH AND SAFETY

Glass mirrors can be used if they are backed with sticky back plastic so that, if they are dropped, the pieces stay on the backing.

TEACHER SUBJECT KNOWLEDGE

We need light to see. The Sun, fire, electric light and torches are all sources of light. The Moon is not a source of light because it reflects sunlight. Darkness is the absence of light, but few children experience 'darkness' because of street lighting, night lights, etc.

We see objects that are not the light source because the light source hits them, is reflected off and then travels to our eyes. Often the light has bounced (been reflected) off several objects before it enters our eyes. Different materials reflect light by different amounts. Dull materials scatter light and do not reflect very well. Shiny objects, such as mirrors, reflect light extremely well. When light strikes a mirror, it is reflected at the same angle as it hits the mirror: we call these two angles the angle of incidence and reflection.

Scientists use the shorthand of straight lines to represent how light travels. This unit provides the opportunity for children to draw diagrams of how light is reflected off surfaces. In Year 3 it will suffice to just draw straight lines. High attainers can add one arrow to the centre of each line to show the direction of travel (which is a feature of Year 6 work).

Shadows are formed when some rays of light continue to travel in straight lines, while other rays are stopped by an object. Objects that do not let light through them are called opaque: these objects make dark shadows.

Objects that let a little light through, such as bathroom windows, are called translucent objects and they form shadows that are not as dark.

Objects that let all or nearly all light through, such as water or clear plastic film, are called transparent. They can make a very faint shadow because they might block a little light, or no shadow at all if they let all the light through.

Mirrors

We see objects because light rays enter our eyes after bouncing off the objects. This bouncing of light off objects is known as reflection. Objects that have a rough surface do not reflect light well; they scatter it and we cannot see ourselves in them. Objects that are very smooth and shiny reflect light well and we can see images, reflections. Most mirrors are made from a smooth piece of glass with a silvery coating at the back of it.

There are different kinds of mirrors: if you look into a plane mirror the image is the same size as the object and the same way up. A concave mirror has a surface that bulges inwards and the image can make a person look smaller and upside down. A convex mirror has a surface that bulges out and the image is usually the right way up but larger.

COMMON MISCONCEPTIONS

Children might think...

- that light is only found when a light is switched on.
- that they can see things because light comes out of their eyes and hits an object.
- that shadows are not related to the object that causes them: in fact, every shadow must be cast by an object.
- that shadows are the reflections of objects: in fact, they are caused when light is blocked.
- that shadows are dark light: in fact, they form because of the absence of light. No light is dark.
- that only mirrors make reflections: in fact, you can see your reflection in many shiny materials.
- that all reflections in mirrors are exactly like the object: in fact, concave and convex mirrors distort images, making them look bigger or smaller.
- that the image in a mirror is on the surface: in fact, the mirror simply reflects light into your eyes.

Children already know...

- they have some personal experience and ideas to draw upon.
- that shadows are dark and are similar in shape to the object forming them.

SCIENTIFIC VOCABULARY: LIGHT AND SHADOWS

You can download a Word mat of essential vocabulary for this topic from *My Rising Stars*.

description: a statement that says what you see

dull: a surface that scatters light and does not look shiny

explanation: a sentence (or sentences) giving a reason for something happening

light source: the place where light originates from

mirror: a shiny polished surface

observation: what we see happening in a scientific test

opaque: not letting light pass through

reflect: to change the direction of light using a shiny surface

shadow: darkness caused by light being blocked

shiny: surfaces that reflect lots of light

translucent: letting some light through

transparent: letting most or all light through

3.1 Light and reflections

GET STARTED

Teach children the 'Light Sources' song (see the list of website links on *My Rising Stars*).

Ask them to spot any sources of light in the classroom. If you have time, tour the school to spot more. Introduce the topic using PowerPoint Slides 1–4.

LET'S THINK LIKE SCIENTISTS

Use these questions to develop research skills and speaking and listening.

- Can you name three sources of light?
- What causes darkness?
- What would life be like without light?

ACTIVITIES

1 SOURCES OF LIGHT

L.O. Recognise that they need light in order to see things and that dark is the absence of light.
Set up simple practical enquiries, comparative and fair tests.

- Use the 'Light Sources' song to teach children light sources. Having learned the 'Light Sources' song, children work in pairs or groups to create their own song, this time putting new objects into the song. Give children time to share their song with another group who are asked to comment on what children have used in their song.
- Show children the clip (see *My Rising Stars* for weblinks). They could use coloured dough to make their own models of light sources. Some children might even make a simple animation.
- Ask children why light sources are important and what the world would be like if there were no light sources.
- Ask children to write their own definition of 'dark' and then to use a dictionary to check their definition. They could use a smiley / frown face to self-assess their definition in comparison to the dictionary one.
- Now ask children how they could show that darkness is the absence of light and share their ideas; if possible, children should test their ideas to see if they work.

YOU WILL NEED

- Video clip of the 'Light Sources' song
- Coloured dough to make models of light sources

ASSESSMENT

Subject Knowledge

- Em. Children require support to suggest different light sources.
- Exp. Children name different light sources and can describe what darkness is.
- Exc. Children use scientific language to explain darkness.

Working Scientifically

- Em. Children need support to think of a practical way to show dark and light.
- Exp. Children are able to test their ideas to show that darkness is the absence of light.
- Exc. Children carry out a test and use scientific language to explain their test and conclusion.

2 DARKNESS BOX

L.O. Recognise that they need light in order to see things and that dark is the absence of light.
Set up simple practical enquiries, comparative and fair tests.

- Give groups or pairs a shoe box each and a small object. Children work in pairs; one person places the object at one end of the box without the other person seeing. The box has a very small hole at the other end to the object. The box with its lid on is placed on the table and their partner looks through the hole; can they see and name the object? No because it is dark inside the box.
- Then their partner gradually opens the box lid at the other end to the object, peeking inside to see if they can see and name the object.
- The other person could measure how high the lid is raised before their partner says what the object is.
- Ask children to think about:
  - Could they see the object when the lid was closed? Why?
  - When could they see the object clearly? Why?
- Then ask children to use their individual whiteboards to draft a sentence to explain how their comparative test helped them understand that we need light to see objects and a sentence to explain what darkness is.
- Challenge children to use scientific language; they could swap whiteboards with someone else so that they can peer assess each other's sentences through giving feedback.
- Tell children to go back to the definitions they created in Activity 1 and try to improve their original definition.

YOU WILL NEED

- Small boxes, e.g. shoe boxes
- Objects to place in boxes
- Individual whiteboards

ASSESSMENT

Subject Knowledge

- Em. Children can describe what happens in their test but need help to link it to ideas about light and dark.
- Exp. Children are able to carry out the activity and describe what happens and link to the ideas of light and dark.
- Exc. Children use their knowledge of light and dark to explain what happens in their test.

Working Scientifically

- Em. Children require support to carry out their simple test.
- Exp. Children carry out the test and are able to draw conclusions.
- Exc. Children use scientific language to explain their results.

3 DARK AREA

L.O. Recognise that they need light in order to see things and that dark is the absence of light.

- Show children a video clip of someone using a torch and what happens when the torch is switched off, or demonstrate this yourself in a dark room. It introduces children to the idea that light is reflected off an object into our eyes so we see. When talking about seeing objects, keep referring to this idea; it is one that children will need to understand by the end of Year 6.
- Ask children how they could create a totally dark area in the classroom; place their ideas on a working wall using sticky notes.
- Children could vote on which idea they think is best then, if feasible, let the group that suggested the idea set the dark area up with objects placed inside.
- Once set up, children can try it out and take a torch inside to see what it is like with and without light and what they can see when the light is on.

YOU WILL NEED

- Video clip of a torch in a dark room
- Torches
- Sticky notes

ASSESSMENT

Subject Knowledge

- Em. Children make suggestions, e.g. switch the lights off, but do not recognise the need for total darkness.
- Exp. Children make workable suggestions.
- Exc. Children use knowledge of light to explain why their suggestion would work.

4 SHINY AND DULL

L.O. Notice that light is reflected from surfaces.

Report on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions.

- Give children a collection of shiny and dull surfaces, e.g. mirrors, polished metals, Perspex, paper, painted surfaces and polished wood. Ask them to find out which ones they can see themselves in and which ones reflect a torch light.
- Challenge them to record and make sense of their results. Use PowerPoint Slide 5 as an example. Children should come up with the idea that shiny surfaces reflect light better than dull surfaces. They can record their results using Activity Resource 3.1.
- Bring the class together to discuss the words *dull and shiny* and what they notice about the materials. Ask them what they notice about material that reflects light. What conclusions can they make? Why do some surfaces reflect light better than others? The aim is for children to recognise that dull surfaces do not reflect the torchlight and they cannot see their reflection in them. They should know that surfaces that are smooth and shiny reflect light (light bounces off it) and they can see their reflection.
- This activity provides a useful formative assessment opportunity to check that all children know the words *dull, shiny, reflect* and *reflection*. If children are unsure, then take time to support children linking the language to the objects in their collection.
- Use literacy skills such as drafting and redrafting to create definitions of words to put in their science dictionary / glossary and even include swatches of materials as examples.

YOU WILL NEED

- PowerPoint Slide 5
- Collection of objects with shiny and dull surfaces
- Activity Resource 3.1

ASSESSMENT

Subject Knowledge

- Em. Children sort according to shiny and dull.
- Exp. Children can say that smooth and shiny surfaces reflect light.
- Exc. Children link properties of materials in explanations, e.g. materials reflect light and they can see their reflection in them.

Working Scientifically

- Em. Children need support to describe how they are sorting materials.
- Em. Children can write sentences or use a video to show which materials reflect.
- Exc. Children choose how they explain how different materials reflect light.

5 FINDING OUT ABOUT MIRRORS

L.O. Notice that light is reflected from surfaces.

- Remind children how to work safely with objects made from glass (see Health and safety, page 43).
- Give children a collection of different mirrors as well as objects that reflect, e.g. make-up mirrors, shaving mirrors and spoons. Ask them to describe what they see and to note any differences. Discuss the fact that some reflections look the same size as the object being reflected while others look bigger or smaller. Use Activity Resource 3.2.
- Ask children to look at their reflection in a plane mirror and observe closely when they do the following:
  - smile
  - close one eye (wink)
  - close the other eye
  - hold up one hand then hold up the other
  - scratch their nose with one hand then the other.
- They should notice that the reflection is the wrong way around; this can be difficult for some children to understand because it requires children to understand left and right and be able to recognise left and right in their reflection.
- Ask children to say why they can see themselves in the mirror and not in, e.g. a carpet or their school jumper. Listen for explanations that show that they know that the surfaces of shiny objects are good at reflecting light and therefore we can see the object in the mirror. Dull surfaces do not reflect light like a mirror and therefore we cannot see our reflection.

YOU WILL NEED

- Collection of different mirrors and reflective objects
- Activity Resource 3.2

ASSESSMENT

Subject Knowledge

- Em. Children can say that smooth, shiny surfaces make good mirrors and they can see themselves in one.
- Exp. Children know which surfaces reflect and can describe what their reflection looks like in a mirror.
- Exc. Children compare shiny and dull surfaces and describe their reflections in a mirror.

6 CONCAVE AND CONVEX MIRRORS

L.O. Notice that light is reflected from surfaces.
Report on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions.

- Introduce the topic using PowerPoint Slide 6.
- Give children a selection of plane, concave and convex mirrors to explore and ask them to find out what are the similarities and differences between them and the reflections they make. As children are working, make sure that they use correct scientific terminology, e.g. *plane, concave, convex, reflect* and *reflections*.

YOU WILL NEED

- PowerPoint Slide 6
- Collection of plane, concave and convex mirrors
- Activity Resource 3.2

ASSESSMENT

Subject Knowledge

- Em. Children are able to describe what they see in each mirror.
- Exp. Children know that light is reflected from the mirrors and that the images are different.
- Exc. Children explain using correct terminology when comparing mirrors, e.g. concave and convex.

- Give children Activity Resource 3.2 to complete as a home–school activity where children find and observe their reflection in surfaces around the home.

Working Scientifically

- Em. Children can demonstrate a reflection.
- Exp. Children can describe through writing, demonstration, etc. how some materials reflect light.
- Exc. Children choose how to report what they know about materials that do and do not reflect light.

7 MIRROR MATHS – HOW MANY?

L.O. Notice that light is reflected from surfaces.

Make systematic and careful observations and, where appropriate, take accurate measurements using standard units, using a range of equipment including thermometers and data loggers.

Use results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions.

- For this activity, glass mirrors are more effective because they give a better reflection than plastic. Working in pairs, children tape two plane mirrors together at the back, so that the tape acts like a hinge. Children place the mirrors at an angle and put an object such as a small toy or a cube between the mirrors. Illustrate with PowerPoint Slide 7.
- Children observe how many images they can see and what happens to the images when they make the angle larger and smaller.
- Higher-attaining children who can use a protractor could measure the angle and create a table to show how changing the angle changes the number of images, and draw a conclusion by looking at the pattern in their data. They should find that the number of reflections increases as the angle between the mirrors decreases.

YOU WILL NEED

- PowerPoint Slide 7
- Two plane rectangular mirrors
- Tape
- Small objects to test reflections
- Protractor

ASSESSMENT

Subject Knowledge

- Em. Children follow instructions and need help to describe the pattern as the angle between the mirrors is changed.
- Exp. Children can say that the number of reflections increases as the angle between the mirrors decreases.
- Exc. Children use their data and scientific language in their conclusions and are able to make predictions for new values, e.g. if they keep making the angle smaller or bigger.

Working Scientifically

- Em. Children can record how many reflections they can see in the mirror.
- Exp. Children recognise that when they change the angle of the mirror the number of images changes.
- Exc. Children recognise a pattern emerging in their data and predict new values (what numbers come next).

8 MIRROR MATHS – MAKING SHAPES

L.O. Notice that light is reflected from surfaces.

Use results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions.

- Children explore making shapes using the two mirrors from the previous activity. Here, children place the mirrors on a sheet of plain A4 paper and draw a dark line between the two mirrors. Use PowerPoint Slide 8 to show children how this is set up. Once again, children are looking for a pattern; ask them if they can suggest what will happen if they change the angle (predict new values), that is when they change the angle of the mirrors making it smaller or greater, the number of sides to the shape changes. Ask children to name the shapes, e.g. triangle, square, hexagon.

YOU WILL NEED

- Two plane rectangular mirrors
- A4 paper
- PowerPoint Slide 8

ASSESSMENT

Subject Knowledge

- Em. Children can say that smooth, shiny surfaces make good mirrors and they can see themselves in one.
- Exp. Children know that the objects are reflected in the mirror.
- Exc. Children are able to say that the surface reflects and we can see images which are the same as the object.

Working Scientifically

- Em. Children follow instructions and need help to describe the pattern as the angle between the mirrors is changed.
- Exp. Children can say that the number of sides changes as the angle between the mirrors decreases.
- Exc. Children use their data and scientific language in their conclusions, and are able to make predictions for new values.

9 MIRROR MATHS – SYMMETRY

L.O. Notice that light is reflected from surfaces.

Report on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions.

- Show children PowerPoint Slide 9 and give them time to create shapes, make butterflies, etc. Challenge children to find out which numbers, shapes and letters of the alphabet are *symmetrical*.
- Remind children that a 2D shape is symmetrical if a line can be drawn through it so that either side of the line looks exactly the same. They might know that this is called the *line of symmetry* but might not know that if they place a mirror on that line then, if the shape is symmetrical, the mirror shows the reflection of half and then the shape appears whole. Children could show others what they have found out or create a video clip to communicate this activity and others in this series of Maths and Mirrors activities.

YOU WILL NEED

- Mirrors
- PowerPoint Slide 9

ASSESSMENT

Subject Knowledge

- Em. Children can say that they can see the shapes / numbers in the mirror.
- Exp. Children know that things are reflected in the mirror.
- Exc. Children are able to say that the surface reflects and we can see images.

Working Scientifically

- Em. With support, children use mirrors to complete, e.g. a shape, letter.
- Exp. Children know that the letter, shape, number is reflected and communicate this to others.
- Exc. Children communicate their own explorations arising from questions that they have asked and answered about different shapes.

10 SAME BUT DIFFERENT

L.O. Notice that light is reflected from surfaces.

Reporting on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions.

- Use PowerPoint Slide 10 to show children the photograph of the word AMBULANCE written on a vehicle and ask what they notice. Why is it back to front? What do they know about mirrors and images? Challenge them to write their name, famous scientists, the words mirror, reflect, reflection so that it can be read when a mirror is used.
- As a final challenge, give children Activity Resource 3.3 to make a mirror maze.

YOU WILL NEED

- PowerPoint Slide 10
- Activity Resource 3.3

ASSESSMENT

Subject Knowledge

- Em. Children can say that they can see the shapes / numbers in the mirror.
- Exp. Children know that things are reflected in the mirror.
- Exc. Children are able to say that the surface reflects and we can see images.

Working Scientifically

- Em. Children need support to describe how to use a mirror to read the word.
- Exp. Children are able to describe how to use a mirror to make an image that can be read.
- Exc. Children explain why the image of the writing appears the correct way around in a mirror.

Why do you think the word ambulance reversed?

3.2 Making shadows

GET STARTED

Read the delightful story *Black Rabbit* by Philippa Leathers to children, which tells the story of a rabbit and its shadow. Use this as a starting point for discussion about shadows, how they are made, etc.

LET'S THINK LIKE SCIENTISTS

Use these questions to develop research skills and speaking and listening:

- What is the difference between a shadow and a reflection?
- What can you investigate about shadows?

ACTIVITIES

1 WHICH MATERIAL IS BEST FOR MAKING SHADOWS?

L.O. Recognise that shadows are formed when the light from a light source is blocked by a solid object.

Make systematic and careful observations and, where appropriate, take accurate measurements using standard units, using a range of equipment including thermometers and data loggers.

- Use PowerPoint Slides 11 to 13 to introduce transparent and translucent materials.
- Give children a range of materials that are *transparent, translucent* and *opaque*, remind them that these are words that they learned in Key Stage 1. Ask them to hold each material up to the light shining from a window. Encourage them to sort the materials into those that let no light through (opaque), some light through (translucent) and all of the light through (transparent).
- Ask them to record their findings in the table on Activity Resource 3.4. This could be done by cutting swatches of the materials and gluing them onto their table. Finally, challenge them to make predictions about each of the fabrics and write them in another column on their table in Activity Resource 3.4.

YOU WILL NEED

- PowerPoint Slides 11 to 13
- A range of materials including some that are opaque, transparent or translucent
- Activity Resource 3.4

ASSESSMENT

Subject Knowledge

- Em. Children classify materials with support.
- Exp. Children classify materials and predict which materials will make the darkest shadow.
- Exc. Children apply their knowledge about the properties of the materials to explain why some materials will make dark shadows.

Working Scientifically

- Em. Children require support to record their observations.
- Exp. Children are able to draw their own table and record their observations.
- Exc. Children record their observations and note a pattern in their data relating to the material and how it lets light through.

2 HOW IS BLACK RABBIT'S SHADOW MADE?

L.O. Recognise that shadows are formed when the light from a light source is blocked by a solid object.

Make systematic and careful observations and, where appropriate, take accurate measurements using standard units, using a range of equipment including thermometers and data loggers.

- Children use Activity Resource 3.5 as a template to make a rabbit using opaque material. They then use the rabbit puppet to find out how to make the Black Rabbit. Tell children to work in pairs (one holding the light source – torch and the other the rabbit puppet) and, as they work, talk to each other about how the shadow is being made. Encourage correct language by giving children the Word mat: Light and shadows. Listen to children and challenge them to describe step by step how the shadow is made, e.g. 'We shine the light source (torch) onto the rabbit which is opaque and the rabbit blocks the light, so behind the rabbit it is dark and this makes a shadow.'

YOU WILL NEED

- Torches
- Opaque material to make a rabbit puppet
- Activity Resource 3.5

ASSESSMENT

Subject Knowledge

- Em. Children demonstrate how they make the shadow.
- Exp. Children use their observations and use scientific language to describe how a shadow is made.
- Exc. Children can apply their understanding to describe how shadows are made in all objects.

Working Scientifically

- Em. Children require support to record their observations.
- Exp. Children are able to use their observations to describe how a shadow is made.
- Exc. Children are able to explain how a shadow is made using scientific vocabulary.

3 BLACK RABBIT

L.O. Make systematic and careful observations and, where appropriate, take accurate measurements using standard units, using a range of equipment including thermometers and data loggers.

- Children use Activity Resource 3.5 to make another rabbit. Challenge children to make 'Black Rabbit' (the shadow in the starter story) and use it to find out how they can use their torch and rabbit shadow puppet to change the Black Rabbit.
- As they work, ask them to think about what they have to do to make the shadow bigger and smaller. Where do they put the torch and shadow puppet and how does it change the Black Rabbit shadow?
- Children should note that shadows get bigger when an object is close to the light source and get smaller when an object is far away from the light source.

YOU WILL NEED

- Torches
- Opaque material to make a rabbit puppet
- Activity Resource 3.5
- Individual whiteboards

ASSESSMENT

Working Scientifically

- Em. With support, children demonstrate how to make and change the shadow.
- Exc. Children explain how a shadow is made and how to change it using appropriate language.
- Exc. Children can apply their understanding to explain how other shadows are made, e.g. their own.

- Encourage children to test what happens when they move the light source (torch) or change the position of the torch, e.g. to the side, above.
- Bring children together and support them in explaining how shadows are made and changed. Using literacy approaches for scaffolding writing, ask children to talk in pairs and orally explain to each other how a shadow is made. Then ask them to write down all of the scientific words they need in their explanation. Follow this by asking children to use those words to draft and redraft their explanation on their whiteboard. Their explanation is ready to write into their book when they are confident they have written a good explanation and have checked grammar and spellings.

4 EXPLORING MY SHADOW

L.O. Find patterns in the way that the sizes of shadows change.

- Make the most of a sunny day to take children outdoors to explore their own shadows on the playground. Give them time to make shadows of different shapes and sizes. They could also work with a friend to create 'crazy shadows' and team up with more children to make unusual shadows. If children are wearing appropriate clothing they could play 'Chase the shadow' or 'Catch my shadow' games.
- Choose a shadow and ask children to talk about how the shadow is made; children could use chalk to write their explanation onto the school playground. They could visit a different explanation and engage in peer assessment, leaving a comment in a different colour chalk.
- Children then use tablets or cameras to take photographs of different shadows in the school grounds and the objects that make them.
- Back in the classroom, children can print their favourite shadow photograph and stick it into their book. Alongside their photograph they should create an explanation of how the object made the shadow.

YOU WILL NEED

- Sunny day!
- Chalk
- Tablets or cameras

ASSESSMENT

Subject Knowledge

- Em. With support, children describe how the shadow is made and how it changes.
- Exp. Children explain how the shadow is made, using scientific language, and they can say how it changes.
- Exc. Children use correct scientific language to explain how the shadow is made and predict how it will change over the day.

TOPIC 4

How does your garden grow?

About this topic

Curriculum link: Year 3, plants

SUMMARY:

Children work scientifically on a variety of quick challenges and longer tasks to learn about plants. They learn about the different parts of plants, what plants need to live, water transportation in plants and pollination.

UNITS:

4.1: Plant parts
4.2: Let's get growing
4.3: Flower power

ACTIVITY RESOURCES:

- 4.1: Plant parts
- 4.2: Flower power
- 4.3: Types of seed

ONLINE RESOURCES:

Teaching slides (PowerPoint) : How does your garden grow?
Interactive activity: How does your garden grow?
CPD video: How does your garden grow?
Pupil video: How does your garden grow?
Word mat: How does your garden grow?
Editable Planning: How does your garden grow?
Topic Test: How does your garden grow?

Learning objectives

This topic covers the following learning objectives:

- Identify and describe the functions of different parts of flowering plants: roots, stem / trunk, leaves and flowers.
- 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.
- Investigate the way in which water is transported within plants.
- Explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal.

Working scientifically skills

This topic develops the following working scientifically skills:

- Ask relevant questions and use different types of scientific enquiries to answer them.
- Set up simple practical enquiries, comparative and fair tests.
- Make systematic and careful observations and, where appropriate, take accurate measurements using standard units, using a range of equipment including thermometers and data loggers.
- Gather, record, classify and present data in a variety of ways to help in answering questions.
- Record findings using simple scientific language, drawings, labelled diagrams, keys, bar charts and tables.
- Report on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions.
- Use results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions.
- Identify differences, similarities or changes related to simple scientific ideas and processes.
- Use straightforward scientific evidence to answer questions or to support their findings.

CROSS-CURRICULAR LINKS

This topic offers the following cross-curricular opportunities:

English

- Create a glossary of key scientific words related to plants.
- Use different question stems to ask questions about plants.
- Interview a gardener or botanist.
- Use adjectives to describe plants, flowers, seasonal change.
- Retrieve and record information from non-fiction books about plants.
- Research a plant of the week, e.g. Venus Fly Trap.

- Increase the legibility, consistency and quality of handwriting.
- Draft and write by composing and rehearsing orally a range of sentences.
- Explain using scientific language.
- Use simple organisational devices such as headings and sub-headings when writing about a fair test.
- Write a set of instructions for growing plants: design seed packet with instructions.
- Write a poem, song or rap about the different parts of a plant and their roles.
- Proofread their own and other's work for spelling and punctuation errors.
- Use conjunctions, adverbs and prepositions to express time and cause when writing about plant growth and observations over time.

Mathematics

- Look at different plants and count the number of petals on their flowers to make a tally chart and draw a bar chart.
- Estimate the answer to a calculation and use inverse operations to check answers.
- Add and subtract numbers mentally.
- Measure, compare, add and subtract: lengths (m / cm / mm); mass (kg / g); volume / capacity (l / ml).
- Interpret and present data using bar charts, pictograms and tables.
- Explore a range of different seeds, taking measurements as you go. What is the largest, smallest, lightest and heaviest? Present findings to the rest of the class.

Computing / ICT

- Use a digital camera to take photographs of trees and plants around school at regular intervals to show change over a year.
- Make a presentation or slideshow about the parts of a plant.
- Use a time-lapse camera to show plant growth over time.
- Use apps for classifying plants and trees.
- Use or create QR codes with pictures or information about plants.
- Use a digital video camera to make a short TV show, 'Garden World', that explains what plants need to grow.
- Make a slideshow presentation using digital photographs of the plants grown during the different activities.
- Make a video using stop-frame animation to explain the process of pollination.

Art

- Use sketch books to record their observations of plant parts and plants growing over time.
- Draw, paint or create a sculpture of a plant in the school grounds or a favourite or unusual plant.
- Create leaf collages, e.g. patterns, faces.
- Leaf rubbings, colours and patterns.
- Still-life drawings.
- Use pressed leaves and flowers.
- Look at the work of David Hockney who painted the same scene through the seasons.

Geography

- Look at plants in different habitats locally, e.g. hedgerow, pond, woodland.
- Map local habitats, e.g. in school grounds.
- Locate habitats around the world, e.g. deserts, rainforests.
- Research interesting / famous / unusual plants around the world.

History

- Famous botanists, e.g. Beatrix Potter, Robert Fortune.
- Famous gardeners, e.g. Capability Brown, Gertrude Jekyll.

STEAM (SCIENCE TECHNOLOGY ENGINEERING ART AND MATHS) OPPORTUNITIES

Invite into class

- A local botanical organisation to work with children, e.g. identifying plants.
- STEM Ambassadors to link with local business and to work with children.
- A florist to give children a demonstration and for children to make flower arrangement.

Visit

- Your local garden centre, so that children can be given a 'masterclass' in planting seeds, potting on, using garden equipment, etc.
- Your local botanical gardens to work with experts.

HEALTH AND SAFETY

Check *ASE – Be Safe* for a list of plants that are poisonous and irritants that should not be used, or log onto http://primary.cleapss.org.uk

TEACHER SUBJECT KNOWLEDGE

The main parts of a flowering plant are:

- the roots
- the stem
- the leaves
- the flower.

The roots of a plant anchor it into the soil. They absorb water and any dissolved nutrients. These are then transported to the rest of the plant via bundles of tubes inside the stem called vascular bundles.

The stem is the main support structure of the plant, allowing it to stay upright and providing a frame for the leaves. In many plants the stem is also a place where nutrients can be stored.

For plants to grow healthy they need a number of things, such as:

- water
- light
- air
- sufficient space
- a supply of minerals and other nutrients.

Plants do not need soil to grow, as long as they get a suitable supply of minerals and nutrients. In fact, in many modern commercial greenhouses plants are grown in a nutrient-rich liquid instead of soil. This growing technique is called hydroponics.

It is important to be aware that there's a difference between what seeds need to germinate and what plants need to grow. Seeds just need warmth and water to germinate, they do not need light. They initially grow using the food stores within the seed. If they do not get any light before these stores are used up, then they can die.

The leaves are where the plant makes its food. They take in carbon dioxide from the air and water from rain, converting them into oxygen and a sugar called glucose. Leaves also get energy from the Sun, capturing it using a green chemical known as chlorophyll. This whole process is called photosynthesis.

Water moves upward to the top of the plant through long, thin tubes running up from the roots through the stems and leaves called xylem. Water moves up the xylem through a process called capillary action. Capillary action is the name of the process when liquids, like water, move up through a solid, like a hollow tube or spongy material. At this stage children do not need to know terms such as xylem or capillary action. When discussing how water is transported in a plant use the word moves and avoid suggesting the plant sucks up water (as a human sucks up water from a straw).

Flowers are the reproductive organs of the plant. They produce pollen and eggs, which then produce seeds that the plant then disperses (spreads away from the plant) so new plants can grow.

Plant reproduction

Flowering plants reproduce sexually. Most flowers have both male and female parts. The male parts produce the pollen and the female parts produce the ova (eggs). Both the pollen and eggs contain half the genetic information necessary to make a new plant, in the same way that sperm and eggs do in animals.

Plants cannot pollinate their own flowers; instead, they need to get their pollen to the flowers of their own plant or of another plant. Often this is carried by insects, but plants can also disperse their pollen into the wind. When pollen lands on the stigma of another flower, it joins with the egg and their DNA combines. The egg is now fertilised. This will happen many times with all the eggs in the ovary.

Each egg develops into a seed and, as this happens, the flower will change and lose its petals. The ovary swells up and turns into a structure known as a fruit. In some plants the fruit is attractive to animals who then eat it, carrying the seeds inside their body until they go to the toilet elsewhere where the seeds can then grow. Other seeds are dispersed on the wind, via water or other methods.

Remember:
Stamen = 'men' = male. Stigma = 'mama' = female.

CHILDREN'S MISCONCEPTIONS

Children might think...

- that plants get their food through their roots: in fact, they take in water and some minerals through the roots, but make their food in their leaves.
- that trees are not plants: they are.
- that mushrooms are plants: they are not; they are fungi.
- that plants get their food from the soil: plants make their own food, but the roots help them get water, minerals and nutrients that help them grow.
- that seeds need light to germinate: this is not true as, they just need water and warmth. There's enough food stored inside the seed to provide the energy it needs to produce a shoot and roots.

Children already know...

- the basic structure of a plant (Year 1).
- that plants need water, light and a suitable temperature to grow and stay healthy (Year 2).
- how seeds and bulbs can grow into mature plants (Year 2).

SCIENTIFIC VOCABULARY: HOW DOES YOUR GARDEN GROW?

You can download a Word mat of essential vocabulary for this topic from *My Rising Stars*.

carpel: female part of the flower – made of stigma, style and ovary

flower: the part of the plant where seeds are made

germinate: when a seed starts to grow and produce a root and shoot

leaves: catch sunlight and use this to make food

life cycle: the stages a living thing goes through during its life

nutrients: materials in the soil that help to nourish plants

ovary: the part of the flower that contains the ovules

ovule: these are like eggs; they develop into seeds

petal: part of the flower that attracts insects, often brightly coloured

photosynthesis: how green plants make their own food

pollen: dust-like powder made in the stamen of a flower

pollination: transferring pollen grains from the male anther of a flower to the female stigma so that new plants can be made

root: helps anchor the plant into the soil; takes up water and nutrients

root hairs: tiny hairs on a root that take water and nutrients from the soil

seed dispersal: the way seeds get from the parent plant to a new place so that they can grow

sepals: protect the rest of the flower as it grows

stamen: the male part of the flower which produces pollen

stem: holds the plant upright and supports the leaves; it contains tubes that allow water to travel from the roots to the rest of the plant

style: the middle part of the carpel, connecting the ovary to the stigma

stigma: part of the carpel that pollen grains attach to during pollination

veins: tubes in the leaf that carry water and food

4.1 Plant parts

GET STARTED

Revise what children learned in Key Stage 1 by placing on each table different fruits and vegetables and challenging children to label each one, e.g. stem, flower, leaf, root, bulb. Use a timer and tell children to complete this in 5 minutes. They then go and look at how other groups have classified their food and decide if they want to change any of their sorts.

LET'S THINK LIKE SCIENTISTS

Use these questions to develop research skills and speaking and listening:

- What do all plants have in common?
- Why don't cacti have big leaves like oak trees?
- Why don't big trees fall over easily?
- How can water get all the way up to the top of a tall tree?

ACTIVITIES

1 PARTS OF A PLANT

L.O. Identify and describe the functions of different parts of flowering plants: roots, stem / trunk, leaves and flowers.

- Introduce the topic using PowerPoint Slides 1 to 4.
- You will need a selection of plants in pots. You could ask a local garden centre to donate a couple of packs of plants so that children have at least one plant between two. Any plant that has flowers, leaves, stem and roots intact will be fine, e.g. pansies.
- Show children how to carefully take the plant out of the pot and remove soil from the roots without damaging them.
- Then children can place the plant on a piece of plain paper that is bigger than the plant and, using a hand lens or a digital microscope, give them time to explore and make observations.
- Ask children to write down words and phrases about what they can see around the plant. Encourage them to identify the different parts of the plants that they can remember from Key Stage 1, e.g. *leaf*, *leaves*, *stem*, *flower*, *roots*.
- Include books, QR codes around the classroom, leaflets and so on so that children can access information to extend their learning. As part of the annotations, ask children to think about and research what each part of the plant does. Explain to children that they are going to find out about the *function* (job) that each part of the plant does and add it to their work.
- Ask children if they can find the *root hairs* on the roots and annotate these. What do they look like? What do they think root hairs do?
- Many children will go further than the basic parts and may want to find out about petals, and the different parts of the flower; do allow them to lead their own learning.
- When children have completed this activity, ask them to visit someone else's annotated plant. They could offer 'peer review' comments as well as taking a piece of information to add to their own work. Each

YOU WILL NEED

- PowerPoint Slides 1 to 6
- Selection of plants in pots
- Large sheets of paper
- Hand lens / digital microscope
- Books and other resources
- Activity Resource 4.1

ASSESSMENT

Subject Knowledge

- Em. Children name the parts of the plant and are supported to describe their function.
- Exp. Children identify, name and describe the function of part of the plant.
- Exc. Children extend their understanding by researching parts of the flower.

pair could photograph their work to place in their book; alongside the picture children should write a sentence to describe the most important thing that they have learned about their plant from this activity.

- Towards the end of this topic you could use Activity Resource 4.1 to check if children know the functions of the parts of a plant or use PowerPoint Slides 5 and 6.

2 PLANTS IN OUR SCHOOL GROUNDS

L.O. identify and describe the functions of different parts of flowering plants: roots, stem / trunk, leaves and flowers.

- Take children out into the school grounds or local park to identify and name a range of plants, many of which they will know from Key Stage 1. Continue to expect children to be able to identify plants; this will help them apply and reinforce past learning. For each plant they identify, get them to look for and name the different parts. This is particularly important in relation to trees since some children do not think a tree is a plant, while others might not recognise that the trunk is in fact the stem of this plant. Children might recognise where roots are where the ground follows their contour.
- Challenge children to think about:
  - How is it the same as the plants they were looking at in the classroom?
  - How is each plant different / the same?
  - How many different kinds of leaves can they find?
  - Where are the roots? How do they know they are there?
  - What is the stem like? How many different flowers can they see? How are they the same and different?
- Get children to use field sketchbooks where they can sketch the outline of trees, sketch plants and take a leaf or flower and press it in their book. Make sure that they identify and name the plant their specimens are taken from as well as name the part and its function.
- Ask children to think about why a tree stem (trunk) is so thick and tall.

YOU WILL NEED

- Sketchbooks

ASSESSMENT

Subject Knowledge

- Em. Children require support to apply their knowledge to plants outside the classroom.
- Exp. Children identify, name and describe the function of parts of plants in the locality.
- Exc. Children extend their understanding by researching information about plants in the local environment.

3 GROW A SEED

L.O. identify and describe the functions of different parts of flowering plants: roots, stem / trunk, leaves and flowers.

- For this activity children grow a seed, e.g. radish or mustard seed, in a small container such as a film canister filled with soil. The aim is for the seed to germinate within a few days so that children can take the seedling out and name parts of the plant, such as *seed*, *seed case*, *root*, *shoot*, *root hairs* and *stem*. In doing this, children are applying their knowledge of plant parts and their function in another context.
- Explain that the seed is not a fully grown plant and teach children to use the term *seedling*.
- If children clean the soil off the roots, they could stick the seedling onto a page in their book and add labels and captions about plant parts and functions. The result will be an annotated pressed seedling.

YOU WILL NEED

- Seeds such as radish or mustard
- Small growing containers, soil

ASSESSMENT

Subject Knowledge

- Em. Children name the parts of the seedling and are supported to describe their function.
- Exp. Children identify, name and describe the function of parts of the seedling.
- Exc. Children are able to label and create captions, researching new information.

4 HOW IS WATER TRANSPORTED IN A PLANT?

L.O. Investigate the way in which water is transported within plants. Set up simple practical enquiries, comparative and fair tests.

- This activity is also demonstrated on the Science in Action video (see *My Rising Stars*).
- The Get started activity will provide an insight into children's ideas about how water is transported up a plant. Some children may find this concept challenging because in plants they cannot see it happening.
- A simple but effective way of helping children to understand is to place celery (with leaves on) into coloured water. Food dye is usually used but be aware that if, it does not work, it is probably the composition of the food dye.
- Give each group some sticks of celery and a container of water with food colouring. Before they place the celery in the water, ask children to predict what they think will happen overnight if the celery is left in the water. They could draw their prediction or write a sentence. Leave the celery for a couple of hours or overnight. Children should take some photos before and after to compare the results.
- The next day children add a comment to their prediction saying if it was correct and how they think the coloured water got to the top of the celery. Ask children to share their ideas. Now give children pieces of celery so that they can observe them using a hand lens or digital microscope or a visualiser to look at the celery in more detail. Give groups a knife (with a safety warning) so that they can cut the celery across the stem and vertically.
- Ask children to cut the celery across the stem and look at each end. What can they see? They should be able to see what looks like tubes. The water travels through these long, thin tubes that go from the roots up through the stems and leaves.
- One way to model what this looks like is to give children a bundle of drinking straws, and explain that these are like the long tubes inside the celery and the water moves up these tubes. In pairs, ask children to describe to each other how water from the soil gets to the top of a plant. Listen to them, ask them to share with another group and see if they need to change their description to improve it. Show children PowerPoint Slide 7 and 8 and discuss their ideas.

YOU WILL NEED

- PowerPoint Slides 7 and 8
- Celery
- Containers of water
- Food dye
- Camera
- Drinking straws
- Hand lens / digital microscope / visualiser
- Knife or scissors to cut celery

ASSESSMENT

Subject Knowledge

- Em. Children can describe what they did and what they observed.
- Exp. Children describe how the coloured water travelled up the tubes in the celery stem.
- Exc. Children can apply the drinking straw model to explain how water is transported in a plant.

Working Scientifically

- Em. Children are supported in following instructions to carry out this activity.
- Exp. Children carry out this comparative test and draw conclusions.
- Exc. Children carry out this comparative test and use their conclusions to ask new questions to test.

5 MULTI-COLOURED

L.O. Investigate the way in which water is transported within plants.

Set up simple practical enquiries, comparative and fair tests.

- Show children PowerPoint Slide 9, which shows a carnation stem split between two containers each with different coloured water. Ask them to predict what will happen if they are left overnight; they should write their predictions down along with why they think this will happen, applying what they have learned from the previous activity.
- Give children a carnation, containers and different coloured water and a knife (with a safety warning) so that they can set up this test. To make it a comparative test they could set up another carnation but this time they use water with no dye.
- Children could use cameras or create a short video clip before and after. Ensure that children create an explanation that includes appropriate scientific language.

YOU WILL NEED

- PowerPoint Slide 9
- Carnations
- Containers of water
- Food dye
- Knife or scissors to cut plant stems
- Camera / tablet

ASSESSMENT

Subject Knowledge

- Em. Children can describe what they did and what they observed.
- Exp. Children describe how the coloured water travelled up the tubes in each part of the stem.
- Exc. Children can apply the drinking straw model to explain how water is transported in a plant.

Working Scientifically

- Em. Children are supported in following instructions to carry out this activity.
- Exp. Children carry out this comparative test and draw conclusions.
- Exc. Children carry out this comparative test and use their conclusions to ask new questions to test.

4.2 Let's get growing

GET STARTED

Take children outdoors to find unusual places where plants are growing, e.g. a crack in the tarmac, walls or even out of guttering. They could take photographs of their observations and make a collage back in the classroom.

LETS THINK LIKE SCIENTISTS

Use these questions to develop research skills and speaking and listening:

- Why do you need to water your plants in the garden during the summer, but not over the winter?
- What aren't all leaves green?
- Why do plants in the rainforest have such large leaves?

ACTIVITIES

1 WHAT DO I WANT TO KNOW? ASKING QUESTIONS

L.O. Ask relevant questions and use different types of scientific enquiries to answer them.

- The aim of this series of activities is to give children the opportunity to ask and answer their own questions about plants and growing seeds. Begin by giving each group a plant, some dead flowers and a range of seeds, e.g. lettuce, radish, beans, peas.
- Ask them to use sticky notes (a different colour for each group) and on each one to write down an observation or something that they know about what is on the table. Encourage them to work together as a group, share ideas and also think back to when they were in Key Stage 1 and what they learned about plants. At the end of this part of the activity children should have sticky notes with lots of ideas and observations.
- Next give children a set of question stems cards, one for each group (printed on different coloured paper).
- Tell children that in the next activity they are going to think and talk about all the things that they would like to know about seeds and plants. They must use the question stems but can only use each question stem once. They should also use scientific language wherever they can. Use PowerPoint Slide 10 to support this activity.
- The groups work together to ask the questions and write each question on a sticky note.
- As children are working, read their questions and help them to improve their questions, e.g. by asking 'What do you mean by best?' 'How can you change your question so that you have to measure something?'.
- These questions will be used in the next activity.

YOU WILL NEED

- PowerPoint Slide 10
- Plants, dead flowers and seeds for each group
- Sticky notes
- Question stem cards

ASSESSMENT

Working Scientifically

- Em. Children require support to ask questions about plants and seeds.
- Exp. Children use the question stems to ask questions about plants and seeds.
- Exc. Children apply knowledge and reword their own questions to improve them.

2 HOW TO ANSWER MY QUESTIONS

L.O. Ask relevant questions and use different types of scientific enquiries to answer them.
Set up simple practical enquiries, comparative and fair tests.

- Group the questions from the previous activity according to how they can be answered. Use PowerPoint Slide 11 to support this activity. Place the following headings either on a working wall or the floor and work with children to help them decide where to place each question. Headings are the different types of enquiry included in the curriculum.
  - Comparative test
  - Fair test
  - Research (using Internet, books, people)
  - Observation (over time)
- If doing this for the first time, it is useful to carry this out as a class activity. For each heading, ask children to think which question could be answered in that way; do not worry if children are unsure or they do not have a question for that category.
- Once children have sorted all of their questions you could use the following approach to answering their questions.
  - Observation questions are carried out by the class at the same time.
  - Research questions go back to the group and they could have specific in class time (maybe in literacy) or children answer them as a home – school activity.
  - Finally, for those questions that demand a comparative or fair test, children could choose the one that they want to do first and they become the focus of the next lesson.
- In this sequence, children have asked their own questions, decided how to answer them and then take back their questions (remembering their colour of sticky note) and next carry out activities to find the answers, some of them using comparative and fair tests.
- In the following set of activities there are suggestions on how children might answer some common questions.

YOU WILL NEED

- PowerPoint Slide 11
- Sticky notes

ASSESSMENT

Working Scientifically

- Em. Children need scaffolding to say what they could do to answer each question.
- Exp. Children can sort qustions according to how they should be answered.
- Exc. Children recognise that there may be several ways of answering a question and can justify their choice.

3 HOW MUCH WATER DO PLANTS NEED TO BE HEALTHY?

L.O. Explain 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.

Make systematic and careful observations and, where appropriate, take accurate measurements using standard units, using a range of equipment, including thermometers and data loggers.

Record findings using simple scientific language, drawings, labelled diagrams, keys, bar charts and tables.

Use results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions.

YOU WILL NEED

- Seeds
- Seed tray or pot with soil
- Syringe or other measuring equipment for adding precise amount of water
- Ruler to measure plant growth

- Most children know that plants need water, so help children to change the original question to consider the amount of water needed for healthy growth. This then challenges children to take measurements, which will ensure that they are working at a more appropriate level.
- There are different ways that children might tackle this question. This is one option.
- Children use quick germinating seeds such as cress, radish or lettuce and choose to grow seeds in pots or seed trays where they can give different amounts of water to seeds. Syringes are very good for this activity because children can measure exact amounts of water and make sure the water goes directly on individual seeds.
- This also ensures that children are using standard measurements (ml) and that they can also measure height of growth. They might decide to water seeds in different compartments of the seed trays beginning with no water, then 10 ml, 20 ml, 30 ml, etc. or in 100 ml.
- They could then complete a table on a daily or twice-weekly basis to record when seeds germinate and how much they grow over a period of time.
- This activity can be a fair test because the seeds are in the same container, soil, light and temperature. It also demands that children make observations over time using standard measures.
- After about two weeks, children might be able to use their data to begin to draw conclusions, make predictions for new values (e.g. how much taller seedlings will grow) and suggest new questions.

	0 ml	50 ml	100 ml
Day 1			
Day 3			
Day 6			

ASSESSMENT

Subject Knowledge

- Em. Children know that plants are living things, but they need support to say that they need things to grow.
- Exp. Children know that plants are living things and need light and water and 'food' (nutrients).
- Exc. Children are able to explain that different plants require different amounts of light, water and nutrients.

Working Scientifically

- Em. Children carry out comparative test, water / no water and describe results.
- Exp. Children use standard measures of water and plant height, record using a table and draw simple conclusions.
- Exc. Children successfully carry out a fair test and use their data to raise new questions, e.g. do all plants need the same amount of water?

4 DO PLANTS NEED SOIL TO GROW?

L.O. Explain 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.
Set up simple practical enquiries, comparative and fair tests.
Record findings using simple scientific language, drawings, labelled diagrams, keys, bar charts and tables.
Use straightforward scientific evidence to answer questions or to support their findings.

- Use PowerPoint Slide 12 as a starting point for this activity. Some children might have asked this question, so in their planning to answer it challenge them to use measurements. If possible do let children choose what to grow the seeds in and for this activity quick-growing seeds such as cress give results within a week.
- Ask children how they would make their test fair, e.g. same amount of soil, sand, stones, sawdust or whatever else they

YOU WILL NEED

- PowerPoint Slide 12
- Quick-growing seeds
- Growing trays
- A range of materials to grow plants in, including soil, sand, stones, etc.

ASSESSMENT

Subject Knowledge

- Em. Children can say that plants need water and light to grow.
- Exp. Children know that plants require air, water and nutrients (food) to grow.
- Exc. Children know that different plants require different amounts of light, water, etc. to grow.

choose to use, measure same amount of water, keep in same place, temperature.

- Plant pack trays, e.g. 6 or 12 compartments per tray, are really useful as they take up less room.
- At the end of say a week, make sure children return to their original question and use their results (e.g. height, number of cress seeds that have germinated) to support their conclusions.
- Link with literacy reminding children to write their sentences with more than one clause by using a wider range of conjunctions, including 'when', 'if', 'because', 'although'.

Working Scientifically

- Em. Children carry out a comparative test and describe what happens.
- Exp. Children use their data and observations to answer the original question.
- Exc. Children carry out a fair test and use their evidence to explain similarities and differences between plant growth.

5 DO PLANTS NEED LIGHT TO GROW?

L.O. Explain 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.

Make systematic and careful observations and, where appropriate, take accurate measurements using standard units, using a range of equipment, including thermometers and data loggers.

Record findings using simple scientific language, drawings, labelled diagrams, keys, bar charts and tables.

Use results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions.

- Children will need to use plants that have already grown, or seedlings.
- This can be a comparative test where children grow two plants one in light and the other in no light, since it will be difficult to ensure the temperature is the same. Over a week or two weeks, both plants should grow but the quality of growth will be different. As adults we know this, so it is important that we discuss children's ideas so that we can encourage them to think about what they will observe.
- In this activity, observations are usually a mixture of measurements (e.g. how tall they grow) and the quality of growth (e.g. yellowing leaves, spindly growth). Keeping a photographic or video diary where children comment on the growth and take measurements would provide evidence from which children can draw conclusions.
- Challenge children to take the next step; to ask further questions (they could return to using their questions stem cards), such as:
  - How much light do plants need?
  - What happens if plants are grown in coloured light?

YOU WILL NEED

- Young plants at similar stage of growth
- Growing trays
- Light source (could be a window sill) and way of blocking out light for some plants
- Ruler to measure growth
- Camera to record results

ASSESSMENT

Subject Knowledge

- Em. Children know that plants need light and water to grow.
- Exp. Children can describe how different amounts of light affect the growth of a plant.
- Exc. Children are able to use their subject knowledge to explain how different amounts of light affect the growth of a plant.

Working Scientifically

- Em. Children carry out a comparative test and describe what happens.
- Exp. Children record and use their data and observations to ask a new question.
- Exc. Children use their evidence to hypothesise 'I think that if we change …, this will happen' and test their idea.

4.3 Flower power

GET STARTED

Collect some flowers with pollen, enough so that children can work in pairs, and observe the pollen using hand lenses, microscopes and digital microscopes. You could also show photographs of pollen under the microscope and pollen sacs on bees.

LET'S THINK LIKE SCIENTISTS

Use these questions to develop research skills and speaking and listening:

- Why is pollination so important to gardeners and farmers?
- Why do seeds make a good food for humans and animals?
- The number of bees is falling. Why might this affect all of us?
- Why are some flowers so brightly coloured?

ACTIVITIES

1 PARTS OF A FLOWER

L.O. Explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal.

- Show children the CPD video as a starting point for discussion about flowers. Tell children they are going to find out about pollination and to do this they will need to know about what is inside a flower. Children become very excited and animated when they are given a flower to dissect. For this activity give children a large piece of paper or card, a flower (lilies are excellent because they are large flowers and the parts are easily seen but children need to keep their fingers off the pollen because it stains clothing). This activity is more successful when children work in pairs to discuss their observations using hand lenses and digital microscopes.
- Tell children to take a close look at their flower, using tweezers, scissors and a knife to take it apart. They should stick each part onto their paper using sticky tape and then use books, leaflets, etc. to research the name of the different parts of the flower.
- Ask children to count the number of *sepals*, *petals*, *stamens* and *carpels* in the flower. Encourage children to share and compare information. Some children may move from labelling to adding captions explaining the function of the different parts. You could use PowerPoint Slides 13 to 15 to support this activity.
- Children can use Activity Resource 4.2 to label the parts of a flower.
- Some children might benefit from using the parts of a flower on the interactive activity, 'Flower power' on *My Rising Stars*.
- To complete this activity, take children out into the school grounds to pick a common flower such as a dandelion. Children then take it back into class and take it apart, stick it in their book and identify the parts of the flower. Get them to apply what they have learned from taking apart the lily to the dandelion. How are the parts different and similar? Here, the aim is for children to recognise that flowers have the same parts and that children can transfer knowledge from one plant to another.

YOU WILL NEED

- Activity Resource 4.2
- PowerPoint Slides 13 to 15
- Flowers for each group, e.g. lilies
- Tweezers
- Scissors or knives
- Hand lenses or digital microscopes
- Large sheets of paper
- Sticky tape

ASSESSMENT

Subject Knowledge

- Em. Children take apart the flower and need support to name different parts.
- Exp. Children identify and name different parts of a flowering plant.
- Exc. Children seek further information about the function of the parts of the flowering plant.

2 WHAT IS POLLINATION?

L.O. Explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal.

Report on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions.

- Use PowerPoint Slides 16 and 17 to explain to children the process of pollination. If possible, at the same time get children to identify the parts of the plant that they have dissected or give them a new flower so that they can make connections between the diagram and the actual flower.
- You could also show children the *Switched on Science, Second Edition* videos or search for other video clips to help reinforce the process of pollination and the role insects play.
- Use PowerPoint Slides 16–18 to explain to children the process of pollination, scaffolding this activity by breaking down the steps and asking children to say which science words they will need to use (see Teacher subject knowledge at the start of this topic). If you give two flowers to each pair and a cotton bud they could 'model pollination' between the two flowers to help them understand the process. When you think children are ready, tell them they are going to work in groups of four to role play the process to demonstrate how pollination works. If children have access to computers they could revise their understanding by playing a video clip (or use a book), so they make sure that their role play is scientifically correct. Tell children that they can use props, e.g. ping-pong balls or beads as the pollen.
- Give children time to rehearse their role play and then perform in front of either another group or the whole class. Their audience should take part in peer assessment by commenting on how successful the group was in showing the process. What was good and was there anything to improve? Video role plays for children to play back and to go on the school web site.
- As a home–school activity, ask children to find out about wind pollination and bring their ideas to school to go on a working wall or in their books.

YOU WILL NEED

- PowerPoint Slides 16 to 18
- Flowers
- Cotton buds
- Video clip of pollination (e.g. *Switched on Science, Second Edition* video)
- Props for role play

ASSESSMENT

Subject Knowledge

- Em. Children are guided by the group in their explanation of pollination.
- Exp. Children are able to explain the main parts of pollination.
- Exc. Children extend the explanation to include the full life cycle, from pollination to seed dispersal to pollination again.

Working Scientifically

- Em. Children are helped by their group to present their information as a role play.
- Exp. Children are able to communicate their research through role play.
- Exc. Children extend their role play to communicate additional information.

3 POLLINATION PLAYTIME

L.O. Explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal.

- This is the perfect opportunity to have some fun with props. Think wings and antennae for the insects and cut out paper petals for the flowers. Perhaps play 'The Flight of the Bumblebee' while the class performs.
  - Step 1: Allocate roles to children. Decide who will be insects and who will be flowers.
  - Step 2: Group children into 'flowers', with one child acting as the stamen and one as the stigma. Other children could play the role of petals.
  - Step 3: Some children act as insects.
  - Step 4: The insects can collect pollen (ping-pong balls) from the stamen of one flower and place it in their bowl.
  - Step 5: They can then deliver the pollen to the stigma of a different flower.

YOU WILL NEED

- Materials for costumes, e.g. wings
- Ping-pong balls or similar to represent pollen, bowls

ASSESSMENT

Subject Knowledge

- Em. Children know their role in this activity.
- Exp. Children can explain their role in this activity in relation to the process of pollination.
- Exc. Children apply their knowledge of pollination to make suggestions of how to refine this activity.

4 A DAY IN THE LIFE OF A FLOWER

L.O. Explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal.

- Link science and literacy by setting children the challenge of writing about pollination from the perspective of a flower. Prior to writing, rehearse ideas about pollination, for example: why is pollination important? Who do they need to attract to help pollination? How does the flower attract pollinators? Make sure that key words to use are collected and displayed along with words from literacy work, e.g. adjectives, conjunctions.
- Support children to:
  - plan their writing
  - draft and write
  - evaluate and edit
  - proofread for spelling (including scientific vocabulary) and punctuation errors.
- Once children have completed their work they could read their own writing aloud, using appropriate intonation and controlling the tone and volume so that the meaning is clear.

YOU WILL NEED

- 'How does your garden grow?' Word mat

ASSESSMENT

Subject Knowledge

- Em. Children could arrange pictures and have writing scaffolded.
- Exp. Children describe the process using correct scientific vocabulary.
- Exc. Children research additional information to extend and enrich their work.

5 LET'S GO ON A POLLINATION HUNT

L.O. Explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal.
Gather, record, classify and present data in a variety of ways to help in answering questions.

- This activity is designed so that children apply their knowledge about plants, pollination and pollinators as well as seed dispersal by carrying out a survey in the school grounds. Children could use a chart, tally chart, camera, sketches, etc. to collect information about:
  - Different kinds of flowers
  - What are the flowers like?
  - Where are the anther / stamens?
  - Does the flower attract insects?
  - Does the flower use the wind to pollinate?
  - Which pollinators did they spot?
- Back in the classroom children share their data and discuss findings and draw a range of conclusions. This then leads to new questions such as 'How could we encourage more pollinators into our school grounds?' or 'How could we help bees?'.

YOU WILL NEED

- Camera or sketchbooks to record different plants

ASSESSMENT

Subject Knowledge

- Em. Children are able to identify some parts of flowers in the school grounds.
- Exp. Children are able to apply their knowledge of flower parts for pollination in different plants.
- Exc. Children apply their knowledge of pollination to compare similarities and differences in the flowers of different plants.

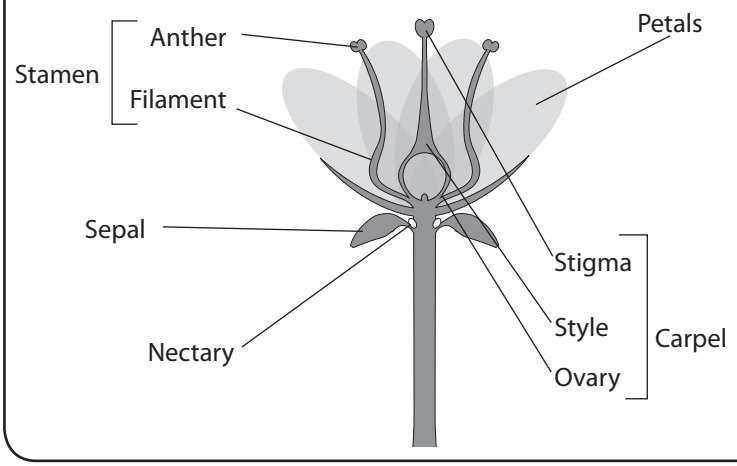
Working Scientifically

- Em. Children focus on one aspect, e.g. finding and comparing two different flowers.
- Exp. Children collect and use data to answer questions about plants, pollination and pollinators in the school grounds.
- Exc. Children identify and recognise patterns in the types of flowers and pollinators in the school grounds.

6 PARTS OF A FLOWER

L.O. Explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal.

- Here is a labelled flower. Children label it themselves using the interactive activity 'Flower power' on *My Rising Stars* or Activity Resource 4.2.



YOU WILL NEED

- Activity Resource 4.2
- Interactive activity: 'Flower Power'

ASSESSMENT

Subject Knowledge

- Em. Children name different parts of a flower with support.
- Exp. Children identify and name different parts of a flower.
- Exc. Children seek further information about the function of the parts of the flower.

7 HOW DO THESE SEEDS SPREAD?

L.O. Explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal.

- This activity will depend on the time of the year, or whether or not you have a store of different seeds and fruits (e.g. seeds not found in local area). Take children out into the local environment to collect a range of seeds with different methods of dispersal, e.g.:
  - Sycamore seeds (wind)
  - Willow herb (wind)
  - Poppy heads (wind)
  - Dandelion heads (wind)
  - Horse chestnut seeds: conkers (gravity)
  - Coconuts (gravity and then water)
  - Alder (water)
  - Willow (water)
  - Blackberries / berries (animals)
  - Burdock hooks (animals)
  - Sea holly (animals)
  - Oak seeds: acorns (animals)
  - Apple (animals)
  - Peas in pea pod (explosion)
  - Geraniums: (explosion)
- Ask children to think about what they learned in Key Stage 1. Why do plants make seeds that have ways of moving away from the parent plant? What is this called? (*seed dispersal*) Make links with literacy and talk about the words *disperse*, *dispersal* and *dispersed* so that children understand when to use them. What would happen if all the seeds belonging to a tree fell under the tree to grow? Some children will have experience and knowledge of seeds and seed dispersals so encourage them to share their ideas. You could use PowerPoint Slides 19 and 20 to support discussion of ideas.
- Give children examples of different kinds of seeds and ask them to look carefully at them, drop them, etc. and then sort them according to how they think that they are dispersed. You could give them headings: wind, water, gravity, animals, explosion.
- Some children could use Activity Resource 4.3.
- As children discuss, encourage them to think about the structure of the different seeds and which parts might stick to an animal or help it be blown by the wind.
- Once children have sorted their seeds ask children to visit other groups to see if they agree with their classifications and leave a sticky note note with a helpful comment.
- Share key learning, e.g. 'What has seeds dispersed by wind?', 'How do they know?', 'What features does it have to help?', 'Where is the seed?'.

YOU WILL NEED

- Activity Resource 4.3
- PowerPoint Slides 19 and 20
- A wide range of seeds as listed in activity notes
- Book or website app to help in identifying seeds
- Sticky notes

ASSESSMENT

Subject Knowledge

- Em. Children sort seeds according to physical similarities and need support to link to type of dispersal.
- Exp. Children use characteristics of seeds to classify.
- Exc. Children apply ideas and can suggest alternatives using physical characteristics of seeds.

8 COPY NATURE

L.O. Explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal.

- Children use what they have found out from their observations about the seeds to make their own. Sycamore seeds, the poppy head (which is like a pepper pot) and dandelion seeds are all ones that children like to make from a range of different materials and then test out.
- This provides a good opportunity to use their design technology skills in taking nature's designs, understanding them and designing, making and testing a copy. Children could test their copy against the real seed and evaluate how well their own seed works. Make sure that children record their design process and describe what they have used and why. How far can children get their seed to move away and can they keep making improvements?

YOU WILL NEED

- Craft materials

ASSESSMENT

Subject Knowledge

- Em. Children need support in identifying the structure of a seed and using materials to make their own.
- Exp. Children identify the key features of the seed and use appropriate materials to make a copy.
- Exc. Children understand and apply the mechanism for dispersal and are able to critically evaluate their model and refine it to improve dispersal.

9 WHAT DO SEEDS AND VELCRO HAVE IN COMMON?

L.O. Explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal.

Ask relevant questions and use different types of scientific enquiries to answer them.

- The aim of this activity is to show how an understanding of how seeds are dispersed was applied to an invention. Ask children to find out the answer to the question 'What do seeds and Velcro have in common?'. Give children the opportunity to work in groups and observe Velcro using touch and sight, using a hand lens or a digital microscope. Make sure that children have different seeds on their table so that they can compare the Velcro and seeds to find out if there are any similarities, e.g. with burrs from the burdock plant.
- Ask children to share their ideas, then ask them to research, either in school or as a home–school activity, who invented Velcro (George de Mestral). You could use PowerPoint Slide 21 as a starting point. Tell children that they can share their research with the rest of the class in whatever interesting way they would like, e.g. role play, video an interview, newspaper headline.

YOU WILL NEED

- PowerPoint Slide 21
- Velcro®
- Seeds that stick to clothes / fur, e.g. seeds from cleavers and the burdock plant
- Hand lens / digital microscope

ASSESSMENT

Subject Knowledge

- Em. Children require hands on experience to make links between Velcro and seeds such as burdock.
- Exp. Children describe the links between Velcro and seeds and research and present information about the inventor.
- Exc. Children apply their knowledge of seed dispersal to explain George de Mestral's invention.

TOPIC 5

Forces and magnets

About this topic

Curriculum link: Year 3, Forces and magnets

SUMMARY:

This topic looks at magnets and their uses, and what makes magnetic poles special, along with the idea that some forces such as magnetic force can act without contact – unlike pushes and pulls, which require direct contact

UNITS:

5.1: Forces and magnetism
5.2: Using magnets

ACTIVITY RESOURCES:

- 5.1: My investigation plan
- 5.2: Bringing magnets together
- 5.3: The magnetic rule
- 5.4: Everyday magnets

ONLINE RESOURCES:

Teaching slides (PowerPoint): Forces and magnets
Interactive activity: Forces and magnets
CPD video: Forces and magnets
Pupil video: Forces and magnets
Word Mat: Forces and magnets
Editable Planning: Forces and magnets
Topic Test: Forces and magnets

Learning objectives

This topic covers the following learning objectives:

- Compare how things move on different surfaces.
- Notice that some forces need contact between two objects, but magnetic forces can act at a distance.
- Observe how magnets attract or repel each other and attract some materials and not others.
- 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.
- Describe magnets as having two poles.
- Predict whether two magnets will attract or repel each other, depending on which poles are facing.

Working scientifically skills

This topic develops the following working scientifically skills:

- Ask relevant questions and use different types of scientific enquiries to answer them.
- Set up simple practical enquiries, comparative and fair tests.
- Make systematic and careful observations and, where appropriate, take accurate measurements using standard units, using a range of equipment including thermometers and data loggers.
- Gather, record, classify and present data in a variety of ways to help in answering questions.
- Record findings using simple scientific language, drawings, labelled diagrams, keys, bar charts and tables.
- Use results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions.

CROSS-CURRICULAR LINKS

This topic offers the following cross-curricular opportunities:

English

- Narrative focus: the story of Magnes the shepherd.
- Use Ted Hughes' *The Iron Man* (novel and film) as starting points for sessions.
- Use non-fiction to research information on magnets.
- Apply features of non-fiction texts, e.g. headings and paragraphs, to represent information on magnets.
- Use topic-related vocabulary.
- Create a short poem or ditty about magnets in order to remember the magnetic rule.

Mathematics

- Present your results in tables and charts.
- Mental addition and subtraction.

Computing / ICT

- Take some photographs and make a slideshow about contact and non-contact forces.
- Represent information about magnets, e.g. a newspaper article on Magnes discovering magnetic rock.
- Make a video to show how the poles of a magnet attract and repel.
- Create dance sequences based on how magnets attract and repel.

Design / technology

- Make a magnet game for a younger year group.
- Investigate products with magnets, e.g. fridge magnets, bags, bracelets.
- Design and make a fridge magnet.

Geography

- Use directional vocabulary using a magnetic compass for orienteering.
- Research what a lodestone is and where can it be found.
- Research how the Earth's magnetic poles have moved in comparison with the geographical poles over the past 100 years.

History

- Research great explorers who used compasses.
- Research the history of magnetism, e.g. Ancient Greece, Turkey, Vikings, and compasses.
- True or false: debate the story of Magnes the shepherd discovering magnetism.
- Research different accounts of how magnetism was discovered and which one has best evidence.

HEALTH AND SAFETY

Children should handle magnets carefully because, if banged or dropped, they can lose their magnetism. They need to be stored carefully and with keepers if they have them. Do not place or store them near computers, videos or televisions.

SUBJECT KNOWLEDGE

A magnet is a material or object that produces a magnetic field. This magnetic field is invisible but produces a force that pulls on only a few other metals, most notably iron, and attracts or repels other magnets. The name points to the very earliest discovery of magnetic materials in Ancient Greece: the word 'magnet' in Greek meant 'stone from Magnesia'. These lodestones were naturally magnetised pieces of iron ore that attracted other pieces of iron.

Magnets produce a magnetic force. The area around the magnet where the force can be detected is called a magnetic field. A magnetic field is strongest at the ends of a bar magnet, which are called poles. Horseshoe magnets also have poles at the two ends. Circular magnets have the poles at the top and the bottom.

Magnets have north poles and south poles. The north and south poles of bar magnets always attract each other. Two north or south poles always repel. This is summed up in the rule 'like poles repel, unlike poles attract'. So, when two magnets are close, they create pushing or pulling forces on one another. These forces are strongest at the ends of the magnets.

The idea that magnets have poles comes from the observation that, if a bar magnet is allowed to swing on a pivot, it always comes to rest facing the same direction at a particular point on the Earth. This is because the magnet is affected by the Earth's magnetic field.

The Earth acts as if it is a large bar magnet with a north and south pole. It is not a bar magnet, it just acts as if it were. So, one end of a bar magnet is attracted to the Earth's North magnetic pole. In fact, this end of the magnet is a north-seeking pole

STEAM (SCIENCE TECHNOLOGY ENGINEERING ART AND MATHS) OPPORTUNITIES

Invite into class

- STEM Ambassadors to set STEM challenges using magnets.
- Artist, e.g. who works with clay, to create clay fridge magnets.
- Historian to help children debate the story of Magnes and differentiate between fact and fiction.

Visit

- Local museum to find out about rock specimens.
- Secondary school to experience strong magnets.

and is called its north pole: it is actually a south pole because opposite poles attract. Confusing but true.

Earth's North and South magnetic poles are not at the same point as the geographical poles. They are some way off. To complicate matters further, the poles constantly move.

Iron is magnetic, so any metal with iron in it will be attracted to a magnet. Most other metals, like aluminium, copper or gold, are not magnetic. Magnets can only be made out of the metals iron, cobalt and nickel. The ones used in schools are called permanent magnets and retain their magnetism for a very long time if carefully looked after.

Permanent magnets come in many different shapes and sizes. Industrial magnets are made by heating a piece of iron to a high temperature and then hammering it as it cools in a magnetic field. Children can make a magnet by stroking an existing magnet from one end to the other of an un-magnetised iron bar, nail or needle repeatedly in the same direction.

Some iron alloys, e.g. steel, can also be made into magnets, although some stainless steel is not magnetic. Some 1p and 2p coins are attracted to magnets as they have a thin, copper coating over a steel disc. Those made before 1992 are magnetic; those made after are not! Most drink cans are made of aluminium and so are not attracted to a magnet. However, tin cans are attracted to magnets because they have a thin coating of tin over iron.

In the investigation, children should find out that most materials are not magnetic.

Children often find it difficult to understand the distinction between a magnet and the magnetic material. The difference can be easily illustrated in the following way. Show children what happens when two magnets are put together – they either attract or repel each other. Then show them what happens when a magnet is brought close to a magnetic material – it is always attracted.

Magnets are used for many different things today. Everything that has an electric motor in it has a magnet. Compasses, speedometers, fridge magnets and Maglev trains all use a magnet as well.

COMMON MISCONCEPTIONS

Children might think...

- that magnets stick to objects because they have magical properties.
- that you can make a magnet out of all metals: in fact, they can only be made from iron, cobalt or nickel.
- that all metals are magnetic materials.
- that all silver-coloured items are attracted to a magnet: this is false, aluminium is silver but is not attracted.
- that larger magnets are stronger than smaller ones: this is also false, the size is not directly related.
- that magnetic field and gravity are somehow linked: they are not.
- that the Earth's magnetic pole is fixed: in fact, it is constantly moving.

Children already know...

Magnets are not met in Key Stage 1 at all. However, children may well have come across them at school or home and seen that they can attract some other materials.

SCIENTIFIC VOCABULARY: FORCES AND MAGNETS

You can download a Word mat of essential vocabulary for this topic from *My Rising Stars*.

attract: pull towards

compass: a device that aids navigation by pointing to Earth's North and South poles

contact: touching

force: a push, pull, twist or turn caused when two objects interact with each other

iron: a metal that can be made into a magnet

magnet: an object or device that attracts iron or another magnetic material

magnetic: attracted to a magnet

magnetic North: the direction of the Earth's magnetic North pole

non-contact: not touching

non-magnetic: not attracted to a magnet

pole: the area of a magnet where the magnetic force is strongest

prediction: what you think might happen in a scientific test

repel: push away

5.1 Forces and magnetism

GET STARTED

Here are two ideas for how you might introduce the topic of magnets and magnetism to children.

Get children into groups and provide a range of magnets with a collection of objects made from magnetic and non-magnetic materials. Give them around 15 minutes to explore and find out as much as they can about magnets. Encourage them to discuss their ideas with each other and listen to their discussions, ideas and language to find out what they know and which words they use correctly and confidently. At this stage there is no need to ask children to feedback as a whole class. They could, however, write down the most important or interesting thing that they have found out and put them on a magnets working wall or use Activity Resource 5.1.

Take children into the school hall or outdoors for a P.E. lesson that focuses on moving small P.E. equipment and learning that to move something there needs to be a push or a pull and that pushes and pulls are forces. Set out the equipment for children to use to get from one end of the hall to the other, e.g. skipping ropes, balls, bats and balls, hoops, and tell them to use a push or a pull to move them. Demonstrate a push and a pull by getting children to work with a partner and then gently push and gently pull each other.

LET'S THINK LIKE SCIENTISTS

Use these questions to develop research skills and speaking and listening:

- How do you make a strong magnet?
- Are magnets found in nature?
- Do magnets lose their magnetism?

ACTIVITIES

1 PUSHES AND PULLS

L.O. Compare how things move on different surfaces.

- Ask children to explain what *forces* they used with the P.E. equipment and what was needed to make it move. Did they use a *push* or a *pull*? For example, kicking a ball; was that a push or a pull? What force did they use when they threw a ball or hit a ball with a bat? Challenge them to work out what forces were used to make a hula hoop move; if children find this hard, ask them to watch what each other does to see if they can work this out.
- Focus on the fact that some forces need contact between two objects. Ask children to state what they are moving (e.g. a ball) and what force they used (e.g. a push). These are called *contact forces*; children will return to this idea later to reinforce the idea that magnets can act without direct contact.

YOU WILL NEED

- Small P.E. equipment

ASSESSMENT

Subject Knowledge

- Em. Children can say whether they used a push or a pull to make something move.
- Exp. Children can say that a push and a pull are contact forces.
- Exc. Children apply the idea of contact forces to explain how a range of objects are moved based on their personal experience.

2 MOVING THINGS ON DIFFERENT SURFACES

L.O. Compare how things move on different surfaces.

Set up simple practical enquiries, comparative and fair tests.

Make systematic and careful observations and, where appropriate, take accurate measurements using standard units, using a range of equipment including thermometers and data loggers.

Record findings using simple scientific language, drawings, labelled diagrams, keys, bar charts and tables.

Use results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions.

- Take children outdoors and ask them to work in pairs to find out how toy cars move over different surfaces. Before they begin, ask them to look around and see how many different surfaces there are in the school grounds; include grass, concrete, soil, tarmac and play surfaces around apparatus. Give them time to compare how the cars move on the different surfaces and, as they work, listen to and discuss their ideas with them.
- This activity is completed outside in the school grounds so children work with everyday surfaces, making the activity more realistic than using surfaces such as bubble wrap, sandpaper and carpet that are usually used when moving cars over surfaces. It would be useful to take out a collection of toy cars, tape measures, chalk, whiteboards and pens for recording results.
- Bring children back together and ask them to work with another pair, telling each other what they have found out. Now ask them to think about how they could work like scientists and prove that the cars move differently on different surfaces. Ask them to set up a fair test to collect data (numbers) to show that the cars go further on some surfaces than others.
- Children should think about:
  - which surfaces they are going to use
  - what contact force they will use to move the car
  - how they could make it fair
  - what they will measure
  - what kind of table they will draw on their whiteboard (this could be modelled on the playground).
- When they have completed their test, bring the class together to discuss their results and also model how to draw a bar graph on the playground, so that the groups can draw their own.

YOU WILL NEED

- Toy cars
- Tape measures
- Individual whiteboards and pens
- Chalk for each group

ASSESSMENT

Subject Knowledge

- Em. Children are able to describe how something moves over a surface.
- Exp. Children can compare how things move over different surfaces.
- Exc. Children are able to suggest ideas as to why things move differently over a variety of surfaces.

Working Scientifically

- Em. Children carry out a comparative test between adjacent surfaces.
- Exp. Children carry out their fair test, graph their results and draw a conclusion about which surface the car travels furthest on and why, e.g. some are smoother, bumpier.
- Exc. Children test their predictions of which surface the car will travel furthest on and use their data to prove if their prediction was correct.

3 WHICH MAGNET IS THE STRONGEST?

L.O. 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.

Make systematic and careful observations and, where appropriate, take accurate measurements using standard units, using a range of equipment including thermometers and data loggers.

Record findings using simple scientific language, drawings, labelled diagrams, keys, bar charts and tables.

Use straightforward scientific evidence to answer questions or to support their findings.

- The important feature of children answering this question is to ensure that they carry out a fair test using standard measures. So, challenge children to think about how they can use, for example, a magnet to move something, e.g. a paper clip at a distance, measuring in cm. Alternatively, children could place masses (weights) in a metal lid and measure the mass that different magnets can move. Or they could count the number of paperclips each magnet can hold.
- Some children could use Activity Resource 5.1 to plan their investigation.
- They should record their results using a table and then transfer this data onto a bar chart. At this stage children may require support to create a graph.
- You could use PowerPoint Slides 5 and 6 to support this activity.

YOU WILL NEED

- PowerPoint Slides 5 and 6
- Different magnets to test strength
- Magnetic objects e.g. paper clips, and measuring equipment
- Activity Resource 5.1

ASSESSMENT

Subject Knowledge

- Em. Children know that magnets pick up some objects.
- Exp. Children know that magnets attract metals.
- Exc. Children know that magnets only attract objects made from some metals.

Working Scientifically

- Em. Children use non-standard measures, e.g. counting paperclips, and have support completing a table and graph.
- Exp. Children use standard measures, and record using a table and bar chart.
- Exc. Children use standard measures and draw their own table and graph.

4 MAGNETISM

L.O. Notice that some forces need contact between two objects, but magnetic forces can act at a distance.

- Make sure that children understand what *pushes* and *pulls* are.
- Get children gently to push and pull an object; focus on the idea that, to be able to do this, they have to touch (have *contact*) with the object.
- Show children the BBC video clip on pushes and pulls (see Useful website links on *My Rising Stars*).
- Ask children to make a list on their whiteboards of all the pushes and pulls they can see in the video. They can divide their whiteboard into two to do this. It might be best to play the video twice as the forces go by quite quickly. Finally, discuss what they have seen.

YOU WILL NEED

- PowerPoint Slide 7
- Objects to push and pull, e.g. with wheels or without
- BBC video clip to demonstrate pushes and pulls
- Individual whiteboards

ASSESSMENT

Subject Knowledge

- Em. Children know that objects can be moved using pushes and pulls.
- Exp. Children know that a force is needed to move an object and a magnet can move some things without touching.
- Exc. Children know the difference between contact and non-contact forces.

- Consolidate and review children's understanding of pushes and pulls. Collect children's suggestions of other pushes and pulls in objects that are in contact with each other, e.g. football and foot, tennis racket and ball. Use PowerPoint Slide 7 to support discussion.
- Finish by comparing the pushes and pulls in this activity with magnets. Do magnets have to touch an object to make them move?
- Tell children that they are going to think about the idea that magnetic forces can act at a distance. They do not have to touch objects to make them move. In future activities remind children of the idea that *magnetism* is a *non-contact force*.

5 DO MAGNETS WORK THROUGH DIFFERENT MATERIALS?

L.O. Notice that some forces need contact between two objects, but magnetic forces can act at a distance.

Set up simple practical enquiries, comparative and fair tests.

Use straightforward scientific evidence to answer questions or to support their findings.

- This is quite a straightforward question for children to answer; they use a magnet and magnetic object to see if they can use the magnet to move the object through, e.g. a desk, door, paper, book and anything that children choose to test. It is also a good opportunity to reinforce the idea that magnetic forces can act at a distance, i.e. through different materials.
- This kind of activity does not necessarily need children to record in a table (but they can use the table in Activity Resource 5.3 if desired). They could take some photographs, stick them into their book and annotate them with their conclusions.
- Give children access to plastic bottles with lids into which they can put metallic objects, e.g. screws, paper clips or nails, so that they can test whether magnets can work through water. Children could video a short clip, describe what they are doing and explain their conclusion. Make sure that children use the appropriate scientific language in their video clip.

YOU WILL NEED

- Magnets
- Magnetic objects
- Activity Resource 5.3
- Camera / tablet
- Plastic bottles

ASSESSMENT

Subject Knowledge

- Em. Children know that objects can be moved using pushes and pulls.
- Exp. Children know that a force is needed to move an object and a magnet can move some things without touching.
- Exc. Children can apply what they know about non-contact forces to create their own test to show magnets work using non-contact forces.

Working Scientifically

- Em. Children need an adult to model the activity first before they work more independently.
- Exp. Children plan and carry out their comparative tests and make a short video.
- Exc. Children use and record standard measures relating to the thickness of material that a magnet can work through.

6 NORTH AND SOUTH POLES

L.O. Describe magnets as having two poles.

Predict whether two magnets will attract or repel each other, depending on which poles are facing.

- Some of the children's questions might focus on why magnets repel each other and attract each other depending on which end of the magnets are together.
- If you have magnets where one half is blue and the other red, then it is easy to call each end a pole: one is north, the other is south. Alnico magnets are red all over so they have a 'dimple' at one end to show it is a north or south pole.
- Children exploring the effect of two magnets being placed close together will feel when magnets are pushing against each other and when they pull each other. Ask them to find the rules about magnets, that is 'like poles repel and opposite poles attract.' So:

  north – north = repel
  south – south = repel
  north – south = attract
  south – north = attract

- Ask children to compare and record what happens when magnets are brought together, and to annotate their results using the terms *attract* and *repel*. Children can use Activity Resource 5.2 to record the findings and Activity Resource 5.3 to reinforce the idea of poles. Use PowerPoint Slide 8 to reinforce their learning.
- They could also make up a song or poem to remind themselves about the rules.

YOU WILL NEED

- PowerPoint Slide 8
- Collection of magnets
- Activity Resources 5.2 and 5.3

ASSESSMENT

Subject Knowledge

- Em. Children know magnets have poles and can describe what happens when poles are put together.
- Exp. Children predict what will happen when poles are put together.
- Exc. Children apply knowledge about poles to explain magnetic marbles, floating magnets.

5.2 Using magnets

GET STARTED

Give children some problems to discuss in pairs or small groups:

1. How can we separate different kinds of cans in a recycling factory? Provide them with a collection of different cans to sort into non-magnetic (aluminium drinks can) and magnetic (iron coated tin).
2. The dressmaker has dropped pins in the button tin – how could they be sorted?
3. How can the school cook quickly sort cutlery from plates?

LET'S THINK LIKE SCIENTISTS

Use these questions to develop research skills and speaking and listening:

- Are all metals magnetic?
- What would life be like if there were no magnets?
- Invent something new that uses magnets.

ACTIVITIES

1 FUN MAGNETIC GAMES

L.O. Notice that some forces need contact between two objects, but magnetic forces can act at a distance.

Observe how magnets attract or repel each other and attract some materials and not others.

- As a starting point for this activity you could show children the Pupil video 'Forces and magnets', which shows children carrying out some of the following activities that children could then make and try out. This might be an activity where children make a game and play it with someone else in their class or a younger year group. Either way, make sure that children have to explain how their games work using correct scientific vocabulary.
- Pictures of the games are on PowerPoint Slide 9 and are meant to be a visual clue so that children can design and make their own.

YOU WILL NEED

- PowerPoint Slide 9
- Pupil video 'Forces and magnets'
- Magnets

ASSESSMENT

Subject Knowledge

- Em. Children require support to make and explain their magnet toy.
- Exp. Children make, demonstrate and explain their toy to an audience using scientific language.
- Exp. Children explain the science behind their magnet toy and can change the language used appropriate to audience.

2 WHERE ARE MAGNETS USED?

L.O. Notice that some forces need contact between two objects, but magnetic forces can act at a distance.

- One of the ways in which we know children understand scientific concepts is when they are able to apply the ideas to new contexts. The aim of this activity is for children to use their understanding to make sense of everyday (and not so everyday) uses of magnets.
- Use PowerPoint Slide Slides 10 and 11 and the video clip about super powerful magnets (see the list of weblinks on *My Rising Stars*).
- Children could record how magnets are used on Activity Resource 5.4. They could also create a class display of items brought from home, e.g. toys, fridge magnets, bags.
- Children might produce their own uses for magnets (see weblink on *My Rising Stars – Weird and Wonderful Uses of Magnets*).

YOU WILL NEED

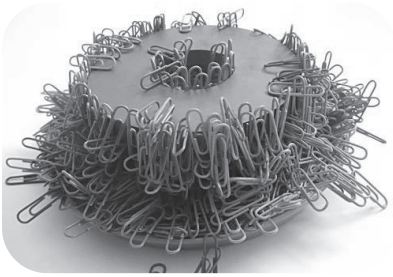
- Activity Resource 5.4
- Online list of weblinks (see *My Rising Stars*)
- PowerPoint Slide Slides 10 and 11

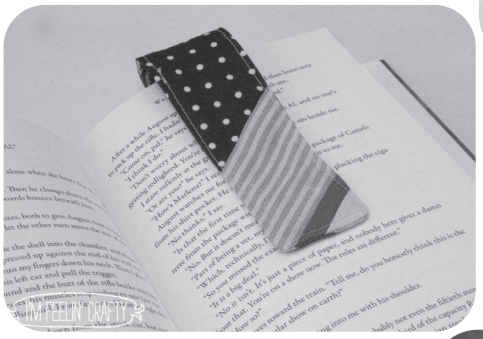
ASSESSMENT

Subject Knowledge

- Em. Children are able to say what kinds of things use a magnet.
- Exp. Children know how magnets are used in their own lives.
- Exc. Children know how magnets are used in different contexts.

Magnets have lots of different uses. Look at these pictures.
How are the magnets being used?





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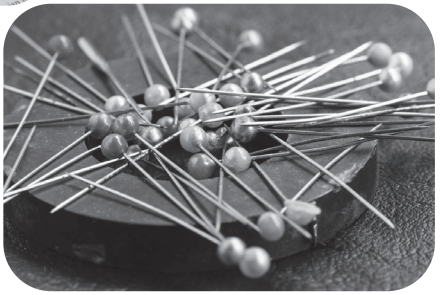


TOPIC 6

The nappy challenge

About this topic

Curriculum link: Year 3, Cross-curricular

SUMMARY:

This topic looks at disposable nappies and provides opportunities for children to ask their own questions and make decisions on how to answer their questions using different scientific enquiry activities.

UNITS:

6.1: Test centre

6.2: Environmental effects

ACTIVITY RESOURCES:

- 6.1: Graph outline
- 6.2: Disposable nappy facts

ONLINE RESOURCES:

Teaching slides (PowerPoint): The nappy challenge

Interactive activity: The nappy challenge

CPD: The nappy challenge

Pupil video: The nappy challenge

Word mat: The nappy challenge

Editable planning: The nappy challenge

Topic Test: The nappy challenge

Working scientifically skills

This topic develops the following working scientifically skills:

- Make systematic and careful observations and, where appropriate, take accurate measurements using standard units, using a range of equipment including thermometers and data loggers.
- Gather, record, classify and present data in a variety of ways to help in answering questions.
- Ask relevant questions and use different types of scientific enquiries to answer them.
- Use results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions.
- Set up simple practical enquiries, comparative and fair tests.
- Use straightforward scientific evidence to answer questions or to support their findings.

CROSS-CURRICULAR LINKS

This topic offers the following cross-curricular opportunities:

English

- Use non-fiction to research Marion Donovan who developed the disposable nappy; write a fact card and role play her story.
- Use a dictionary to check the meaning and spelling of words, e.g. absorbent.
- Ask questions about nappies and decide how to answer them.
- Organise paragraphs when writing in science.
- Use headings and sub-headings in writing.
- Annotate deconstructed nappies.
- Research reusable nappies and use persuasive writing to encourage parents and carers to change from using disposable to reusable nappies.
- Participate in a debate: for and against disposable nappies.
- Design and create an advertisement for a disposable or towelling nappy.

Mathematics

- Compare sizes of different nappies.
- Measure absorbency.
- Measure strength and elasticity.
- Big sums: calculate nappies used per week, month, year.
- Write and carry out a survey, e.g. types of nappies used by parents and carers; record results using a database or tally chart.
- Present the results of the survey in a bar chart or graph.
- Work out the cost per nappy. Are they good value for money?
- Work out the cost differences between disposable and towelling or bamboo nappies.

Computing / ICT

- Photograph the different components of a disposable nappy.
- Video interview with a parent.
- Blog about disposable versus fabric nappies: what do you think?
- Use video clips to explore polymer crystals.
- Internet research into the issues about disposable nappies and landfill.
- Internet research into who invented disposable nappies and bamboo nappies.

Geography

- Disposable nappies into landfill: what are these and where are they in our local area?
- Where do the different components come from, e.g. are they wood pulp, cotton?

Design / technology

- Design and make your own nappy.

History

- Create a timeline to show what great great grandparents, great grandparents, grandparents and parents used as nappies.
- Research how people used to wash and clean towelling nappies; interview an older person.

STEAM (SCIENCE TECHNOLOGY ENGINEERING ART AND MATHS) OPPORTUNITIES

Invite into class

- A scientist or anyone who works in product design or testing.
- A STEM Ambassador or local authority environmental office to explain the impact of nappies on the environment.
- Parents to interview about nappies and their use.
- Local authority environmental officer to talk about disposing of household waste.
- A newspaper / TV reporter to work with children on how to communicate their findings.

Visit

- A local supermarket to find out about different nappies sold.

TEACHER SUBJECT KNOWLEDGE

What is inside a nappy?

When a disposable nappy is taken apart, it can be seen to consist of a shaped pad covered in a soft liner and enclosed in a waterproof outer layer. The centre layer of the nappy is made from a mixture of wood pulp and cotton; these materials are used because they soak up (absorb) the baby's urine and retain the moisture in this layer so that the baby stays dry. In the very centre of this there are some small crystals; if you rub the centre part of the nappy over some black sugar paper, you may find that powder or small crystals drop out (absorbent polymers). If you have ever made fake snow using a white powder, you will know that the tiny crystals absorb (soak up) and retain moisture. So that any urine or faeces do not leak out, parts around the legs are elastic and the waistband is designed to be adjustable: usually the 'tabs' are made from plastic and are like Velcro.

Who invented disposable nappies?

An America woman named Marion Donovan is credited with inventing disposable nappies. She began designing in 1946 because she found the towelling nappies she used leaked through to her children's clothes. She began by using a shower curtain with a cloth nappy inside and used press studs to keep it together. Gradually she improved her design using paper that was strong and absorbent, but no one believed it was a good idea and it was not until 1961 that a man called Victor Mills used her idea to make Pampers.

Disposable nappies are convenient. Some though would argue that they harm the environment; they make up around 4% of UK waste that goes into landfill. Parents use about 4–5 disposable nappies every day.

Other kinds of nappies

Other types of nappies are available such as cloth nappies and, more recently, bamboo nappies made from bamboo yarn that is said to be softer and more absorbent than a terry nappy. There are reusable nappies that have a throwaway liner inside a pair of waterproof baby pants that can be worn again.

How are nappies tested?

Nappies are tested by the manufacturer, mums' groups and *Which?* Magazine. These are the sorts of things they test.

1. Absorption: the amount of urine (liquid) a nappy can hold.
2. Rewet: after 5 minutes, is the surface of the nappy dry or wet?
3. Leakage: if any urine or faeces leaks from the legs.
4. Strength of the Velcro: how much force it takes to open a nappy and how many times the Velcro can be opened and sealed.

Who wears nappies?

Babies wear nappies, but so do astronauts (they are called 'Maximum Absorbency Garments'). Crew members on the Space Shuttle were given three disposable nappies because they would not be able to go to the toilet as the rocket was being launched or when it re-entered the Earth's atmosphere. They are also used when astronauts go outside on space walks.

Some children and adults with medical problems also need to wear disposable nappies in the form of disposable pants.

Environmental impact

There are many arguments for and against both disposable and towelling nappies. One of the aims of primary science is to give children access to advantages and disadvantages so that they can engage in debate and understand that they have choices.

Disposable nappies	Towelling nappies
end up in landfill and can contaminate ground water	use cotton that has to be grown, which includes use of fertiliser and transport
result in human faeces going into landfill	use energy in the industry that makes nappies
use resources to make them, e.g. trees and water	have to be washed so they use electricity, water and detergents
use energy in the manufacturing process	
take hundreds of years to degrade	
use chemicals that can be irritants	

The arguments for and against are not straightforward since disposable nappies are very convenient for parents to use and the nappy industry is working to reduce the environmental impact of its products.

CHILDREN'S MISCONCEPTIONS

Children might think...

- that only babies wear nappies.

Children already know...

- that babies wear nappies.
- nappies need to be changed often.

SCIENTIFIC VOCABULARY: THE NAPPY CHALLENGE

You can download a Word mat of essential vocabulary for this topic from *My Rising Stars*.

absorb: to soak up, e.g. liquid

absorbent: able to soak up, e.g. liquid

bamboo: a fast-growing grass that can be used to make cloth

cloth: a woven fabric made from, e.g. wool, cotton

cotton: a plant that is grown to make cotton thread and fabric

disposable: can be thrown away after it has been used

elastic: a material that can be stretched or compressed and will return to its original shape

faeces: waste from bodies from the process of digestion

liquid: a substance that can be poured and takes the shape of its container

material: anything from which an object can be made

nappy: absorbent material used to absorb and keep urine and faeces from a baby's skin

plastic: a synthetic material, or a material that when stretched does not return to its original shape

properties: a characteristic of something, e.g. waterproof, flexible

urine: a yellowish liquid containing waste from the body when a human urinates

Velcro: a fastener that uses hooks

waterproof: keeps out water

wood pulp: wood that has been ground to a fine pulp

6.1 Test centre

GET STARTED

Ideally, a parent or carer associated with the class comes in to talk to children and answer questions about nappy changing. They then demonstrate to the class how to change a nappy.

LET'S THINK LIKE SCIENTISTS

Use these questions to develop research skills and speaking and listening:

- Why do some people use disposable nappies?
- What other kinds of nappies are there?
- What materials are used in a disposable nappy? What properties do they need?
- Why do you think people who make nappies test them?
- What kind of tests do you think they do?
- What do you think happens if a test fails?

ACTIVITIES

1 EXPLORING A DISPOSABLE NAPPY

L.O. Make systematic and careful observations and, where appropriate, take accurate measurements using standard units, using a range of equipment including thermometers and data loggers.

Gather, record, classify and present data in a variety of ways to help in answering questions.

- The aim of this activity is for children to explore the materials that a disposable nappy is made from. Either working in pairs or groups of four, tell children that they are going to take apart (deconstruct) a disposable nappy to find out as much as they can about it. As they take the nappy apart using scissors, they should stick pieces of the nappy onto a large sheet of paper using tape, label them and annotate them with information.
- Remind children of their learning about materials from Key Stage 1 where they learned about the names and *properties of materials*.
- Challenge children to group the materials and classify them, e.g. identify type such as *plastic*, *cotton* or properties such as *waterproof*, *absorbent* (if children know this word) and note observations such as feels like Velcro, sticky, like a mesh or net. Also encourage children to think about why these materials have been used. You could use PowerPoint Slide 5 to support discussion.
- At the end of this activity, bring together the class to share what they have found out about disposable nappies; the information could be used to begin a working wall on nappies.

YOU WILL NEED

- PowerPoint Slide 5
- Disposable nappies for each group
- Scissors
- Sticky tape
- Large sheets of paper

ASSESSMENT

Working Scientifically

- Em. Children take apart a nappy and group according to obvious observable features and materials.
- Exp. Children make systematic observations, classify according to names and properties of materials and record their findings.
- Exc. Children apply their knowledge of materials and their properties to suggest why materials have been used for different parts of the nappy.

2 ASKING QUESTIONS: WHAT ELSE DO WE WANT TO KNOW ABOUT A DISPOSABLE NAPPY?

L.O. Ask relevant questions and use different types of scientific enquiries to answer them.

- Children use question stem cards to ask a range of questions about whatever else they would like to find out about disposable nappies and also use their experience from the previous activity. The aim is for children to ask their questions and then, in Activity 4, they will organise their questions according to how they can be answered.
- You could use PowerPoint Slides 6 and 7 to support discussion. In groups of four, children place the question stem cards on their table and, through discussion, come up with a question for each stem. Once the question is agreed, it is written on a sticky note (each group has its own colour notes) and the used question stem is put to one side. Let children go back to their sheet of paper from Activity 1 and the disposable nappy that has not been taken apart to stimulate ideas for questions.

YOU WILL NEED

- PowerPoint Slides 6 and 7
- Question stem cards
- Sticky notes (different colours for each group if possible)

ASSESSMENT

Working Scientifically

- Em. Children require an adult to scaffold using different question stems.
- Exp. Children use their experience of the nappies to ask a range of questions.
- Exc. Children use their knowledge of the properties of materials to ask questions.

3 CHECKING OUR QUESTIONS FOR MATHS AND SCIENTIFIC LANGUAGE

L.O. Ask relevant questions and use different types of scientific enquiries to answer them.

- Ask children to look at their questions from Activity 2 to see if they can change any of the words to make them more scientific and help to decide what to measure, e.g.:
  - 'Which nappy holds the most wee?' becomes 'Which nappy absorbs the most urine?'.
  - 'Which nappy is the best?': Children clarify what 'best' means to become 'Which nappy keeps the baby driest for the longest time?'.
  - 'Which is the best elastic?' becomes 'Which elastic stretches the furthest?'.
  - 'Why do the nappies have white bits in them?' becomes 'Why do nappies have white powder inside?'.
- Some children will need a lot of scaffolding for this activity and it could help to choose some questions from each group and ask the whole class to help change the questions from a good question to an excellent scientific question.

YOU WILL NEED

- The Nappy Challenge Word mat

ASSESSMENT

Working Scientifically

- Em. Children are given suggestions to choose from to improve their questions.
- Exp. Children use scientific vocabulary from a word bank and a list of measurements, e.g. capacity, time, length, to improve their questions.
- Exc. Children are able to sort through their questions, choose and change them appropriately.

4 HOW CAN WE ANSWER OUR QUESTIONS?

L.O. Ask relevant questions and use different types of scientific enquiries to answer them.

- Children decide what kind of scientific enquiry activity they can use to answer the questions they have asked in Activity 3. Give children the following headings, which link to the different enquiries listed in the curriculum. They could be on the floor, on display or on a whiteboard:
  - *Observe*: Use the senses, e.g. What does the nappy feel like?
  - *Sort and classify*: What are the names of the materials used in the nappy?
  - *Do a fair test*: Which elastic stretches the furthest?
  - *Do a comparative test*: Which nappy is the softest?
  - *Research*: How are nappies made?
  - *Look for patterns in numbers*: Which nappy is the most popular? (a survey)
- Support children in deciding how each of their questions can be answered. This does take time but give children the opportunity to show that they can take the questions they have asked and decide which scientific enquiries they will carry out to answer them. This is probably best as a whole-class activity unless your children are already confident in this approach.
- Once the questions on the sticky notes have been placed under the appropriate headings, you could use them to manage the rest of this topic, e.g. all research questions could go home and children bring information back for the working wall, or use a literacy lesson to use non-fiction text. Those that are observation or classification could be carried out in a given lesson, while the questions to be tested could take place over a series of lessons. Finally, some questions will lend themselves to a survey, so this could be a whole-school activity where children create a set of questions for their survey that goes to all parents and the data entered in a simple spreadsheet. Children then use the data to draw conclusions, e.g. 'Which is the most popular nappy?', 'Which nappies do parents use at night and during the day?'.

ASSESSMENT

Working Scientifically

- Em. Children require support to decide how to answer their question and might be given an 'either / or', e.g. look on the Internet.
- Exp. Children discuss and decide how to answer their questions.
- Exc. Children recognise that some questions can be answered in more than one way.

5 WHICH NAPPY IS THE MOST ABSORBENT?

L.O. Set up simple practical enquiries, comparative and fair tests.

Make systematic and careful observations and, where appropriate, take accurate measurements using standard units, using a range of equipment including thermometers and data loggers.

Use results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions.

- Children test nappies to see which is the most absorbent. Year 3 children should be using standard measures, so ask them to think about some of the following:
  - How will they make their test fair, make same size nappy, pour on same place, same way?
  - When will they stop pouring 'urine'? When it seeps out of the nappy or pools on top of the nappy (becomes saturated)?
  - What will they use to measure the urine (ml, l)?
  - How will they make sure that they do not spill water everywhere? (safety)
  - What will their table look like?
- It is always fun for children to use 'yellow' water, using either a food dye or orange cordial in the water. Children should use a table to record their results and then use them to draw a graph; for this, they could use Activity Resource 6.1.
- You could use the graph on PowerPoint Slide 8 to model how to draw a graph and how to draw conclusions. Ask the class a series of questions using the data in the graph such as:
  - Which nappy absorbed the least amount of urine?
  - Which nappy absorbs the most urine?
  - How much more urine did Nappy 3 absorb than Nappy 1? What kind of sum will you do?
- Make sure that, when children write their conclusions, they use their graph and include numbers, e.g. 'The most absorbent nappy was X because it held 670 ml of urine which was X ml more than the second best nappy that held X ml'. Encourage children to carry out subtraction calculations.
- Children could use their data from this activity to answer the question 'Are the most expensive nappies better than the cheapest?'.

YOU WILL NEED

- A range of different nappies
- Water (yellow colouring optional)
- Activity Resource 6.1
- PowerPoint Slide 8

ASSESSMENT

Working Scientifically

- Em. Children require support to carry out a simple comparative test comparing two nappies.
- Exp. Children carry out a fair test, use a table, draw a graph and write a conclusion.
- Exc. Children use the data in their conclusion and raise further questions, such as 'Would the same nappy be the best if the urine was left for 10 minutes?'.

6 WHICH NAPPY ELASTIC STRETCHES THE FURTHEST?

L.O. Set up simple practical enquiries, comparative and fair tests.

Make systematic and careful observations and, where appropriate, take accurate measurements using standard units, using a range of equipment including thermometers and data loggers.

Use straightforward scientific evidence to answer questions or to support findings.

- Children will need to take the elastic from different nappies to carry out a fair test to find out which one stretches the furthest. Ask children to think about what the elastic is used for in a disposable nappy and how they will measure it.
- Ask children to think how to keep the test fair, e.g. making sure that each piece of elastic is the same length to start and is stretched in the same way. What will they use to measure, e.g. metres, centimetres, millimetres, and how will they record their results? Children could use a two-column table and stick a sample of the elastic against the name of the nappy and then the distance it stretched. Children could convert the data in the table into a bar graph, either using the graph outline on Activity Resource 6.1 or a computer-generated graph.
- Finally, children should use their data (scientific evidence) to answer the original question 'Which nappy elastic stretches the furthest?'. Challenge children to use scientific language such as *data*, *conclusion*, *elastic*, *stretched*.

YOU WILL NEED

- Elastic from different disposable nappies
- Scissors
- Activity Resource 6.1
- Tape measures

ASSESSMENT

Working Scientifically

- Em. Children require support to carry out a simple comparative test comparing two nappies.
- Exp. Children carry out a fair test, use a table, draw a graph and write a conclusion.
- Exc. Children use the data in their conclusion and raise further questions.

7 WHO INVENTED NAPPIES?

L.O. Ask relevant questions and use different types of scientific enquiries to answer them.

- Children use a different scientific enquiry to answer their question, that is research. You could set up a folder on Marion Donovan or, if children are able, give them access to the Internet to search for information. Alternatively, this could be a home–school task for children to research and bring back key facts for a working wall or display on disposable nappies.
- There are numerous ways that children could communicate what they have found out, e.g. role play, hot seating, a fact file or even a letter written by Marion Donovan trying to convince someone to make her nappies.

YOU WILL NEED

- Websites or other research resources about Marion Donovan

ASSESSMENT

Working Scientifically

- Em. Children listen to or are told the story and re-tell it orally.
- Exp. Children use simple organisational devices such as headings and sub-headings when writing up research.
- Exc. Children use more than one source of information and choose their own way to record their work in science.

6.2 Environmental effects

GET STARTED

Give children this incredible fact: 'About 8 million disposable nappies are thrown away each day in the UK.' Now engage children in using maths skills to do a 'big number' calculation to work out how many in one week, month and year. Do they think this is a good thing? What is their reaction? Does this mean that there are more nappies thrown away each year than there are people living in the UK? Ask children to find out.

LET'S THINK LIKE SCIENTISTS

Use these questions to develop research skills and speaking and listening:

- How many nappies do parents use in one day?
- Which brand do they buy? Why?
- What happens to disposable nappies?
- How long do they take to decay?
- Why is bamboo used for nappies?

ACTIVITIES

1 NAPPY SURVEY

L.O. Ask relevant questions and use different types of scientific enquiries to answer them.

Gather, record, classify and present data in a variety of ways to help in answering questions.

Use straightforward scientific evidence to answer questions or to support their findings.

- In the previous unit of this topic children asked questions about nappies and decided the best way to answer them. Some of the questions children asked might have been placed under pattern seeking, as part of a whole-class survey on nappies. For example, children might have asked about 'Which nappy is used the most?', 'Do mums use the same nappy all of the time?', 'Do mums buy the same nappy all of the time?'.
- Return to these questions and explain to children that they are going to make and carry out a survey to find out more about nappies and that this means asking parents and carers questions. Ask each group to think about and decide on three questions that they would like answered. You could set up a simple survey sheet, e.g. yes / no answers or numbers and each group could type in their questions which, once printed out, could be given to children to take home.
- To collate answers, each group could be given certain questions and a tally sheet to collect data information; alternatively, if children are able, an Excel spreadsheet could be used.
- Finally, children could use the results to answer questions, e.g. 'Which is the most popular brand of nappy?'.

ASSESSMENT

Working Scientifically

- Em. Children could carry out a simplified survey asking adults in the school and using a tally chart to record data.
- Exp. Children collect and use data to answer the original question.
- Exc. Children can use the data to answer questions and also link data from different questions, e.g. the favourite brand is only used at night time.

2 SHOULD DISPOSABLE NAPPIES BE BANNED?

L.O. Ask relevant questions and use different types of scientific enquiries to answer them.

Use straightforward scientific evidence to answer questions or to support their findings.

- Show children PowerPoint Slide 9 and, working in pairs or small groups, children work out the 'Big sums' on the slide; they could use calculators. The aim is to help children understand how many nappies one baby uses over the different timescales then, if this is multiplied by how many new babies have been born to parents of children in the school (a survey could get this information), the numbers become even more staggering. It might help children to have some understanding of how many nappies go into landfill. You might need to go over how to carry out calculations, reminding and supporting children in applying maths skills.
- Consider asking a local supermarket to donate some nappies so that children can see what 10, 20, 30 nappies look like when piled up; they might find it hard to visualise.
- Give children the information cards in Activity Resource 6.2. The statements are for and against the use of disposable nappies and should be cut out so that children can sort them into 'For' and 'Against'. You could use PowerPoint Slide 10 as a focal point for discussion.
- Show children PowerPoint Slide 11. Some children could research bamboo nappies and find out if they are environmentally friendly.
- Children could research what happens to nappies once they have been used; prompt children's thinking by showing PowerPoint Slide 12. This activity is best carried out as a paired or group activity so that children engage in discussion about where to place each card and why.
- Children could also research the use of towelling, bamboo and reusable nappies and compare these to disposable. Finally, the class could vote using tokens on which type of nappy they think might be best for parents or for the environment.

YOU WILL NEED

- PowerPoint Slides 9 to 12
- Activity Resource 6.2

ASSESSMENT

Working Scientifically

- Em. Children require support and choose between, e.g. two statements.
- Exp. Children discuss the information and are able to explain their choices.
- Exc. Children discuss the information and may decide that some could be placed under both headings: they may also think of some arguments for and against themselves.

3 DESIGN AND MAKE YOUR OWN NAPPY

L.O. Use straightforward scientific evidence to answer questions or to support findings.

- One way to assess children's understanding is to provide a context in which they can apply the knowledge and skills they have been developing. This final activity uses children's experiences of a wide range of nappy products and their properties as well as how to carry out tests, which means that children will have knowledge and skills to apply in designing their own nappy. Children could work in pairs and, through discussion, create annotated diagrams to show what the nappy will look like and the materials they will use and why. Give children a range of materials to choose from and challenge children to use their knowledge of materials and their properties when they design their nappies. Before making their nappy, give children time to 'swap' their design with another pair, so that they can give and receive feedback from their classmates. Can they make it environmentally friendly?
- Children make and test their nappy and evaluate it against their original design. Children could record their work through, e.g. their design diagrams and annotated photographs of their tests, and finally design and create an advertisement for their nappy.
- Finally, show PowerPoint Slide 13 as an example of how to develop a concept map about disposable nappies so that children can reflect on what they have learned and use the map to record their ideas and understanding.

YOU WILL NEED

- Materials to make a nappy, e.g. tissue paper, cardboard, textiles, Velcro
- Camera
- PowerPoint Slide 13

ASSESSMENT

Working Scientifically

- Em. Children make a nappy using some knowledge of properties, e.g. soft and they use photographs as part of their advertisement.
- Exp. Children use their knowledge of materials and nappies to design, test and evaluate their nappy and communicate the properties of the materials in their advertisement.
- Exc. Children apply their understanding of materials and their environmental impact, and are able to explain and justify the reasons for using each component using arguments in their advertisement.

1.1 Testing rocks

a) Are rocks hard?

Rub the rock slowly with a piece of coarse sandpaper or scratch it with a small pebble.

Does it leave a mark?

Type of rock	Observation

b) Are rocks waterproof?

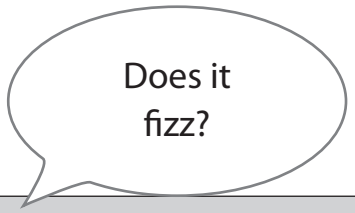
Does it soak in or stay as a drop on the rock?

Type of rock	Observation

1.1 Testing rocks

c) Do rocks react?

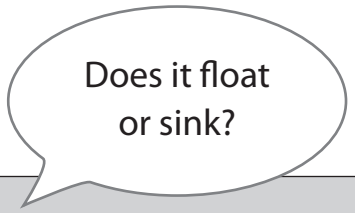
Use a dropper and squeeze 3 or 4 drops of vinegar onto the rock. Some rocks contain a material like chalk which fizzes with vinegar.



Type of rock	Observation

d) Are all rocks heavy?

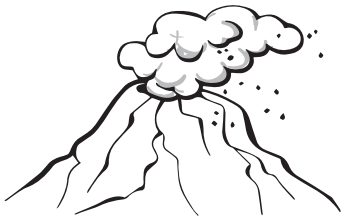
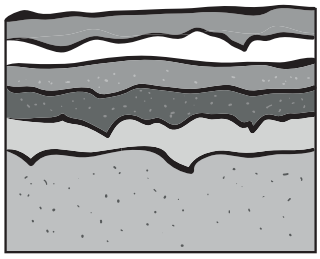
Slowly place each piece of rock into a bowl of water.



Type of rock	Observation

1.2 The rock family

This table might help you to decide what type of rock you have.

Type of rock	Appearance	Draw and label your rock sample
Igneous  **Examples** Granite, Pumice, Basalt	Hard Dark Heavy May contain crystals or holes No fossils	
Sedimentary  **Examples** Chalk, Limestone, Sandstone	Layers Crumbly with round grains Contains fossils Light colour Not heavy	
Metamorphic  **Examples** Granite, Pumice, Basalt	Light and dark bands 'Clink' when tapped Large grains	

1.3 Soil investigation

What is soil like?

a) Look at the soil and feel it.

Is it gritty?

Is there anything in it?

What colour is it?

Soil sample	Observations

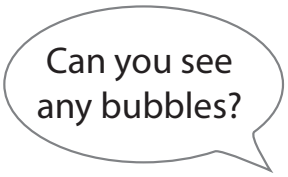
b) Try sieving the soil with different sieves.

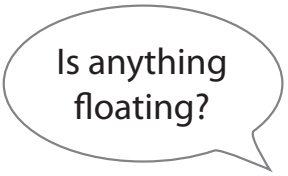
Do all parts of the soil go through the sieve?

Soil sample	Observations

1.3 Soil investigation

c) Shake some soil in a large jar of water.



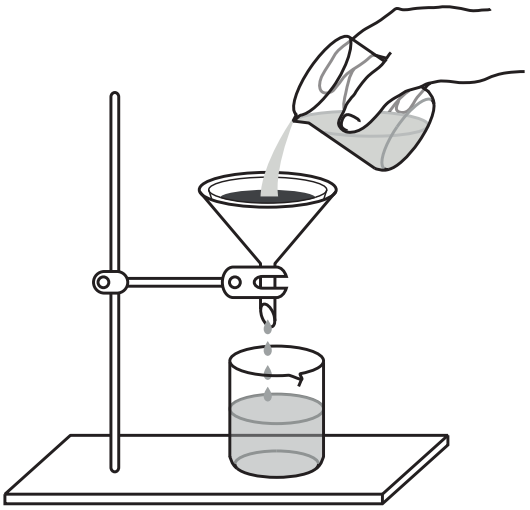


Soil sample	Observations

d) Leave it until the next day.
Draw what you see. How big is each layer?

1.3 Soil investigation

You are going to use equipment like this to test 3 different soils to see how much water passes through each soil.



a) How much soil will you use?

b) How much water will you use?

c) How will you make your test fair?

d) How will you decide which is fastest?

1.3 Soil investigation

e) Draw a table for your results below.

1.3 Soil investigation

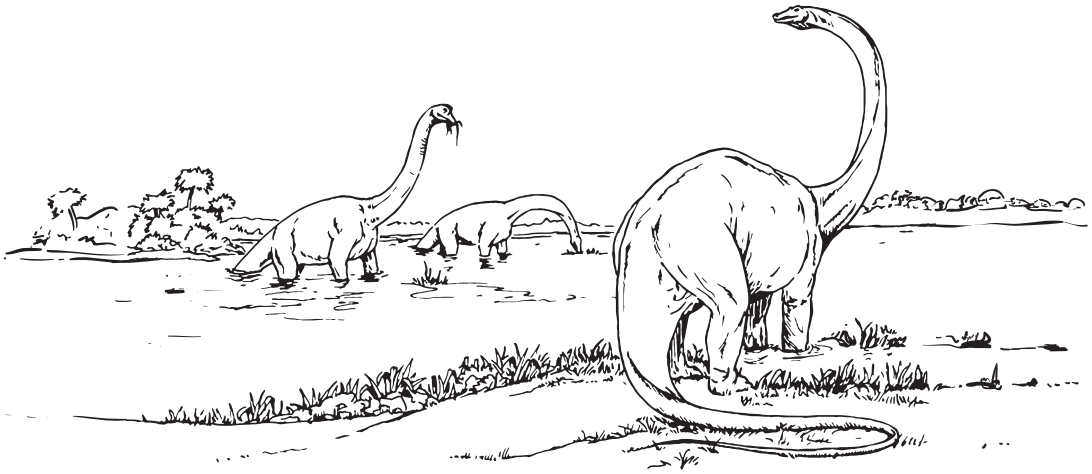
f) What did you find out?

g) What do you think the soils might be like inside to explain your results? Draw your thoughts below.

Soil 1	Soil 2	Soil 3

1.4 Fantastic fossils

The Earth was formed 4.5 billion years ago. This is hard to think about! It is easier to imagine all this time as just one day.



a) Add this information to the time line below.

- 6pm fossils appear
- 8pm land plants appear
- 8.15–9.30pm insects develop
- 8.15–9.30pm amphibians invade the land
- 9.30–11pm dinosaurs rule!
- 11pm mammals appear
- 11.59 pm humans appear

Midnight 12am	3am	6am	9am	Noon 12am	3pm	6pm	9pm	Midnight 12am

b) What do you think happened from 12am to 6pm?

2.1 My food diary

Write the time for each meal and what you ate.

Day:	
Breakfast	I ate:
	
Morning snack	I ate:
	
Lunch	I ate:
	
Dinner	I ate:
	

2.2 Food groups

Food groups
Sort the foods into the different food groups. Some foods may appear in more than one column.

Fruit and vegetables	Starchy foods	Proteins	Fat and sugar	Milk and dairy

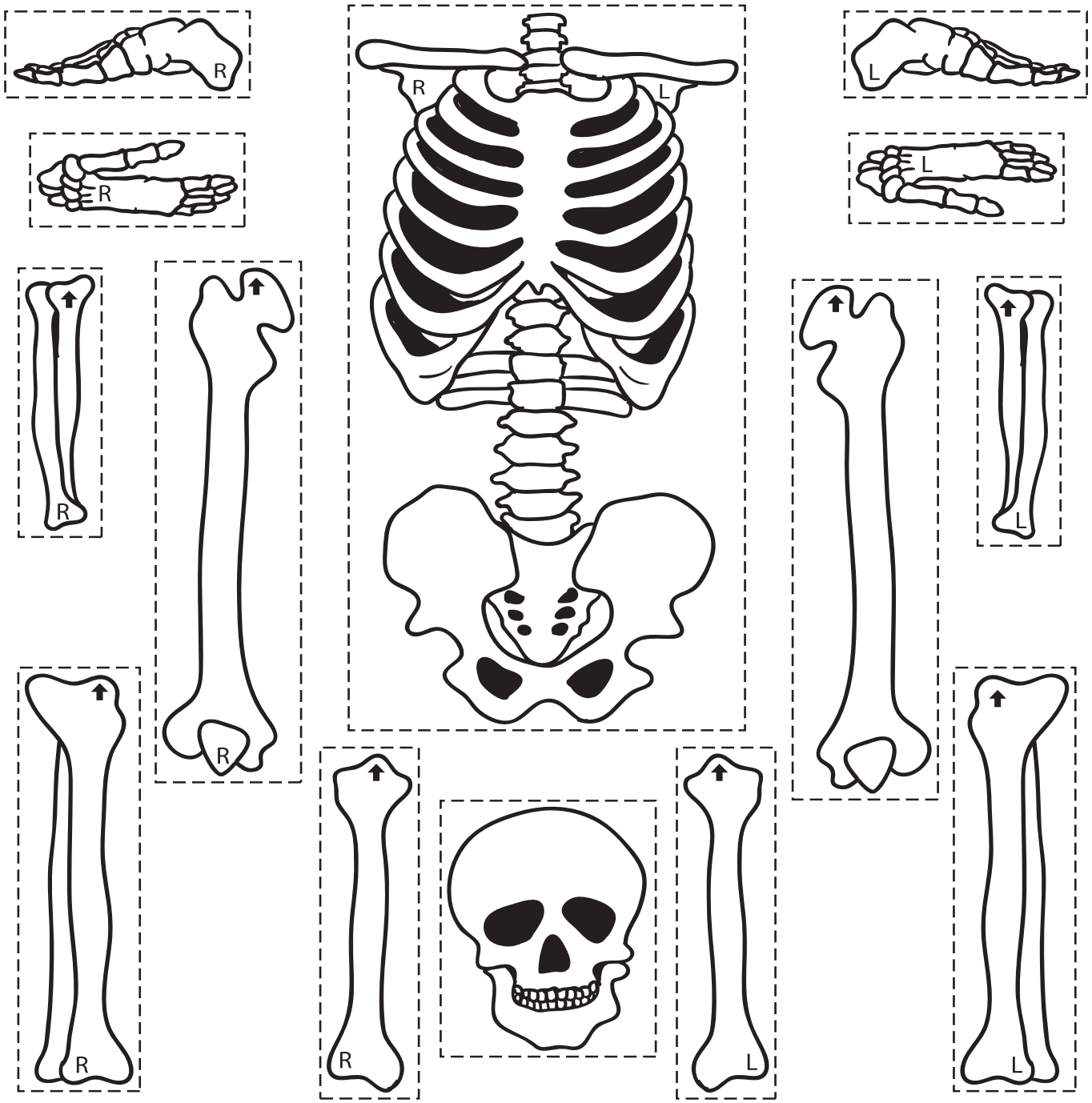
2.3 What I eat

	Dinner / Packed lunch
Monday	
Tuesday	
Wednesday	
Thursday	
Friday	

2.4 Build a skeleton

Cut out these bone pieces and use them to build a skeleton.

Find out the names of the bones and label your skeleton.



3.1 Shiny or dull?

Shine a light on different surfaces. Can you see your face in them? Are the surfaces dull or shiny? Write your results in the table.

Surface	Dull or shiny?	Is light from a torch reflected?	Can I see my face in it?
Mirror			
Polished metal sheet			
Sheet of Perspex			
Sheet of paper			
Piece of polished wood			
Shiny painted surface			
Dull painted surface			

What do the results tell you?

3.2 Reflections

What do reflections in different mirrors look like?

Look at your reflection in different mirrors. Write what the reflection looks like.

Type of mirror	What the reflection looks like

3.3 My mirror maze

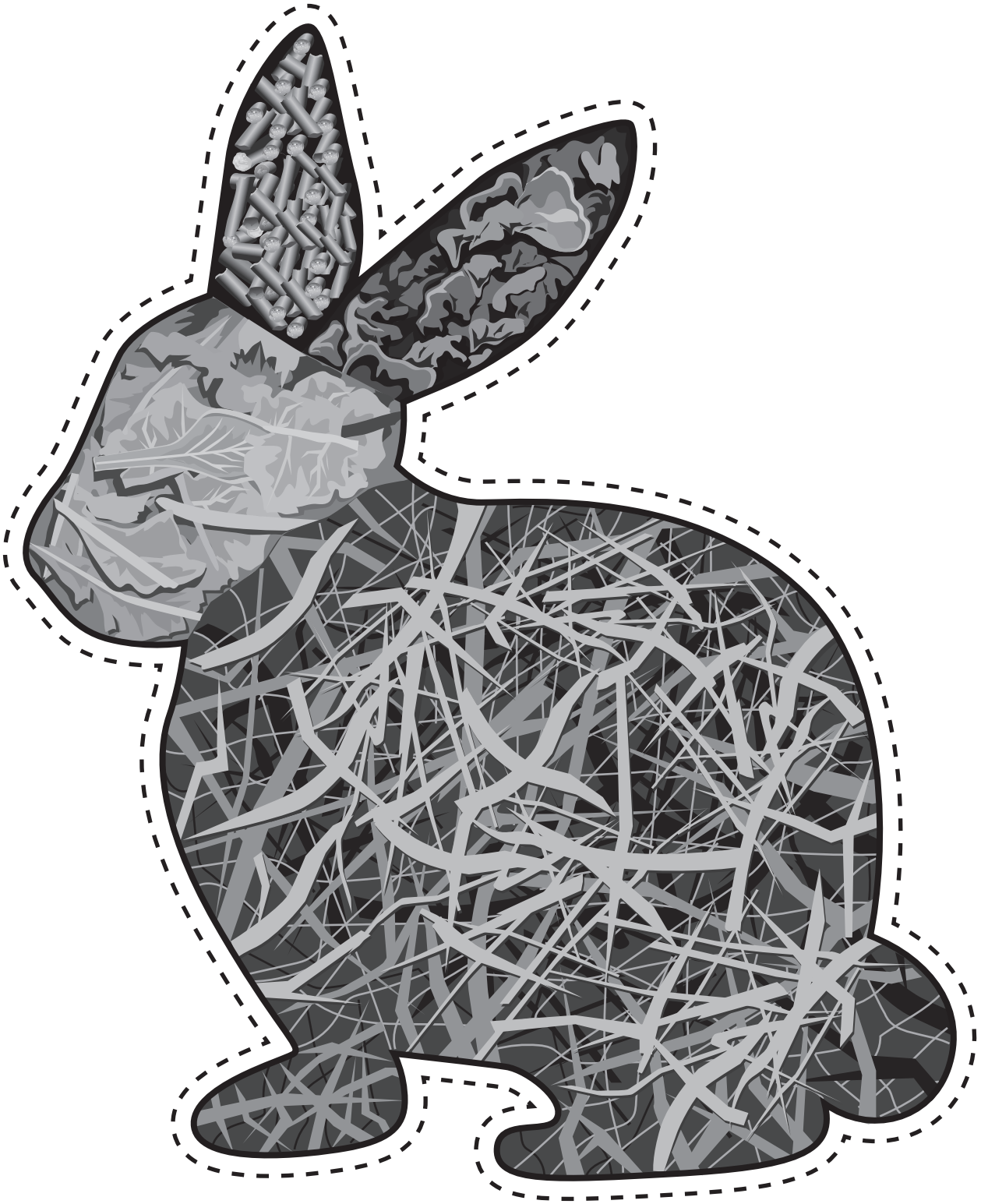
Make a mirror maze. Draw it in the box below and show how the light travels

3.4 How dark are the shadows?

Hold a material between a torch and a screen. Record how dark the shadow is in the table.

Name of material	Is it opaque, translucent or transparent?	What the shadow looks like

3.5 Black Rabbit



4.1 Plant parts

Label the parts of the plant. For each part say what job it does.

Name:
Job:

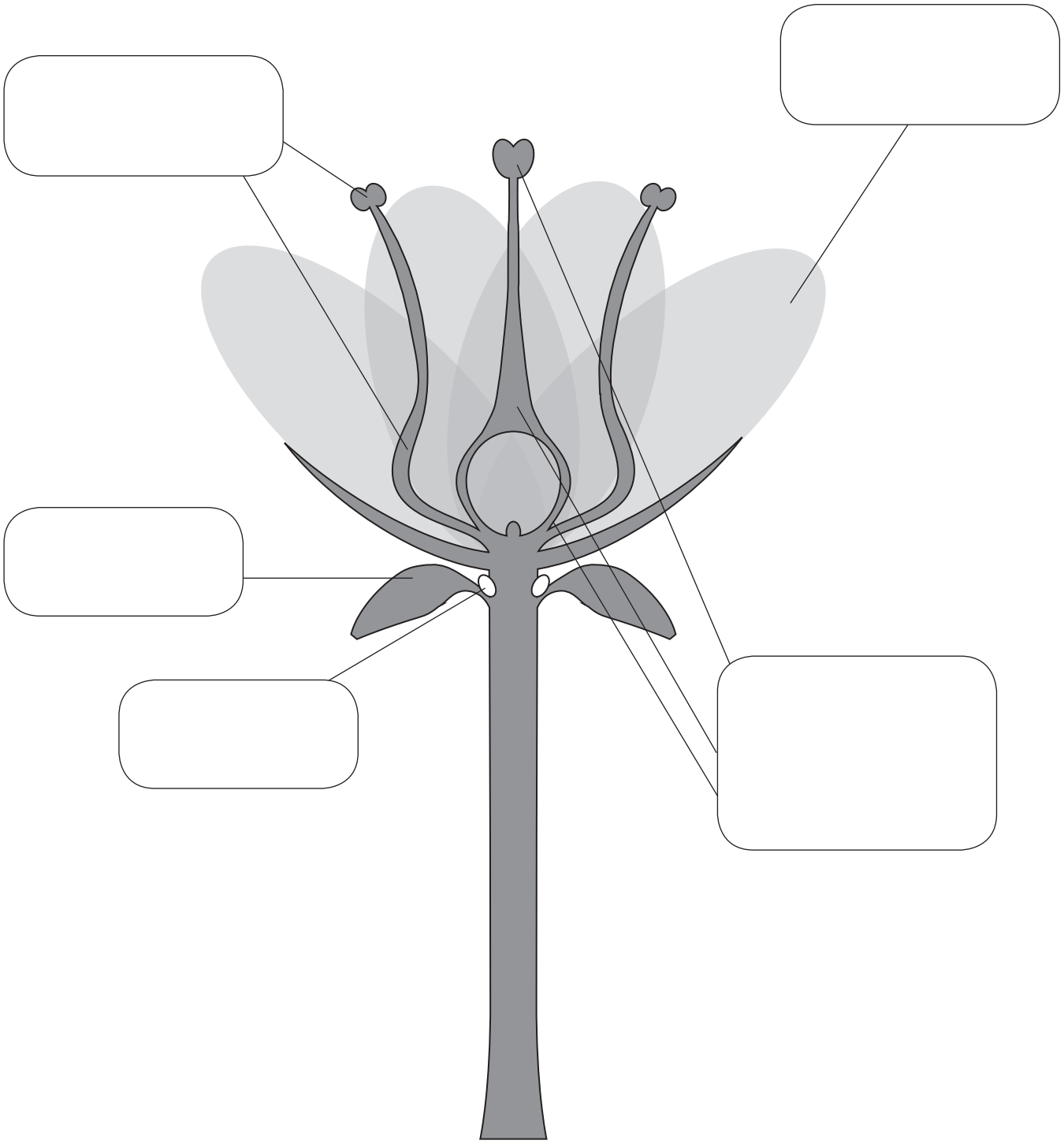
Name:
Job:

Name:
Job:

Name:
Job:

4.2 Flower power

Label the parts of the flower.



4.3 Types of seed

Type of seed:	Draw a picture of the seed:	How do you think this seed is spread?
Type of seed:	Draw a picture of the seed:	How do you think this seed is spread?
Type of seed:	Draw a picture of the seed:	How do you think this seed is spread?
Type of seed:	Draw a picture of the seed:	How do you think this seed is spread?
Type of seed:	Draw a picture of the seed:	How do you think this seed is spread?
Type of seed:	Draw a picture of the seed:	How do you think this seed is spread?

5.1 My investigation plan

I want to find out:

The equipment I will need is:

Variables – What could we change?
We could change:

We are only going to change:

Fair test – What will we keep the same?
We will keep…

Method – What did we do?
Firstly we…

Then we…

5.1 My investigation plan

Measure – How are we going to record our results?

We could record our results by using:

diagrams bar charts drawings tables tally sheets writing lists pictograms

Prediction – What do you predict will happen?

I predict that…

My results –

Conclusion –

I think this has happened because…

5.2 Bringing magnets together

Take some different magnets. Bring them together in different ways and record what you see happening in the table.

Draw how the magnets are arranged	Describe what happens

What do you think is happening?

5.3 The magnetic rule

Label the poles of a bar magnet. Suspend it from a thread. Bring another bar magnet close and record what happens. Try to do it in different ways. Come up with a rule which the magnets follow.

Before you do this, make a prediction.

I predict that . . .

What I observed:

My drawing of how the magnets came together	What I observed

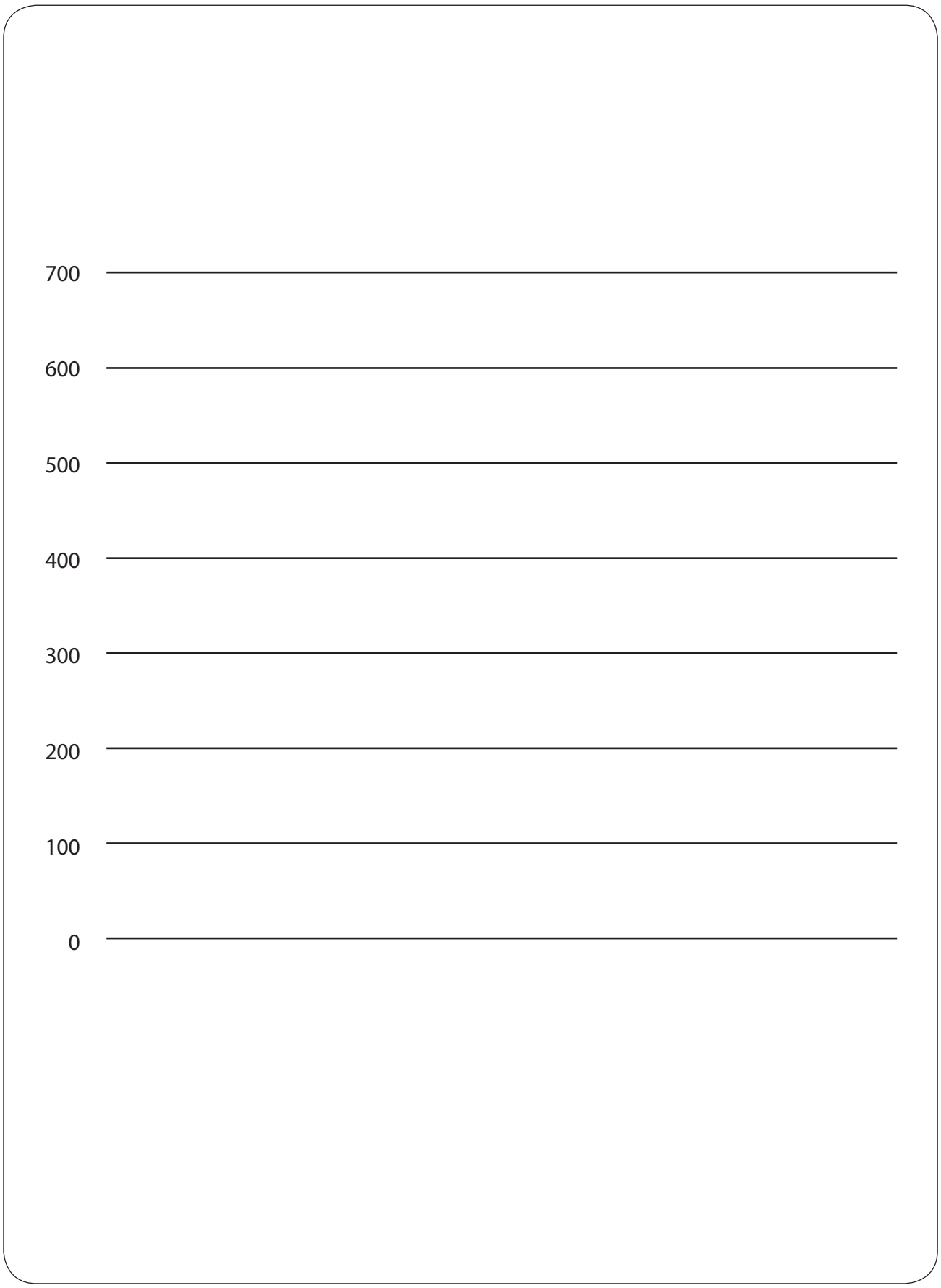
The rule I came up with is:

5.4 Everyday magnets

Complete the table by listing everyday uses of magnets and saying what property makes it useful.

Where do you find the magnet?	What property makes it useful?

6.1 Graph



6.2 Disposable nappy facts

You can throw disposable nappies away so there is no mess or smells.	Disposable nappies can absorb more urine than towelling nappies.
Disposable nappies do not use electricity because they do not have to be washed.	Babies will wear about 5,000 nappies. All of these go into a bin and then into landfill.
Towelling nappies can be used for other things, e.g. changing mat.	If you use towelling nappies, you won't have stinky nappies in your bin.
The poo in towelling nappies needs to be scrubbed before they are washed.	Disposable nappies are light and easy to carry.
Towelling nappies are cheaper because they can be washed and reused lots of times.	Towelling nappies are made from natural materials that are better for a baby's skin.