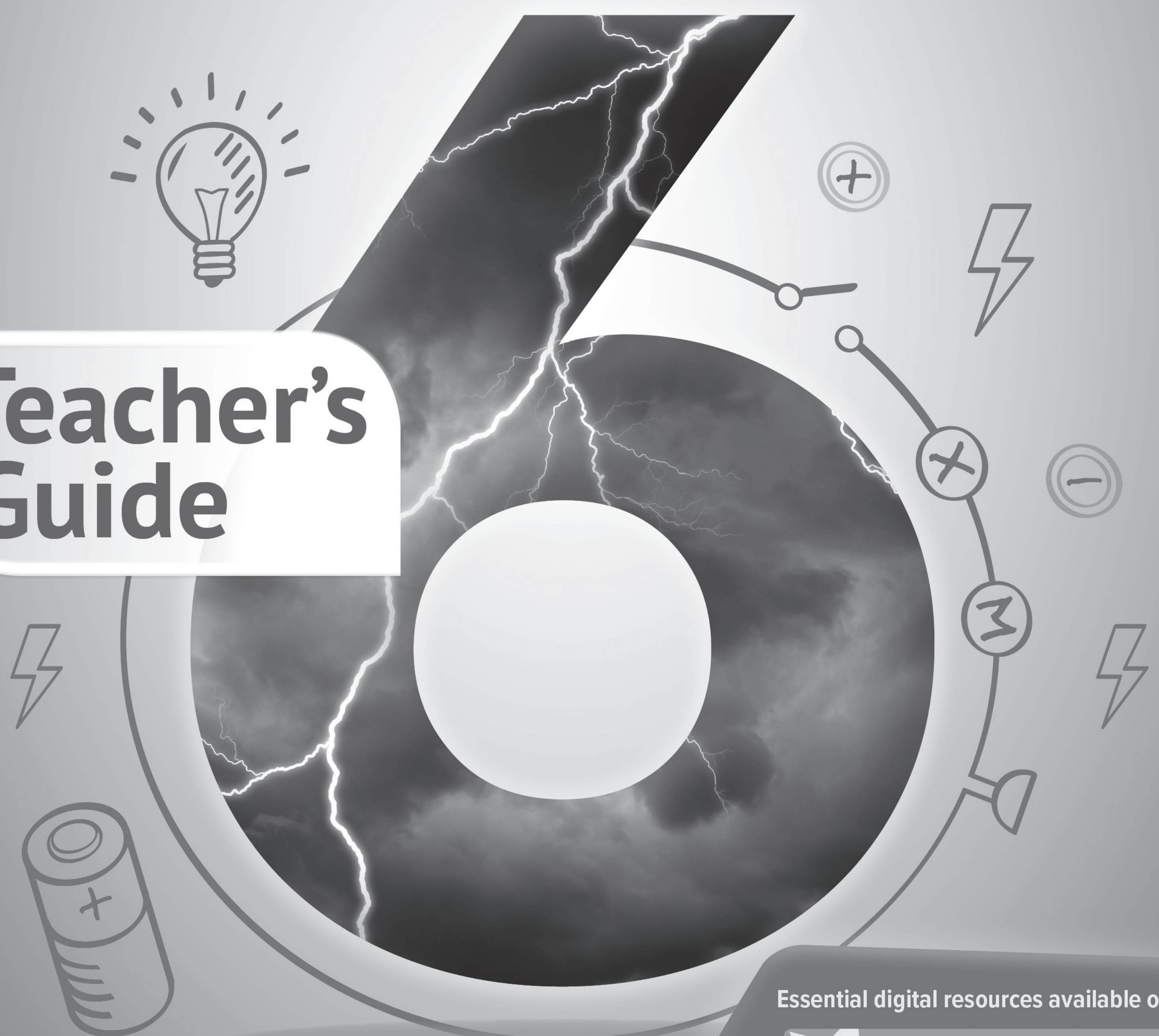
RISING STARS

SWITCHED ON Science

Second Edition



Teacher's Guide

Essential digital resources available on

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Contents

How to use Switched on Science, Second edition

HOW THE YEAR 6 TOPICS FIT WITH THE NATIONAL CURRICULUM

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, to ensure retention.

WHAT IS INCLUDED IN THE PRINTED AND ONLINE RESOURCES?

Teacher's Guide structure

Each Teacher's Guide contains six topics covering the primary science programme of study and more. The first five topics, designed to each last 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.

Topic overview pages

At the beginning of each topic, learning outcomes for Working scientifically are listed as well as the Subject knowledge concept statements. These are taken directly from the science programme of study. The topic overview section also offers cross-curricular opportunities, essential scientific vocabulary, health and safety guidance, big questions for research and discussion and, crucially, background subject knowledge for teachers. This enables non-specialist teachers to quickly up-skill themselves with the relevant scientific knowledge and language before beginning the lesson. Also listed here, are possible misconceptions that teachers may come across, as well as a run-down on what children should have learnt up to this point (so, reference to similar topics in lower year groups).

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 plus working scientifically where appropriate. At the end of each activity, guidance is given for assessment purposes.

Activity resources

Scaffolds, diagrams, tables, timelines, etc. to accompany the activities can be found at the back of the Teacher's Guide. They are photocopiable, and can be downloaded (and edited) as word documents from our online platform (accessed online via *My Rising Stars*). Teachers do not have to create their own resources (unless they wish to) and all are available as editable files.

Teaching PowerPoints

After listening to feedback from teachers who were creating their own PowerPoints to teach the topics in the first edition of *Switched on Science,* the second edition now contains a teaching PowerPoint for each topic. This gives teachers a front-of class resource which compliments the activities.

Pupil videos

Every year group has pupil-facing science videos (accessed online via *My Rising Stars*). There is one pupil video per unit which are clearly referenced throughout the book.

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CPD (Continuing Professional Development) videos

Switched on Science, Second Edition has CPD videos (accessed online via *My Rising Stars*). There is one CPD video per unit. They are designed for teachers and additional staff members to 'brush up' on subject knowledge before beginning a topic. Many of them show a practical example of an activity in the unit. The CPD videos are referenced clearly in the 'About this topic' panel at the start of each new topic.

Editable medium term planning

You will find all teaching notes, editable activity resource sheets and six stimulating interactive activities, covering all topics on the *My Rising Stars* website. There are also half-termly editable plans. 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 into *My Rising Stars*, where you can access all online resources for *Switched on Science, Second Edition.*

Assessment and progression

Switched on Science, Second Edition, has been written so that the activities in each year group show progression from one year to the next and from topic to topic.

Support for assessment is linked to every activity across all year groups. Each activity begins with an indication of the learning objectives for that activity. Where appropriate there is a learning objective (L.O.) for subject knowledge or working scientifically or both. Each activity is written to help the children meet these learning objectives.

At the end of each activity, there is a section which suggests how the teacher could assess children to find out whether they are at Emerging (Em.), Expected (Exp.), Exceeded (Exc.); some schools might use different terms. These are suggestions for what to look for when carrying out a formative assessment and will also help teachers when considering next steps for children, moving them from Emerging to Expected to Exceeding.

For those schools who want to use end-of-topic tests, these can be found online. They can be downloaded or photocopied and given to the children as required. *Switched on Science, Second Edition* year group packs cover Key Stage 1 and Key Stage 2, with content and working scientifically skills revisited and reinforced throughout.

TOPIC 1 Classifying living things

About this topic

Curriculum link: Year 6, Living things and their habitats

SUMMARY:

Children build on their learning about grouping living things in Year 4 by looking at the classification system in more detail. The topic is divided into two units, Children first revisit their knowledge of classification and creating keys, before developing their knowledge by looking at fungi and bacteria. Children also look at the work of Carl Linnaeus, the scientist who first made important the function of naming and classifying to 'identify' organisms.

UNITS:

1.1: Classifying animals and plants

1.2: Classification kingdoms

ACTIVITY RESOURCES:

1.1 Animal, vegetable or mineral?

1.2 Looking at leaves

1.3 Leaf record sheet

1.4 Carl Linnaeus cards

ONLINE RESOURCES:

Teaching slides (PowerPoints): Classifying living things

CPD video: Classifying living things

Pupil video: Classifying living things

Interactive activity: Classifying living things

Word mat: Classifying living things

Editable Planning: Classifying living things

Topic Test: Classifying living things

Learning objectives

This topic covers the following learning objectives:

- Describe how living things are classified into broad groups according to common observable characteristics and based on similarities and differences, including microorganisms, plants and animals
- Give reasons for classifying plants and animals based on specific characteristics.

Working scientifically

This topic develops the following working scientifically skills:

- Plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary.
- Take measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate.
- Record data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs.
- Use test results to make predictions to set up further comparative and fair tests.
- Report and present findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations.
- Identify scientific evidence that has been used to support or refute ideas or arguments.

CROSS-CURRICULAR LINKS

This topic offers the following cross-curricular opportunities:

English

- Derivation of words and build new names of groups and classification of objects from Latin or Greek meanings.
- Folk tales related to plants, stories behind plants e.g. Shepherd's Purse.
- Read Beatrix Potter stories and write in the same genre.
- Research, take notes, create a biography of Carl Linnaeus, Beatrix Potter.

Computing / ICT

- Use a branching database to use and make classification keys.
- Use digital microscope.
- Plan, script and record a public health video about microorganisms.

Design and technology

- Investigating yeast in baking.
- Design and make a microbe.

Geography

- Explore the range of flora and fauna in other countries and contrast with UK.

History

- Use of plants, e.g. in medicine.
- Preserving food through the ages, e.g. pickling, salting, smoking.
- Research Carl Linnaeus, Charles Darwin.

Art

- Observational drawings of plants and animals.
- Biological drawings, with Latin names.
- Look at work of Beatrix Potter as a mycologist (studying fungi).

Outdoor learning

- Explore the range of wildlife, plants and animals in the local environment.
- Use classification keys.

STEAM (SCIENCE TECHNOLOGY ENGINEERING ART AND MATHS) OPPORTUNITIES

Invite into class

- Biologist, botanist from a local university outreach group to work with children, help identify plants and animals and teach Latin names.
- Arrange for a STEM ambassador to work with the children.
- An artist to teach children how to do observational drawings.
- Local wildlife group to talk with children.

Visit

- Local wildlife reserve for children to work with staff.
- Local botanic gardens for children to work with staff.
- Local marine centre for children to work with staff.
- Local secondary school to use microscopes.

TEACHER SUBJECT KNOWLEDGE

Living things

Living things are divided into groups, with members of each group having similar features. The obvious first grouping is animal or a plant, (covered in Year 4). Animals can be divided into invertebrates and vertebrates (Year 4 Programme of study). In this topic we will consider the other three groups: fungus, monera (microbes) and single-celled organisms called protists.

Each time we divide up the living things by particular characteristics, the groups become smaller until we end up with the organism being 'identified'.

Animals

The animal kingdom can be divided into two broad groups based on whether they have a backbone (vertebrate) or not (invertebrate). Invertebrates range from totally soft-bodied animals such as sponges and jellyfish, shelled animals such as mussels and barnacles, to complex spiders and insects. Some invertebrates have an exoskeleton (*exo* = external or out), some have no hard structures at all. Invertebrates are subdivided into protozoa, annelids (worms), echinoderms (sea urchins), molluscs and arthropods (insects, crustaceans and arachnids).

Plants

The plant kingdom can also be divided into two groups, flowering and non-flowering plants. Flowering plants include sunflowers, roses and lilies, and non-flowering include mosses and ferns. There are some obvious differences between plants and animals. Plants are green and they can photosynthesise, whereas animals cannot. Photosynthesis is the process by which a plant uses the energy from the light of the sun to produce its own food. Organisms such as coral are often thought to be plants, when in fact they are animals, but this can only be seen at the cellular level.

Fungi

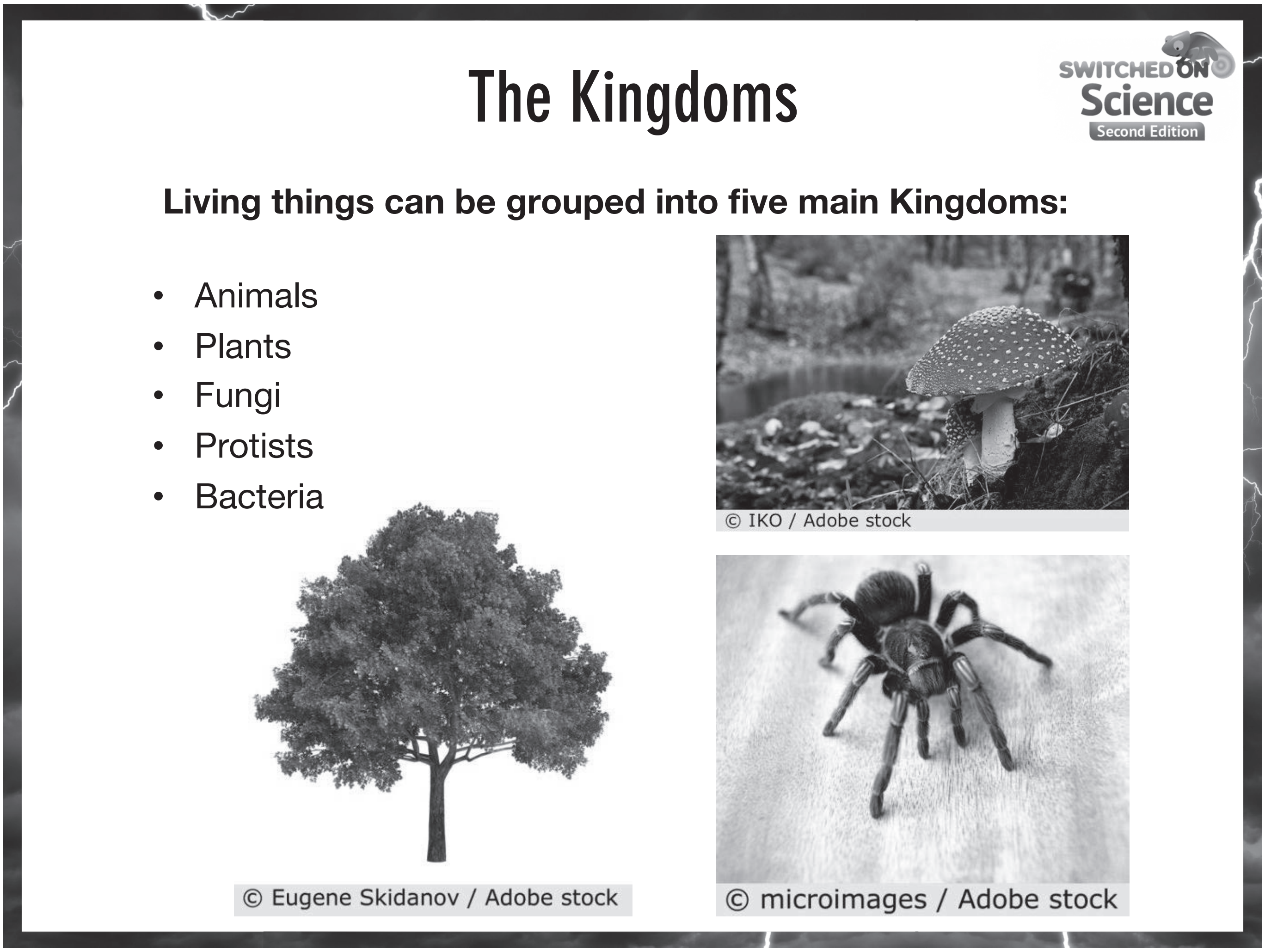
Many children think that fungi are plants, but they are in fact a separate kingdom. Many fungi play the role of decomposers, breaking down plant and animal material. Mushrooms and toadstools are the reproductive parts – they appear above ground to spread spores. Mushrooms forming a fairy ring are usually all part of the same single organism. The mould that grows on our food is also a type of fungus. Other single-celled fungi, such as yeast, ferment sugar and produce ethanol (alcohol) and carbon dioxide gas. They are very important in making bread, as the gas causes bubbles in the dough and makes the bread rise.

Prokaryotes, including bacteria

Prokaryotes are the group that bacteria (and blue-green algae) belong to. Bacteria are a large and diverse group of single-celled organisms without a nucleus. They are microscopic and found almost everywhere on Earth. They can live in extreme environments, from boiling hot springs to deep in the oceans and even grow on nuclear waste. They are found in the intestines of many animals, including humans, and aid digestion. Other bacteria can cause infectious diseases such as cholera, tuberculosis and bubonic plague. Bacterial infections can be treated by antibiotics.

Protoctists

These are single cells or groups of single cells, the most well-known are amoeba and slime moulds. They are all single-celled organisms that are not bacteria.



THE FIVE KINGDOMS IN LIVING THINGS

PLANTS

Multicellular.

Make their own food: Photosynthesis.

(Absorb CO_2 release O_2)

Oak, Rose, Cactus...

ANIMALS

Multicellular.

Feed on other living things. (camivores, herbivores)

Most of them Move.

Lizard, Snakes, Whale...

PROTISTS

Most are found in water.

Unicellular

Amoeba: *absorbs food through its cell membrane.*

Multicellular

Algae: *unicellular or multicellular. They make photosynthesis to create their own food.*

MONERA

Unicellular.

Bacteria found in water, air, land, etc. almost everywhere....

Used also to create food such as Yoghurt or cheese.

Ebola, flu...

FUNGI

Unicellular or multicellular.

They feed on the remains of other living things (dead animal bodies or dead plants)

Decomposers

Yeasts, mushrooms…

Carl Linnaeus and classifying organisms

Carl Linnaeus (1707–1787) invented the two-part naming system that is used to classify species of living thing. Linnaeus realised that new plants were being discovered and named, but nobody gave much thought to which family or group they might belong to, or resemble. He started to classify plants into 24 classes according to the number and position of their stamens and pistils. Although later botanical knowledge revealed that this system was inadequate, it did lay the foundation for the science of plant taxonomy.

CHILDREN'S MISCONCEPTIONS

Children may believe ...

- That there are only two groups of living things – animals and plants.
- That plants are green and 'traditionally plant-like'.
- That coral is a plant.
- That fungi aren't alive.
- That mushrooms and other fungi are plants.
- That microbes are always bad.
- That all animals move and have legs.

Children already know ...

- That there are ways to classify living things.
- That there are invertebrates and vertebrates.
- That two of the main groups of living things are animals and plants.
- Some of the features of animals and plants.
- That fungi and microbes exist.
- That 'germs' cause diseases.

SCIENTIFIC VOCABULARY: CLASSIFYING LIVING THINGS

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

amphibian: an animal with an internal skeleton that lives both in and out of water

bacteria: single-celled organisms, most of which can only be seen with a microscope

bird: an animal that can often fly and has an internal skeleton

fauna: living things that are animals

fermentation: a change brought about by ferment (e.g. yeast into alcohol)

fish: an animal with an internal skeleton that lives in water and has gills

flora: living things that are plants

fungi: taxonomic kingdom comprising all the fungus groups and sometimes also the slime moulds

genus: the group that an organism belongs to

insect: an animal with six legs

invertebrate: animal without a backbone

mammal: an animal that gives birth to live young

microbe: tiny single-celled bacteria

mushroom: any of various fleshy fungi including the toadstools, puffballs, coral fungi and morels

organisms: living things

reptile: are animals that are cold-blooded. Most reptiles lay eggs and their skin is covered with hard, dry scales

species: the sub-group within the genus that an organism belongs to

toadstool: any of various mushrooms having a stalk with an umbrella-like cap

vertebrate: animal with a backbone

1.1 Classifying animals and plants

GET STARTED

Remind children that the topic is classification, something that they have done before e.g. classifying materials, animals and plants in Year 4. The video 'Classifying animals and plants' gives a good introduction to animal classification. You can also use PowerPoint slides 1–5.

Give the children a selection of sweets – liquorice allsorts or dolly mixtures are great for this – and ask them to sort them in as many ways as they can and to make a list of their categories, e.g. shape, colour, layers. First group to get to seven shouts 'seven' and everyone stops, that group shares their categories.

LET'S THINK LIKE SCIENTISTS

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

- You have found a plant that you don't recognise. What could you do to try to name it?
- Are trees plants? How can you tell?
- What about a Venus fly trap: is it animal or a plant? What features tell you? What makes it unusual?

ACTIVITIES

1 QUICK CLASSIFICATIONS

L.O. Give reasons for classifying plants and animals based on specific characteristics.

- The aim of this set of activities is to revise and practise making a range of classification keys to check that children remember how, and are confident in constructing them. Limit the number of items so that these are short activities in different contexts. For each key make sure that children can give reasons for the way that they have classified items. Following the starting point, the next activity is to revise how to create a simple classification key. For this children could use lolly sticks or use dry-wipe pens on their table.
- The first classification is to use their liquorice allsorts and sort them / classify them by creating a classification key which will then be used by another group to check that it works. Use PowerPoint slides 6 and 7.
- Ask the children to work in small groups and collect eight items from around the classroom and to create a classification key for those items. Explain that they should use scientific language, so as a class, make a list of e.g. properties of materials *rigid, flexible, transparent, opaque, solid, liquid, gas*. Remind them that they should use questions to structure their classification, and take part in peer assessing each other's classification key, offering suggestions and good points. It is important that children know the answer has to be yes or no. You could play a yes/no question game first.

YOU WILL NEED

- Liquorice allsorts
- Lollipop sticks
- Dry-wipe pens and rubbers
- Chalk
- Activity Resource 1.1
- PowerPoint Slides 6 and 7
- Interactive activity
- Video: Classifying living things

ASSESSMENT

Subject Knowledge

- Em. Children sort into common categories e.g. colour, shape.
- Exp. Children create classification keys and can say how they sorted items.
- Exc. Children discuss alternative ways of classifying objects.

- Children use the picture cards on Activity Resource 1.1 to create their own classification key. To add a different dimension, use a timer or piece of music to challenge children to complete their identification key within a specific time. You could use other sets such as plastic invertebrates, shells or other items you may have available.
- Next take children outdoors and ask them to collect eight ‘interesting or unusual’ things (discuss safety with children) for them to create a classification key using twigs or chalk as lines on the school playground. Once again, children peer assess, chalking a speech bubble comments on the playground, or go into the hall and use hoops and masking tape.
- Children could play the Interactive activity to sort animals into groups e.g. mammals, birds. Use the Classifying critters video to emphasis the usefulness of classification.

2 CLASSIFYING THE LOCAL ENVIRONMENT

L.O. Describe how living things are classified into broad groups according to common observable characteristics and based on similarities and differences, including microorganisms, plants and animals.

Give reasons for classifying plants and animals based on specific characteristics.

- Explain to the class that they are going to make a set of identification cards to help children in Year 4 classify and identify plants and animals in the school grounds or local environment. Ask them to discuss what they think the cards should be like so that the Year 4 children will find them easy to use.
- Explain to the class that they are going to be split into groups of four and that each group will be allocated an area in the school grounds or local environment, e.g. grass area, hedgerow, group of different trees, wall with living things on, flower bed, vegetable patch. They are going to make a key to classify invertebrates or plants in that area, whichever they think they find enough of to make a key for about six plants or animals. Their keys will then be given to Year 4 for them to find the area and use the key to identify what lives there.
- Children should observe the living things carefully and start to decide if there are any that can go into groups together. They could collect invertebrates, leaves, etc. and use hand lenses to discover observable differences. The children might find Activity Resources 1.2 and 1.3 helpful. Encourage children to look at the form of leaves, e.g. simple leaves, compound leaves (made up of smaller leaflets), palmate (looks like the palm of a hand), serrated edges, veins. They could take photographs of these living things, including the plants to be used in the key later. They should return the living things to their habitats; do discuss why this is important. Of course children will need to use keys or identification books themselves if they do not know the name of some plants or invertebrates.

YOU WILL NEED

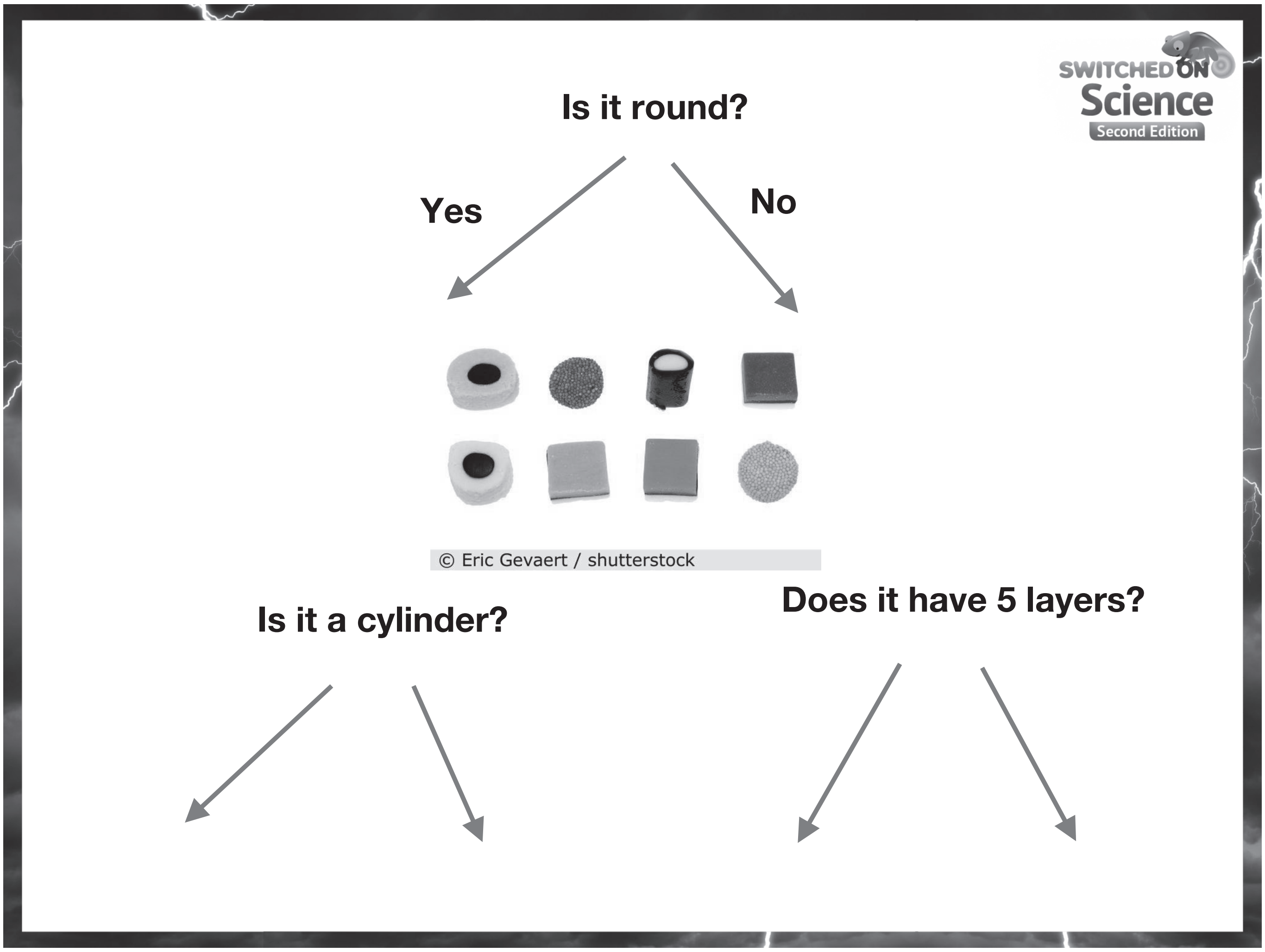
- Collecting trays
- Identification keys and books
- Hand lenses and magnifiers
- Activity Resources 1.2 and 1.3
- Cameras

ASSESSMENT

Subject Knowledge

- Em. Children collect and sort according to observable features and, with help, create a key.
- Exp. Children use identifiable features to create classification keys. They also use keys if they do not know the name of the plant or invertebrate.
- Exc. Children discuss alternative ways of classifying the plants or invertebrates. They are more likely to use scientific terminology to classify, e.g. antennae, segments, veins.

- Discuss with the groups what features they used to collate their invertebrates and plants. Each group produces a branching key of their living things.
- Back in class the children should prepare their keys and provide some notes on how to use the key. Prior to finalising their work make sure that Year 6 children peer assess and ‘sign off’ the work of another group.
- If possible Year 6 children could work alongside Year 4 children to help them use the keys they have produced. Children could draw the keys or create the keys using a computer programme and then print out. If appropriate the keys could be laminated and form part of the resources for Year 4.



1.2 Classification kingdoms

GET STARTED

Ask the children to collect ten things from around the classroom and put them in the middle of their table. Then tell them to take it in turns to ask another member of the group to pass them one of the objects, but they must not use the name of the object. For example:

'Please pass me the thing that I use to write with.'

The point of this is to explore why we need names for things.

LET'S THINK LIKE SCIENTISTS

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

- Why is bacteria sometimes good and sometimes bad?
- If you leave bread out, why does it get mould on it?
- What is mould?
- What has yeast in it and how does it work?
- Why do people pickle food?

ACTIVITIES

1 CARL LINNAEUS

L.O. Describe how living things are classified into broad groups according to common observable characteristics and based on similarities and differences, including microorganisms, plants and animals.

Give reasons for classifying plants and animals based on specific characteristics.

Identify scientific evidence that has been used to support or refute ideas or arguments.

- Discuss what the world would be like if we didn't have names for objects. It would take us much longer to ask for something like a drink or cake. (The Get Started activity will help). Explain the importance of Carl Linnaeus (show children slides 8–12) whose work people have been using for hundreds of years to help them classify and name plants and animals. Use Activity Resource 1.4 with children. Before the activity begins explain to children that they are going to have to remember information and to think about what helps them remember things, e.g. key words, making a picture in their mind.
- For this activity the children are working in groups, where all children work individually and then return to their group to share information they have gathered.
- Each person is given a card with a piece of information on about Linnaeus (see Activity Resource 1.4).
- They read the card and have to remember what the card is about.
- They then swap their card for someone else's, read it and remember the contents.

YOU WILL NEED

- Activity resources 1.4
- PowerPoint slide 8–12
- Video and posters on Linnaeus (see Useful Websites list) on *My Rising Stars*

ASSESSMENT

Subject Knowledge

- Em. Children can say that animals and plants can be sorted into groups, e.g. birds, reptiles.
- Exp. Children can describe how living things can be organised and suggest why this is useful.
- Exc. Children are able to apply their knowledge of Linnaeus and explain the reasons why classification is useful.

Working Scientifically

- Em. Children know some things about Carl Linnaeus.
- Exp. Children know why Carl Linnaeus is important to classification.
- Exc. Children understand how the evidence of using Linnaeus's classification helped scientists.

- This happens about five times so that everyone in the class has around five key facts to remember.
- Then the children return to their group and, on a large piece of paper, they all write down facts about Linnaeus. They should talk with each other to help remember what they have learned.
- Children then visit each other's work and can add to a group's information and also take away information that they did not know about or forgot.
- Bring the class back together and ask questions to help children make sense of what they have learned e.g.:
  - How did Linnaeus's work help scientists who were arguing and could not decide the best way to classify living things?
  - What did Linnaeus develop?
  - How did he make naming things easier?
  - What is his work important and useful today?
  - How have we used the work of Linnaeus when we were in Year 4 and now in Year 6?
  - What are the Kingdoms and what do you know about each one?
- The video on Linnaeus (see Useful Websites list on *My Rising Stars*) will help reinforce key ideas about Linnaeus. You can also access posters and leaflets about this scientist.
- Remind children that thanks to the work that Linnaeus did we are now able to classify living things into five kingdoms: animals, plants, fungi and two other groups protista and monera. Tell them to write these down and, as a home / school activity, to find out about two living things that belong to each kingdom and bring the information back to class to share.

2 BACTERIA

L.O. Describe how living things are classified into broad groups according to common observable characteristics and based on similarities and differences, including microorganisms, plants and animals.

Give reasons for classifying plants and animals based on specific characteristics.

- Before the children come in to the classroom, put some glitter on your hands. As they come in, shake some children's hands and transfer some glitter onto their hands. Don't say why. Come back to this later.
- Show PowerPoint slides 8, 9, 10, 11, 12 to remind children of what they know about Linnaeus. Then use slides 13–15 and ask children what they found out from their home / school activity about the different kingdoms. In small groups, ask children to share what they found out and then get them to collect new information from the whole class.
- Ask children to discuss what they know about bacteria and which kingdom bacteria belong to and how they know. Bacteria are microbes which are very small living things, which you can only see if you use a microscope. Make links with Literacy and ask children what the prefix 'micro' means.

YOU WILL NEED

- Glitter
- PowerPoint slides 8–21

ASSESSMENT

Subject Knowledge

- Em. Children know that bacteria do not belong to the groups called animals and plants but cannot explain why.
- Exp. Children know living things are grouped into kingdoms and that bacteria are not animals or plants and belong to different kingdom.
- Exc. children can apply their knowledge of bacteria to everyday life e.g. where different bacteria can be helpful or harmful.

- Now ask children to look around, who has glitter on them and where can they see glitter. Explain that the glitter is modelling bacteria (a microbe), you have pretended that you had bacteria on you and shook hands with children, they passed it onto furniture etc. What did the children notice? What does this tell them about bacteria?
- Explain that bacteria are classified as tiny, single-celled microscopic organisms. Inside, they are quite different from plants, animals and fungi. They reproduce by splitting themselves into two, and those two bacteria then split themselves into two.
- You could use slide 16 and children could place their initials on the continuum, or create a chalk, string or masking tape continuum line on the floor. They should decide how much they agree or disagree with the statement ‘All bacteria are bad’ before standing on the continuum line and explaining their thinking at this present time. Take a photograph of where children are standing.
- Ask children to think about why bacteria are in a kingdom of their own and not with animals or plants? This activity could be used to find out what the children already know about bacteria.
- Show children slide 17, which gives information about the bacteria E.coli. Set a challenge: tell children that some bacteria, such as *E. coli* which causes food poisoning, double in number every 20 minutes. If one got inside you, how many would there be after three hours? What about 12 hours?
- With the children, read through PowerPoint slide 18 which provides additional information on bacteria and then show children slides 19, 20 and 21. Now return to the statement ‘All bacteria are bad’, and ask children to go back to the continuum and ask what they want to do, stay or move? Ask children to explain their decision.

3 FABULOUS FUNGI

L.O. Describe how living things are classified into broad groups according to common observable characteristics and based on similarities and differences, including microorganisms, plants and animals.

Plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary.

Report and present findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms, such as displays and other presentations

- Provide children with a range of mushrooms for them to cut up and practise observational drawing by sketching first a whole mushroom and then a half mushroom. Put a plant on the table and ask children to observe similarities and differences so that children see that the mushroom does not have leaves, it does have a stem, it is not green, it does not make its own food like a plant. Give children access to information so that they can label the parts of a mushroom. See PowerPoint slide 22 for questions to support this.

YOU WILL NEED

- PowerPoint slides 13–15, 22–24
- Range of foods created by fungi, e.g. bread, yoghurt, salami, cheeses
- Hand lenses
- Knives
- Chopping boards
- Mushrooms
- Clear sandwich bags
- Sticky labels
- Fresh bread (avoid long-life bread)

- Use slides 22, 23 and 24 to help explain to the children that mushrooms are neither plant nor animal. It is part of a completely different group called fungi. Fungi are not like plants; they cannot make their own food (they don't photosynthesise). Fungi do not make pollen like plants do; they reproduce by making spores. They are not green. Explain that the group of fungi can be further divided and that yeast and moulds are types of fungi. See slides 13 and 15 on kingdoms
- A good way to show how mushrooms reproduce by making spores is for children to be given another whole mushroom and to remove the stem and leave the mushroom gills downward on a piece of white paper or card overnight. When they take the mushroom off the paper they will be left with a pattern of how the spores have dropped from the mushroom gills.
- Ask children to create a 'Continuum Line' in their book like the one on slide 16 and ask them to decide whether they think fungi are good or bad and to write a sentence to explain their decision.
- As a home / school activity ask children to research the life cycle of fungi and draw a life cycle diagram to share with the rest of the class.
- Mould is in the same group as fungi, children may be more familiar with this, so ask children to share what they know about mould.
- Most children will know that some foods go mouldy and what this looks like. You could present each group with a piece of food, e.g. cheese or bread that has gone mouldy, and ask children to discuss with their classmates why food goes mouldy, what happens when food goes mouldy and where does the mould come from.
- Ask children to think about what they would like to test about mouldy food, tell them to use 'Which' and 'How does' questions stems:
- Which food goes mouldy the fastest?
  - Which is the best way to store bread to bread to stop it from going mouldy?
  - How does the temperature affect how quickly mould grows on food.
- This leads into children setting up and carrying out fair tests to answer their questions using a slice of bread and a sandwich bag. One way to start mould on bread is for children to press their hand down flat onto the slices of bread.
- Put one slice into a sandwich bag and label the bag with information e.g. the child's name, bread date it was placed into the bag and for example, whether it was placed in a freezer or temperature where it was left in the classroom. Children check the bags every couple of days and see how much mould has grown.
- Once their investigation or investigations are completed the children could create a 'Mouldy Bread Book'. Inside they could:
  - Explain why mould is part of the Fungi kingdom.
  - Explain how mould grows.
  - Say why mould can be dangerous.
  - Describe their fair tests.
  - Explain their results using any data.
  - Suggest how people stop food from going mouldy and why, e.g. pickling, salting, freezing, drying.

HEALTH AND SAFETY

Once sealed, the sandwich bags must never be re-opened. Mould spores can be dangerous and they are an irritant to asthmatics. Dispose of the finished bags carefully. Check ASE Be Safe! Or CLEAPSS for safety guidance.

www.ase.org.uk
www.cleapss.org.uk

ASSESSMENT

Subject Knowledge

- Em. Children can say that mould belongs to the group called fungi.
- Exp. Children can say that fungi is one of the Kingdoms used for classifying living things.
- Exc. Children at able to explain why fungi are not placed in other Kingdoms.

Working Scientifically

- Em. Children carry out a fair test with support and describe what they did and what happened.
- Exp. Children plan and carry out a fair test and use their results to draw conclusions.
- Exc. Children apply what they know about mould and are able to make causal relationships between what they did in their fair tests and their results.

TOPIC 2 Healthy bodies

About this topic

Curriculum link: Year 6, Animals, including humans

SUMMARY:

In this topic children build on learning from Years 3 and 4 about the main body parts and internal organs (skeletal, muscular and digestive system). It considers life processes that are internal to the body, such as the circulatory system. The impact of lifestyle on bodies, particularly of humans, is also considered. Scientists are continually finding out what is good and bad for us, and their ideas do change as more research is carried out.

UNITS:

2.1: Circulatory system
2.2: Exercise
2.3: Diet and lifestyle

ACTIVITY RESOURCES:

2.1 Is your heart in it?
2.2 Race against time
2.3 Out of puff
2.4 Reading the label
2.5 Deaths from smoking
2.6 Dangers of smoking
2.7 Milking it
2.8 Milking it

ONLINE RESOURCES:

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

Learning objectives

This topic covers the following learning objectives:

- Identify and name the main parts of the human circulatory system, and describe the functions of the heart, blood vessels and blood.
- Recognise the impact of diet, exercise, drugs and lifestyle on the way their bodies function.
- Describe the ways in which nutrients and water are transported within animals, including humans.

Working scientifically skills

This topic develops the following working scientifically skills:

- Plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary.
- Take measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate.
- Record data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs.
- Use test results to make predictions to set up further comparative and fair tests.
- Report and present findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations.
- Identifying scientific evidence that has been used to support or refute ideas or arguments.

CROSS-CURRICULAR LINKS

This topic offers the following cross-curricular opportunities:

English

- Research parts of the body. Pupils should plan to find out what information they need before using non-fiction text.
- Ask questions to improve their understanding when using non-fiction.
- Use contents pages and indexes to locate information.
- Create a script for a role-play video, e.g. stop smoking advert.
- Research Christiaan Barnard and first heart transplants.
- Participate in for and against arguments for making organ donation compulsory.
- Draft and redraft a story or poem on the journey of blood around the circulatory system.
- The children write a letter as part of their work on changes in opinions about health and lifestyle over the years.

Numeracy and mathematics

- Bar graphs.
- Measuring capacity and time.
- Calculating difference.
- Calculate bpm (beats per minute) – take pulse for 15 seconds multiply by four.

Computing / ICT

- Use the Internet to research information.
- Use digital pulse meters.
- Create an infographic, e.g. statistics about heart disease.
- Create a podcast on the circulatory system, interview a nurse or doctor on keeping the heart healthy.
- Use tablets, digital video cameras or audio recorders to create a healthy living advert.
- Use tablets to create a dangers of smoking video.
- Plan and create an exercise video for the class, or a healthy eating food programme with the children as TV chefs demonstrating a healthy meal.
- Research the effects of smoking and drinking.
- Spreadsheets could be used to analyse smoking data.

Design and technology

- Design and make a model heart.
- Create a circulatory system board game.

Drama

- Role-play the circulatory system.
- Script and present a short play about saying ‘no’ to alcohol and cigarettes.

Art

- Look at microscope pictures of blood cells and platelets and then create collages, patterns and prints from observations.

PSHE

- Discuss the dangers of drugs and alcohol abuse.
- Role-play persuading a friend not to smoke.
- Discuss the wider issues of being healthy, e.g. feeling safe, having friends, not being bullied.

STEAM (SCIENCE TECHNOLOGY ENGINEERING ART AND MATHS) OPPORTUNITIES

Invite into class

- Year 7 science teacher to show children anatomical model of body systems including the heart.
- Year 7 science teacher to work alongside class to collect and graph data.
- A parent or someone from the school community who stopped smoking, to discuss the effect on their health and lifestyle.

Visit

- A local secondary school to dissect a heart.
- A local pharmacist to learn about the safe use of medicines and what is available to help people stop smoking.

HEALTH AND SAFETY

When children carry out exercise in activities ensure children do this safely and do not over exert themselves.

SUBJECT KNOWLEDGE

Circulatory system

The circulatory system is made up of the heart, the lungs, blood and the vessels it travels through. Its function is to transport nutrients, gases and wastes between the cells of the body and the digestive system, respiratory system and excretory system. It also carries hormones for internal communication and co-ordination, and white blood cells for fighting disease, as well as assisting in maintaining body temperature.

The heart is a huge muscle that never appears to rest. In fact it does rest – between each heart beat! It beats rhythmically, contracting two sets of chambers to act as a double pump to move blood around the body. It is about the size of a closed fist, and is protected by the ribs.

The arteries carry blood away from the heart while veins return blood to it, the veins have valves that only allow the blood to travel one-way so that the blood keeps moving in the correct direction.

One misconception the children may have is that the arteries carry only oxygenated blood, when in fact they carry some de-oxygenated blood too. It is more appropriate to talk about how the air we breathe in has oxygen in it, while the air we breathe out has less oxygen and more carbon dioxide.

The right side of the heart pumps deoxygenated ('used') blood through the pulmonary circuit to the lungs, where it picks up oxygen and where carbon dioxide is released. The blood is then returned to the left side of the heart, which is sufficiently muscular and powerful to pump the blood through the systemic circuit to all tissues of the body, including the kidneys for waste removal, and the liver for blood sugar regulation.

Blood

Blood is made of a watery yellow fluid called plasma that carries dissolved nutrients, hormones and proteins. It contains red blood cells, which carry gases around the body and make the blood appear red. It also carries white blood cells, which fight against disease. The blood also contains platelets, which form the scabs we get on a cut as part of the healing process.

Exercise and diet

Exercise has many effects on the body. During exercise the heart rate and breathing rate increase to provide more oxygen to the muscles and to remove carbon dioxide quicker. Regular exercise can lead to stronger muscles and bones. The heart will become stronger with a reduced risk of heart disease. There is also an increase in lung capacity.

To provide the energy for exercise, the body breaks down fats and sugars stored in the body. Regular exercise, along with a balanced diet, can prevent obesity.

Exercise also has effects on mental health and mood. It releases endorphins which makes humans feel happier and more calm.

During recent years there has been more focus on obesity in Britain with people getting bigger and less healthy. This has an effect on the NHS as it impacts on the nation's health. It is important that children are educated about the importance of health and diet to their lives.

John Boyd Orr was born in Ayrshire, Scotland in 1880, the middle child of a family of seven. He was a medic in the trenches during World War I and witnessed how the poor diet and conditions led to the poor health of the soldiers he served with. After the war he set up the Rowett Research Institute. He was the first scientist to show that there was a link between poverty, poor diet and ill health. James Lind conducted one of the first ever clinical trials based on the theory that citrus fruits cured scurvy.

Drugs

Smoking accounts for a quarter of all deaths by cancer in the UK. Cigarette smoke contains around 4000 different chemicals, including 70 that can cause cancer. It contains tar, which can damage the lungs and stain teeth and fingers as well as cause cancer. These can also damage the heart and blood vessels.

The smoke also contains poisons such as hydrogen cyanide and carbon monoxide. The nicotine in cigarettes is very addictive, and many people find it very hard to give up smoking.

These chemicals are contained in tiny doses, but accumulate in the body with every cigarette. The trend for using Vapes is not without issues for health, they still give a dose of nicotine and the vapor from e-cigarettes has chemicals in it that can be harmful to children. The liquid in e-smoking devices is also poisonous if drunk or if it comes into contact with the skin. Some children might believe that smoking fewer cigarettes means that they will not develop lung diseases or cancer. Research shows that smoking as little as one cigarette a day is bad for a person's health, making them nine times more likely to die from lung cancer as a non-smoker.

Alcohol is also a drug, but not one that many consider in the same light as smoking. However, it is just as addictive. Alcohol causes damage to organs in the body too, this time the liver. The liver breaks down the alcohol as part of its detoxification process. However, it also produces chemicals that aid digestion, and if the liver is damaged through excess alcohol then these chemicals cannot be made. Drinking too much can also affect your emotional state, as it can make you feel very happy or send you into depression as you feel panicky.

CHILDREN'S MISCONCEPTIONS

Children may believe…

- That blood only reaches some parts of the body.
- That the structure of the heart is how they imagine, e.g. romantic heart shaped.
- That the word diet means slimming and reduced calorie intake, rather than the idea that a person's diet is what they eat and drink.
- That you can't get addicted to alcohol.
- That just trying one cigarette is OK.
- The heart lies on the left side of the chest.

Children already know…

- That exercise is good for you from general learning and everyday life.
- That the heart pumps blood around the body.
- That smoking is bad for you.

SCIENTIFIC VOCABULARY: HEALTHY BODIES

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

addiction: an uncontrollable urge to do something as it makes you feel good

aorta: a major artery carrying blood from the heart to the rest of the body

artery: a blood vessel carrying blood away from the heart

atrium: chambers of the heart that receive blood from the veins

blood: the liquid that transports oxygen around the body

capillaries: tiny blood vessels between the end of the arteries and the start of the veins

carbon dioxide: gas released when humans and other living things breathe, or when materials are burned

circulatory system: system of organs and tissues, including the heart, arteries and veins, which circulate blood around the body

de-oxygenated: not containing oxygen

exercise: the activity of exerting your muscles in various ways to keep fit

heart: the organ that pumps blood around the body

lungs: the organ that gathers in air as part of breathing

nicotine: the addictive substance in cigarettes

oxygen: the gas in the air that is needed for respiration

oxygenated: enriched with oxygen

pulse: regular throbbing of the arteries, which can be felt at certain parts of the body such as the wrist

respiration: the process of breathing or taking in oxygen

vein: a blood vessel carrying blood back to the heart

ventricles: chambers of the heart from which blood is forced into the arteries

2.1 Circulatory System

GET STARTED

Show children PowerPoint Slide 6 and, working in groups, children create a body outline around one of their group and draw, label and annotate with information what they know about the human body, in particular the skeleton, muscles and digestive system. Alternatively, Activity Resource 2.1 could be used. If children know anything about other systems (e.g. respiratory and heart) then encourage them to include their ideas. This is a way of eliciting children's knowledge and help to remind them of what they already know. This outline should be saved so that children can compare it with a new outline and information at the end of this unit. Children could create organs out of dough and add them to their picture, providing an opportunity to find out what children know about the position of organs and their relative sizes.

LET'S THINK LIKE SCIENTISTS

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

- Do all animals have hearts?
- Does the heart ever get tired? Does it ever rest?
- What happens if you hold your breath?

ACTIVITIES

1 WHAT DO YOU WANT TO KNOW?

L.O. Identify and name the main parts of the human circulatory system, and describe the functions of the heart, blood vessels and blood.

Plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary.

Report and present findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations.

- In this activity the children research questions about the heart and circulatory system, before deciding how they present their findings to classmates. Children could work in pairs or small groups. Give groups the opportunity to share their questions before they begin, to inspire ideas.
- Show children PowerPoint Slides 7 and 8 which support preparation for research. This activity links literacy and scientific research skills by challenging the children to decide what they want to know prior to researching their answers. Tell children to use the question stems on Slide 8 and to make sure that they use each stem at least once, to ensure that they ask a wide range of questions. Additional questions could then be the basis for home science learning.
- Check children's questions to make sure that they link to information about the heart and circulatory system, supporting children to reconsider questions where appropriate and help focus on key areas

YOU WILL NEED

- PowerPoint Slides 7 and 8
- Large sheets of paper

ASSESSMENT

Working Scientifically

- Em. Children require support to decide how to tell others about what they have found out.
- Exp. Children are able to communicate their answers using scientific vocabulary,
- Exc. Children explain their answers linking different parts of the circulatory system.

Subject Knowledge

- Em. Children ask questions about the heart and, with support, find answers.
- Exp. Children ask a range of questions and use their research to communicate to an audience.
- Exc. Children use their research and make links between the heart, lungs and idea of a circulatory system.

of learning. Questions might lead to children carrying out research on the position of the heart, its function, parts of the heart, how it works or its links to lungs and other parts of the body.

- Allow pairs/group to decide how they will communicate their research, this could include, posters, fact files, leaflets, videos, models or a role-play. Challenge children to check that their research answers their questions. When children have completed their work, they should share it with other children for peer review. This will reinforce what they have found out as well as extend their knowledge.

2 WHAT DO YOU KNOW?

L.O. Identify and name the main parts of the human circulatory system, and describe the functions of the heart, blood vessels and blood.

- The aim of this session is to challenge children to remember and use the information about the heart and circulatory system gained in the previous research activity.
- Start the session with a game of 'Memory Maps' to recap what was learned in the previous research session. Display a diagram of the circulatory system. You can use slide 14 or your own. Divide the class into teams or groups. One child from each group comes up and has 1 minute to look at the image before returning to the group and drawing what they remember on their group's large piece of paper. The next child comes up from the group and looks, then goes back and adds any information not provided by the first person, and so on. Team members can discuss which bits they need to look at to improve their picture before they go up to look. At the end of the activity, give points for key information e.g. parts of the heart, lungs, names and functions.
- Staying in groups, ask the children to work through the questions below before sharing their answers with the class. Encourage other groups to add to the answer if they have additional information. This sharing of knowledge should create exemplar answers as well as expose any gaps. When sharing answers, use the corresponding PowerPoint slides to consolidate learning:
  - Where is the heart in the body and how big is it? (Slide 10)
  - Can they complete the labels for veins, arteries, heart, lungs and liver? (Slide 9)
  - What is the heart's function (job)? (Slide 11)
  - What do the arteries do? (Slide 12)
  - What do the veins do? (Slide 12)
  - What happens when the blood goes from the heart to the lungs and from the lungs back to the heart? (Slide 11, 13)
  - Why is it called the circulatory system? (Slide 14)
- To finish the session, use PowerPoint Slide 15 to teach the children how to find their pulse: firstly on their wrist and then on their neck. Children work out their heart rate by using the calculation on Slide 15. Ask children to calculate the average heartbeat of the children in their group. You could extend this by asking the children to do a calculation using larger numbers to find out the average heart rate for the whole class.

YOU WILL NEED

- PowerPoint Slides 9–15

ASSESSMENT

Subject Knowledge

- Em. Children know some things about the heart, but not as part of the circulatory system.
- Ext. Children are able to name parts of the circulatory system and describe the function of the heart.
- Exc. Children know the function of the circulatory system and how each part works in relation to the others.

2.2 Exercise

GET STARTED

Take children for a PE lesson either indoors or outdoors. Tell children that, as they are working, they should observe what is happening to their body, e.g. their heart and breathing rate quicken, sweating. Tell them to take and record their pulse rate before they begin an activity and at the end, making a note on a sticky note with their name on it. The aim is for children to compare their resting pulse rate prior to activity, immediately after the activity and then a period of time after the activity, when the pulse rate should have returned to normal. What do they notice? Use PowerPoint Slide 16 as focus for class discussion.

LET'S THINK LIKE SCIENTISTS

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

- What happens to people's organs when they don't exercise?
- Find out what is the least healthy country in the world. Why is that and how could they change it?

ACTIVITIES

1 CHANGES IN HEART AND BREATHING RATE

L.O. Recognise the impact of diet, exercise, drugs and lifestyle on the way their bodies function.

Plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary.

Take measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate.

Record data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs.

Use test results to make predictions to set up further comparative and fair tests.

Identify scientific evidence that has been used to support or refute ideas or arguments.

- Following the results of the PE lesson (see Get started), ask the children to think about how they could prove that exercise affects their heart rate. Tell the children that you believe that, as you exercise, your breathing rate increases, *but your heart rate stays the same.* You might want to write this sentence on the whiteboard so that they children can keep returning to it and you can mind map ideas around it together. Do they agree with you? Explain that the children have to prove you wrong or right and be scientific, as you want facts and figures to inform explanations of why.
- The children come up with ways in which they can disprove your theory that your heart rate doesn't increase when you

YOU WILL NEED

- Timers and digital pulse meters, if available
- PowerPoint Slides 17 and 18
- Activity Resource 2.2

ASSESSMENT

Subject Knowledge

- Em. Children can say that their heart beats faster when they run, jump etc.
- Exp. Children know that their heart rate increases with exercise.
- Exc. Children can make links between increased heart and breathing rate is because the body needs more oxygen.

Working Scientifically

- Em. Children carry out a comparative test and can say that their heart rate increases with exercise.
- Exp. Children carry out a fair test and base their conclusion on their data.
- Exc. Children use their data to show that the body requires additional oxygen during exercise so the heart need to work harder.

exercise. Children need to carry out their activity and produce results that can back up their ideas. They might repeat something like the starter activity where they measure heart rate and breathing rate before and after activity and create a table of results. They can then continue to take measurements at regular intervals after exercise to see what happens.

- Discuss together how the results could be improved e.g. repeating them. Discuss why this would be a useful idea. How will they make sure that their results are reliable? Do they need to rest between the exercises and have more than one person doing it and take the results from each person? This is an increase in sample size.
- Children should plan to carry out a fair test to answer this question. Make sure that they:
  - Control necessary variables, e.g. type of exercise, length of time.
  - Take accurate measurements, using digital pulse meters or taking and calculating beats per minute. Use PowerPoint Slide 17 to discuss the use of digital measurements.
  - Record data using a table.
  - Transfer data from a table to a bar or line graph (type of exercise and time = bar graph; before/after exercise at intervals, for continuous data = line graph).
  - Use their test results to make further predictions and set up new fair tests.
- Using their test results children should draw conclusions using the data they have collected to disprove your theory, for example:
  - 'The more exercise I did, the faster my heart beat. It started at *x* beats per minute and ended at *x* beats per minute. My breaths were *x* per minute and at the end were *x* per minute.'
- Make sure that, as part of their conclusion, the children use their subject knowledge to explain the science underpinning their results, for example, 'when we exercise our body needs more oxygen, so the heart has to work harder'. Use PowerPoint Slide 18 to support children applying their subject knowledge. Discuss whether your idea has changed and how their data has convinced you that you were wrong.
- At this point children should have linked increased exercise and the need for the heart to pump more oxygen around the body. Now ask children to ask and answer, through fair tests, new questions, for example,
  - How does the *type of activity* affect heart rate? (Activity Resource 2.2)
  - How does the *length of time* they do the activity for affect the heart rate?
  - Does *how tall someone* is affect heart rate?
- Ask them to present their results and their explanation of why pulse and breathing rate increase. This could be as a news reporter, talking to an expert, or as a series of photographs and captions.

2 LUNG CAPACITY

L.O. Take measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate

Report and present findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations.

Identify scientific evidence that has been used to support or refute ideas or arguments.

- Prior to this activity children measure around their chest and log the measurement. This can be used later to find out if there is a relationship between chest size and lung capacity. As a starter, ask the children to discuss what they think lung capacity means. They could use dictionaries or online resources to find out.
- Use Activity Resource 2.3, the experiment is best done outside. Clean the end of the tube with disinfectant wipes. Half fill a bucket with water. Fill a plastic bottle with water, then put on the lid. Hold it upside down in the bucket of water and remove the lid. Put the plastic tube inside the bottle, keeping hold of the other end. Take a very deep breath, put the tube in your mouth and blow as hard as you can until your lungs feel totally empty. Mark the side of the bottle where the water level now is. Show children PowerPoint Slide 19 which illustrates how this is set up, or hand out Activity Resource 2.3. Watch the CPD video ‘Healthy Bodies’ to see this investigation being done.
- The children then empty the bottle before using a measuring jug to fill the bottle with water just up to the line that they marked. Measure how much water it takes to fill the bottle to their line and produce a table and graph of this data – who has the biggest lung capacity? Why do you think this is? Is it what you expected?
- Get children to put their individual results onto a class database which includes chest measurements alongside lung capacity. Do children see generalisation in the pattern? (Not a perfect pattern but there is a pattern with some anomalies.)
- You might discuss together as a class whether having a bigger lung capacity would help you exercise more. Given previous subject knowledge learned about the circulatory system (that the body needs more oxygen when it exercises, which is why breathing rate increases along with the heart rate), the children might instinctively say yes. This is, in theory, true, however you would discuss how the overall fitness, lifestyle, activity, age, health and diet of the person, would also all have a bearing on the results.

HEALTH AND SAFETY

Be aware of children with asthma. Clean the mouthpiece of the tube with antiseptic wipes, then dry with a paper towel.

YOU WILL NEED

- PowerPoint Slides 19 and 20
- Display board
- Large bucket (per group)
- Large plastic drinks bottle – a 5-litre water bottle works best. If you can get enough for each group of children to have their own, they can measure their lung capacity afterwards.
- 50 cm plastic or rubber tubing
- Activity Resource 2.3
- CPD video ‘Healthy Bodies’

ASSESSMENT

Working Scientifically

- Em. Children describe the activity and what happened, they need support to use data.
- Exp. Children collect valid data, can say why they trust their data and use it to support their ideas about breathing and exercise.
- Exc. Children use their knowledge of the circulatory system to explain their data.

2.3 Diet and Lifestyle

GET STARTED

Ask the children what we mean by the word 'healthy'? What does it mean to them? What kind of choices do they make that help them to stay healthy. Working In groups, explain to children that they are going to discuss their ideas first and choose some words and phrases that summarise their discussions. They can write them as speech bubbles on a large sheet of paper.

Give children time to go around each of the tables and read what other groups have written. Discuss what the groups had in common along with any differences, and summarise on the whiteboard or a working wall display. Share the learning outcome with the children, explaining that in Year 6 they will learn to recognise the impact of diet, exercise, drugs and lifestyle on the way their bodies function. At this point you could use the Pupil video video 'Healthy Bodies' to aid discussion.

LET'S THINK LIKE SCIENTISTS

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

- How would you go about finding out if a food stuff had an impact on health?
- What are vitamins and minerals for? What happens if we don't have them?
- People say food is addictive – is this correct?

ACTIVITIES

1 DIET

L.O. Recognise the impact of diet, exercise, drugs and lifestyle on the way their bodies function.

- Tell the children that they are going to begin with diet; that is what they eat and drink. Give each group a selection of tins or packets of different food and drink and ask the children to classify them scientifically. Ask children what they think 'scientifically' means in this context. It means to sort them according to how they affect health. Therefore, sorting by food groups, calories, how much salt, whether they think they are good or bad for the body (not colour or shape). Tell them to keep how they have sorted them secret for now and have other groups try to work out what they are classified by. Discuss the different ways the groups classified them and how effective it is.
- Use PowerPoint Slide 21 to help explain how food labelling works and what information is given. Many packets now use colour coding to show nutritional values, so it's worth looking at this with the children also. The example on the slide is of a tin of baked beans, which is high in salt and sugar. It's there to help people make choices of how much to eat of the food and to think about what other food is high in for example, sugar and salt. A good idea is to show children how much sugar or salt the quantity is, is by pouring it out or weighing it out or counting teaspoons, e.g. 'How many teaspoons of sugar in one portion of baked beans?'
- Tell children that they are going to look at the labels on some of the foods on their table and use the information to complete Activity Resource 2.4.
- Bring the class back together and ask them what they have learned about food and diet? How can they help themselves to make some better food choices in future?

YOU WILL NEED

- Activity Resource 2.4
- PowerPoint Slide 21
- 6–8 packaged food items with readable nutrition labels and colour coding.

ASSESSMENT

Subject Knowledge

- Em. Children sort foods but they need help to use personal science knowledge, e.g. food type, calories.
- Exp. Children can describe how food label information can help them make choices.
- Exc. Children make links between the idea of reading food labels and balancing their diet through more informed choices.

2 WHAT IS A DRUG?

L.O. Recognise the impact of diet, exercise, drugs and lifestyle on the way their bodies function.

- Ask children to discuss and write down a definition for the word 'drug' and share their ideas. Encourage children to consider alternative definitions and whether or not they agree. Then tell them to check their definition with the one in their dictionary. What are the similarities and differences between them?
- Explain to the children that the purpose of this activity is to create a presentation to share with the school about drugs. It might be presented at assembly, to another class or simply within the class.
- Give each group a range of packets and containers. Make sure that they are all empty. Include for example: cigarette packet(s), e-cigarette packets, coffee jar, tea packet, cola can, medicinal drug containers (e.g. children's over-the-counter medicine, paracetamol), alcoholic drink bottles or cans. Ask children to think about their definition and to decide which of the items are drugs. Some schools send a letter or use the school website or blog to inform parents about the content of healthy living sessions so that they are aware of the areas that children will be learning about.
- When they have finished, explain to children that all the items on the table are drugs and that the word 'drug' means any chemical that has an effect on the body, including caffeine and alcohol. Discuss the idea that the items on the table are all drugs, but some of them are medicines too. Help children to differentiate between the two. Children may be surprised that cola, coffee and tea are considered as drugs, but their research will help them to understand why.
- Discuss the purpose of the activity again: To create a presentation to inform their peers about drugs. Talk together about what features and language they will have in their presentation. Allow them to think creatively in groups about how they might represent their findings. Give them a six-slide limit (if they choose PPT). Some children might want to create a short video or slide show of photographs.
- Give children time to research what effects the following drugs have on the body: tea, coffee, cola, alcohol and cigarettes and, as a group to collect around four pieces of information about each, which shows their effects on the body. Discuss with children how they will record this information. Emphasise that they should think about how to organise themselves as a group so that this task is carried out within a given timescale.
- Bring the class together to share information and discuss how what they now know can help them make informed choices. Remind them of the previous activity where they learned that reading food labels helps them to make better choices. Ask them to think how what they have found out helps them make better choices.
- Encourage them to use photographs of the items on the table and to consider what information should be on which slide. Make sure that they help others to understand the difference between drugs and medicines and how the drugs (including medicines) affect the body and a person's health.

YOU WILL NEED

- Range of packets and containers for different drugs as described in activity notes
- Computers

ASSESSMENT

Subject Knowledge

- Em. Children know that there are drugs and medicines but required help to differentiate the two.
- Exp. Children know the difference between drugs and medicines and know that drugs affect how the body works.
- Exc. Children make a link between developing their understanding of medicines and drugs and how this can help them to make choices.

3 CIGARETTES AND ALCOHOL

L.O. Recognise the impact of diet, exercise, drugs and lifestyle on the way their bodies function.

- Ask children to vote on whether they think that the government should be able to tell people whether or not they can smoke in public places like restaurants, cinemas, shops, on a bus or train. Get children to work out what percentage of the class agree and disagree with this.
- Remind children that the learning outcome is to recognise the impact of diet, exercise, drugs and lifestyle on the way their bodies function. Remind them that they know that cigarettes and alcohol are drugs, they are addictive.
- Share the information on Slides 22–25, giving children time to process the information and discuss the issues, so that they are able to share concerns and questions. Be sensitive to those children who have family members that smoke. Ask children to think about whether any of the information has made them think differently about smoking and, if so, why. Give children Activity Resources 2.5 and 2.6 to complete.
- Next show children Slides 26 and 27 which relate to alcohol. Give children the opportunity to discuss the issues raised about drinking alcohol and, as with smoking, be aware that some children may have family members who drink.
- Tell the children that they are going to create a public health message to warn people of the dangers of smoking and drinking.
- Give them options to choose from, or allow children to come up with their own ideas, such as:
  - A role-play ‘Say no to smoking’ or ‘Don’t drink because your friend does’.
  - A poster advertisement to encourage people to quit smoking or drinking.
  - A TV commercial no longer than 60 seconds long, with a slogan people would remember.
- When children have completed their different ways of communicating healthy choices give children the opportunity to present their work.

YOU WILL NEED

- PowerPoint Slides 22–27
- Activity Resources 2.5 and 2.6

ASSESSMENT

Subject Knowledge

- Em. Children know that smoking and alcohol are not good for the body, they need support in describing how the body is affected.
- Exp. Children know how smoking and alcohol affect the body.
- Exc. Children make a link between developing their understanding of smoking and alcohol and how it affects the body and can explain how this can help them to make healthier choices.

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4 MEET THE SCIENTISTS

L.O. Recognise the impact of diet, exercise, drugs and lifestyle on the way their bodies function.

- Show the images from Slides 29 and 30 and discuss scurvy and rickets with the children. What do you think causes these things? Look them up in your dictionary to find out if you are right.
- Explain to children that the work of scientists in the past and today means that we understand more about what makes a healthy diet and that this knowledge has led to many illnesses associated with poor diets becoming less common.
- Now use Activity Resource 2.7 which introduces children to the work of a scientist called John Boyd Orr. In Britain, in the early 20th century, the diet of many people was very bad, especially among the poor. Foods that we consider normal today such as milk and fresh fruit were not commonly eaten. As a result, many people, especially children, suffered from malnutrition. They didn't grow enough, were underweight and had weak bones.
- In the 1930s a scientist called John Boyd Orr led an experiment to look at how he could help these children. One group of children was chosen to be sent extra food and each child was given a small bottle of milk every day to drink at school. Orr also studied another group that didn't get any extra food or milk. This experiment lasted a year. He measured how their height and weight had changed over the year. His work helped to persuade governments to give free milk to children in schools.
- When children have completed the work on Activity Resource 2.7, explain that they are going to write a one page scientific report which explains how Orr carried out his investigation and his conclusions based on his data. Use Activity Resource 2.8 and have children write a letter to the Prime Minister of the time, explaining why children should have milk. Ask the children to include any other information you have gained about health and how your body works to back up your ideas.

YOU WILL NEED

- PowerPoint Slides 28–32 Access to research facilities, either the library or the Internet
- Activity Resources 2.7 and 2.8
- Range of everyday vegetables, meat, canned vegetables and processed foods or packets of these

ASSESSMENT

Subject Knowledge

- Em. Children can describe what John Orr found out.
- Exp. Children can use the data from John Orr's work to write a report.
- Exc. Children use the data from John Orr's work and additional research on the health benefits of milk to write a report.

TOPIC 3 Evolution and inheritance

About this topic

Curriculum link: Year 6, Evolution and inheritance

SUMMARY:

Building on what they learned about fossils in Year 3, children find out more about how living things have changed over time. They are introduced to the idea that characteristics are passed from parent to their offspring, but that they are not exactly the same. They should also appreciate that variation over time can make animals more or less likely to survive in particular environments (adaptation). Children look at evolution and Charles' Darwin's theory of natural selection, as well as palaeontologist Mary Anning's work with fossils.

UNITS:

3.1: What can fossils tell us?
3.2: Inheritance and adaptation
3.3: Evolution

ACTIVITY RESOURCES:

3.1 Adaptation – penguin
3.2 Adaptation – camel
3.3 Adaptation – cactus
3.4 Charles Darwin
3.5 Charles Darwin presentation

ONLINE RESOURCES:

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

Learning objectives

This topic covers the following learning objectives:

- Recognise that living things have changed over time and that fossils provide information about living things that inhabited the Earth millions of years ago.
- Recognise that living things produce offspring of the same kind, but normally offspring vary and are not identical to their parents.
- Identify how animals and plants are adapted to suit their environment in different ways and that adaptation may lead to evolution.

Working scientifically

This topic develops the following working scientifically skills:

- Identify scientific evidence that has been used to support or refute ideas or arguments.

CROSS-CURRICULAR LINKS

This topic offers the following cross-curricular opportunities:

English

- Make links with Kipling's *Just So Stories*. Contrast these with the actual process of natural selection. Audio versions can be found on the Storynory site: www.storynory.com/category/rudyard-kipling/
- Research and write a biography of Mary Anning.
- Research and write information cards for museum fossil exhibits.
- Research the life and work of Charles Darwin, Alfred Russel Wallace.
- Script an animation showing evolution.
- Research how scientists and farmers use inheritance, e.g. breeding animals and growing plants.
- Create a new animal and produce a fact card showing its inherited features and adaptations.

- Draft and re-daft an explanation on breeding dogs to create a new breed for a specific owner.
- Read diary entries from Darwin, write a diary entry.
- Use a graphic organiser to record and compare similarities and differences.
- Read *The Rabbit Problem* by Emily Gravett
- Present a report about the peppered moth, or enact this as a drama to illustrate what happened. This could be as a school assembly.
- Write a script for their presentation and use their reading and research skills to create it.

Numeracy and mathematics

- Produce graphs and charts from the data collected.

Computing / ICT

- Use interactive games that model evolution.
- Produce an audio or video presentation on evolution of an animal.
- Use the Internet safely to research information.
- Produce an audio or video podcast-style presentation, depending on the equipment and time available, or could produce a regular presentation.
- Use software such as Comic Life to create a comic strip story about Mary Anning or a news report.
- Use desktop publishing packages to produce fact cards on dinosaurs.

Geography

- Plot Darwin's Voyage on the *Beagle*.
- Find the Galapagos islands on a map or globe.

History

- Research and create a timeline to show how the modern horse has evolved from the hyracotherium.
- Learn about Charles Darwin and conditions aboard the *Beagle*, comparing between then and now.
- Discuss creation ideas of various religions and why Darwin's theory caused such a stir in Victorian times.

Outdoor learning

- Children observe animals and plants and how they have adapted to their habitats.

STEAM (SCIENCE TECHNOLOGY ENGINEERING ART AND MATHS) OPPORTUNITIES

Invite into class

- A biologist from a local secondary school or university to work with children.
- A vet or dog breeder.
- A palaeontologist from a local university or museum.
- A local conservationist to talk about conserving plants and animals in your region.

Visit

- Local museum to research fossils and question experts.

TEACHER SUBJECT KNOWLEDGE

Inheritance

The way we look is controlled by our genes, which are a mixture of those from our parents – half from the mother and half from the father.

Some characteristics are carried by a single pair of genes, others by lots of genes working together. Some characteristics, such as brown eyes, are dominant. If your mother has a blue-eyed gene and your father a brown version and these come together in the fertilised egg cell, the brown will 'win' and you will have brown eyes. Only if you have two blue-eyed genes will you have blue eyes. In this way two people with brown eyes could both have the blue-eyed gene, and have a blue-eyed baby.

In the case of identical twins, a fertilised egg splits in two. The genes in each half will be exactly the same, and so twins formed in this way will look identical in many ways. But even identical twins can look slightly different: they might decide to change their hair style, or hair colour, eat different diets, etc. These are environmental changes, rather than genetic ones. External features can also change how we look, as well as our genes.

Evolution

The process of evolution by natural selection was proposed by Charles Darwin in 1858 and was based on work he carried out over the previous 30 years. It is important to note that animals do not 'choose' to change. They have an advantage over other animals, so will survive long enough to breed and pass on their characteristics.

During his time on the Galapagos Islands, Darwin collected specimens of the different species of finch living on the island. It wasn't until he returned to the UK that he studied these specimens and realised how important they were. By noticing that finches on the different islands had beaks that were adapted to their environment, and realising that finches whose beaks weren't adapted wouldn't survive, Darwin was able to start working out his theory of evolution.

Evolution is not 'just a theory'. There is an overwhelming amount of supporting evidence and scientists believe it is the best mechanism for explaining how the wide variety of life on Earth came about.

The process takes place over very long timescales. For example, the evolution of the polar bear from the brown bear took between 100,000 and 250,000 years. Brown bears gradually moved north in search of food. Those bears best suited to life in the cold survived, and passed on those characteristics to their offspring.

Fossils

Planet Earth is 4.6 billion years old. The first life began in the seas around 3.6 billion years ago. The earliest life were single-celled creatures like bacteria and algae. Gradually life became more complex and multicellular life began.

Human beings have only been around for a tiny fraction of the Earth's history. If the entire history of the Earth was condensed into a 24-hour day, Homo sapiens wouldn't appear until a few seconds before midnight.

Fossils tell us a lot about living things that died millions of years ago. The parts that become fossilised can tell us about how they looked, how big they were and even what they ate by looking at their teeth (and sometimes fossilised poo!). There are some things we can't work out so easily, such as their skin colour or texture, as skin does not fossilise.

Areas such as Lyme Regis on the south coast of England are excellent places to find fossils. The cliffs are made of sedimentary rock, such as limestone and sandstone, that would have been at the bottom of the sea millions of years ago. Chalk cliffs are made from the skeletons of billions of microscopic sea creatures.

Creatures that died in this sea would have sunk to the ocean floor and in some cases become buried and eventually become fossils. Millions of years later, the movement of the Earth's plates pushed the sea floor upwards, forming land. Fossil seashells have sometimes been found at the top of high mountains. A very famous site for fossils is called the Burgess Shale in Yoho National Park in the Canadian Rockies, 500 million years ago it used to be sea floor, but now is 2000 m above sea level!

CHILDREN'S MISCONCEPTIONS

Children may believe…

- That boys will look like the father's side of the family and girls like their mother's side.
- That particular features are identical, such as mother's nose and father's eyes, rather than them being a blend of the two.
- That evolution can only happen over millions of years.
- That fossils are very large and only of dinosaurs.

Children already know …

- That we all have different characteristics like eye colour, nose shape and hair colour.
- That offspring look similar to their parents.

SCIENTIFIC VOCABULARY: EVOLUTION AND INHERITANCE

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

adaptation: a small change that a living thing goes through

dinosaur: a particular kind of reptile that lived in prehistoric times

evolution: change in living things over time

fossil: a living thing that has been turned to stone by one of several methods

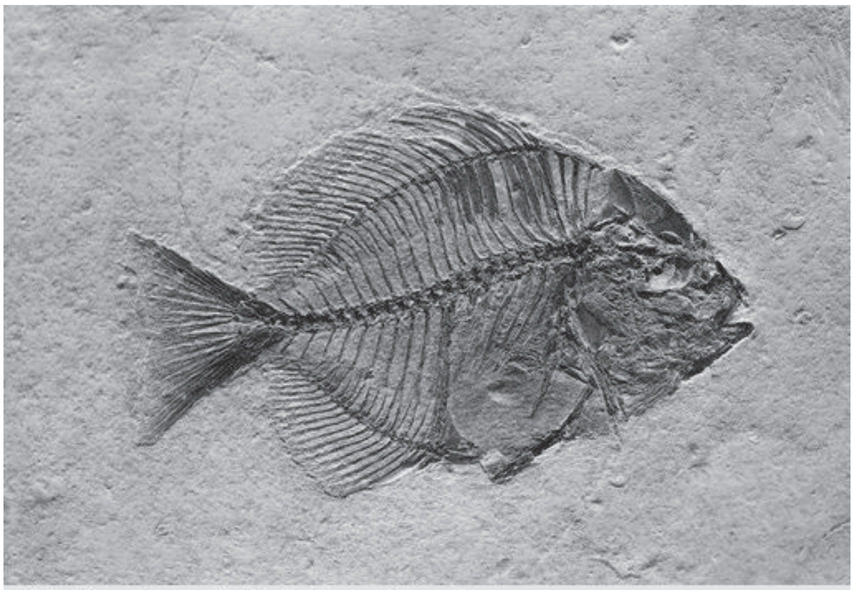
inherited: the way that a trait or characteristic is passed to offspring from parents

natural selection: a process in which living things adapt themselves in order to survive, that they don't have any control over

prehistoric: the time classed as 'before history' as it was so long ago it hasn't been recorded or written

variety: differences between things as part of a whole group

What does the fossil tell us?



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- Creatures that died in the sea would have sunk to the bottom and in some cases become buried and eventually become fossils.

3.1 What can fossils tell us?

GET STARTED

Look up the meanings of numbers, such as million, billion, etc. Look at numbers and keep adding more zeros. Ask the children if they can match the numbers to the names.

LET'S THINK LIKE SCIENTISTS

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

- Fossils come in a range of sizes. What is the biggest one ever found?
- How can you tell how old a fossil is? There is more than one way!
- There are some places in Britain that are better for finding fossils than others. Where are they and why are these the best places?

ACTIVITIES

1 LIFE ON EARTH TIMELINE

L.O. Recognise that living things have changed over time and that fossils provide information about living things that inhabited the Earth millions of years ago.

- Explain to the children that the Earth is very old. In fact, scientists have worked out that it is 4.6 billion years old.
- Remind children that they learned about fossils in Year 3 and that by looking at fossils and working out their ages, scientists have been able to find out when life first started. They also know when dinosaurs became extinct because have found no dinosaur fossil younger than 66 million years old.
- Explain to the children that everyone is going to create a timeline of life on Earth, show children Slides 19 and 20. It is very hard for children to appreciate such long periods of time. Using Slide 19 might help some children understand that humans have been on the Earth for only a very short amount of time in the Earth's history.
- The following data (page 36) gives options for creating the timeline in different places. The timeline should run from earliest times on the left to the most recent events on the right. Measure the distances from the right-hand side.
- Take the children outside and map out the timeline over 100 m to illustrate how long the Earth has been in existence. Share with the children that if the entire history of the Earth was condensed into a 24-hour day, *Homo sapiens* wouldn't appear until a few seconds before midnight.

YOU WILL NEED

- Per group of two or more children: sheet of A4 paper
- Coloured pencils / marker pens
- Very long tape measure or measuring wheel
- Video camera
- PowerPoint Slides 19 and 20

ASSESSMENT

Subject Knowledge

- Em. Children participate in the activity, they need support to relate the model to the idea of time over millions of years.
- Exp. Children know that life has evolved over millions of years and that different forms of life appeared at different times in the Earth's history.
- Exc. Children show an interest in, for example, the extinction of the dinosaurs and research alternative theories of extinction at home or at school

	Million years ago	Wall display / cm	School field / m
Present day	0	0	0
Modern humans appear (*Homo sapiens*)	0.2	0.01 cm	0.006 m
Last ice age	2.4	0.13 cm	0.07 m
First human-like animals appear	2.5	0.14 cm	0.08 m
Dinosaurs wiped out by asteroid	66.4	3.7 cm	1.8 m
First flowering plants	141	8 cm	3.9 m
Birds appear	195	11 cm	5.4 m
First dinosaurs and mammals	230	13 cm	6.4 m
First reptiles	340	19 cm	9.4 m
First insects	360	20 cm	10 m
First amphibians	370	21 cm	10.2 m
Plants appear on land	420	23 cm	11.6 m
Cambrian explosion – the first fish	530	29 cm	14.7 m
Simple multi-celled creatures appear	700	39 cm	19.4 m
Algae, fungi, single-celled animals appear	2100	117 cm	58 m
Life first begins with single-celled creatures like bacteria	3600	200 cm	100 m

- Each group writes the title of their step in large letters on a piece of paper (or these could be printed beforehand).
- Measure out 100 m. Place ‘Life begins’ at one end, and ‘Present day’ at the other end.
- Tell each group how far it is along the line. The groups work out where to stand along the line and hold up their signs.
- Another group could make a short video moving down the giant timeline from the start of life to the present, showing each of the groups and their signs.
- Alternatively you could allocate each group one of the steps in the timeline. Each group creates a drawing to illustrate their given stage on the timeline.
- If presenting the timeline on a board, the above measurements assume a display length of 2 m. Place a long thin strip of paper along the middle of the board.
- Tell groups how far their stages are along the line.
- Groups use pins to mark their positions on the timeline and link them to their images with string. This will make it easier as the events become closer together. Place the images above and below the timeline strip.

2 FOSSILS AND MARY ANNING

L.O. Recognise that living things have changed over time and that fossils provide information about living things that inhabited the Earth millions of years ago

- Show children the video clip about fossils (see Useful Website list). Discuss the content of the video and how the person presented the information. What was good about it? Explain that children are going to create their own video presentation as part of this activity.
- Show children the video about Mary Anning (available online). As they watch it they should take notes of key points for use later. Discuss the video, particularly Mary Anning's work and how it has influenced science and what we know today.
- Show children Slides 21–25 and discuss the importance of Mary Anning's work.
- Explain to the class that they are going to carry out two activities to help Year 3 children in their topic about rocks and fossils.
- Working in groups of four, children use the information from the video, the activity sheet and any further research they need to:
  - script and role-play a four-minute sequence about Mary Anning, or;
  - use software such as Comic Life to create a comic strip story about Mary Anning.
- Before they begin children should develop a set of criteria for creating a successful video or comic strip which will help Year 3 children to understand Mary Anning's life and how important her work on fossils was.
- Working in groups, children choose and research five fossils and create a fact card on each one for Year 3 children to read and find out about fossils. Before they begin children should develop a set of criteria for a successful fact card. When they have completed their fact card another group should peer assess against the success criteria and give feedback. Refer to their class timeline and indicate where the fossil would come on the timeline to reinforce the length of time.
- Watch Pupil video 'Evolution and Inheritance (1)' to round up the topic.

YOU WILL NEED

- Video clips (see Useful Websites list *on My Rising Stars*)
- Card for fact cards
- Video recording equipment
- PowerPoint Slides 21–25
- Pupil Video 'Evolution and Inheritance (1)'

ASSESSMENT

Subject Knowledge

- Em. Children can tell the story of Mary Anning and know that she found fossils.
- Exp. Children know that Mary Anning provided evidence through her collection of fossils of what some living things looked like millions of years ago.
- Exc. Children recognise Mary Anning as scientist (palaeontologist) and that her fossils are evidence of evolution.

3.2 Inheritance and adaptation

GET STARTED

Give children a range of pictures of different cats and dogs and their offspring and challenge them to match them up within a given time, e.g. 30 seconds.

Ask children how they knew which offspring belonged to which adult animal, and discuss that they looked for similarities of certain features also called traits or characteristics. Ask what conclusion they can draw about parents and their offspring.

After this activity, you could show the children the Pupil video 'Evolution and Inheritance (2)' which looks at inherited characteristics in humans and animals.

LET'S THINK LIKE SCIENTISTS

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

- Some families have a common feature that makes them very recognisable. Look at pictures of the British Royal Family. What features do they share? What is the recognisable characteristic? Why is it there?

ACTIVITIES

1 GUESS WHO

L.O. Recognise that living things produce offspring of the same kind, but normally offspring vary and are not identical to their parents.

Identify scientific evidence that has been used to support or refute ideas or arguments.

- This activity will need to be set up prior to this lesson and the children coming into the room.
- Ask colleagues if they would offer photographs of themselves and their parent/s or themselves and their own children. Label the pictures of the parents a letter of the alphabet e.g. A, B, C and the children numbers, e.g. 1, 2, 3.
- Show some images of babies and ask the children, what phrase they will often hear adults saying to the parents about them ('Don't they look like you!', or 'Doesn't she have her father's nose!'). Place pictures of teachers or famous people and their children – can they match the child to the parent? Get them to write down the pairings, e.g. A and 3.
- Discuss children's results and why focusing on similarities and discuss is important when discussing traits (characteristics) such as hair colour, eye shape and colour.
- Now move on to discussing similarities and differences. Use the suggested video clip to look at the similarities and differences between twins (see Useful Website list – Guess who). Then use PowerPoint Slide 6 and discuss how some members of a family look like each other, they have characteristics and traits passed down from parents and grandparents.
- Show children the Mr Men Inheritance PowerPoint (see Useful Websites list on *My Rising Stars*) which helps children to develop their understanding of inheriting traits from parents. Discuss the idea that some traits are inherited, from our parents and some are things that we can change such as hair length, or colour. Explain that these are called environmental features. We are looking for inherited features. Give children time to do some dictionary work by finding out what inherited means to help them become more secure in their understanding.

YOU WILL NEED

- Mr Men Inheritance PowerPoint (see Useful Websites list)
- Pupil video
- Video clip re twins (see Useful Website list – Guess Who)
- PowerPoint Slide 6

ASSESSMENT

Subject Knowledge

- Em. Children can say that children can look like their parents e.g. eye and hair colour.
- Exp. Recognise that humans and other living things produce offspring of the same kind. They can describe how in humans the children are not identical to their parents but have some traits.
- Exc. Children can apply their learning to suggest traits that have been passed down.

2 DESIGNER DOGS

L.O. Recognise that living things produce offspring of the same kind, but normally offspring vary and are not identical to their parents

- Children will be familiar with dogs and this provides an excellent way to help children understand how traits are inherited. Prior to the activity make sure you ask all children to bring a toy dog to school and that it should have a collar (this could be a piece of paper attached to string or ribbon) with its name on so that it can be returned to its owner.
- Working in groups children place all of their toy dogs in the middle of their table then classify them in as many different ways as they can, for example, size, ears, tail or no tail, colour, spots, type of fur.
- Now explain that they are going to breed a new type of dog and they have to use traits from two different dogs, they should draw their new dog and then give their breed a name. Remind children of recent new breeds such as a labradoodle (labrador and poodle) and that the name should give clues to the two types of dogs they have used to breed. Explain that this is how dog breeders breed new breeds although this might take a few years.
- Extend this activity by giving children cards with different people and their requirement for a new dog, for example:
  - Elderly person living in a flat – needs a small dog that does not moult and requires little exercise.
  - Family with young children who like walking – need a medium-size dog, that has a calm nature and does not need a lot of grooming.
  - Charity that trains dogs for sight-impaired people, needs medium-size dog, intelligent so it learns quickly, calm and does not need a lot of grooming.
- Children could use dog books and the Internet, e.g. Kennel Club to find out which types of dogs could be bred to create new breeds for these people.

YOU WILL NEED

- Toy dogs

ASSESSMENT

Subject Knowledge

- Em. Children know that humans and animals have babies and these look like their parents.
- Exp. Children use their knowledge that animals have offspring and can use the idea of inherited traits to breed a new dog.
- Exc. Children recognise that breeding a new type of dog will take a number of generations, that it will take time for these changes to happen.

3 ADAPTATION

L.O. Identify how animals and plants are adapted to suit their environment in different ways and that adaptation may lead to evolution.

Identify scientific evidence that has been used to support or refute ideas or arguments.

- Take the class into the school grounds or local environment, and working in pairs they look for invertebrates and carefully collect and observe several different varieties. Tell them to discuss how they think that each invertebrate is suited to living in its habitat. They should make observational drawings and annotate them.
- Back in the classroom, ask the pairs to join up to create groups of four and share what they have found out about invertebrates in previous topics and how they think that they are suited to their habitat. Ask them to discuss why being suited to their habitat is important. Introduce the word 'adapted' and ask children to use

YOU WILL NEED

- Lollipop sticks
- PowerPoint Slides 7 and 8
- Books and access to the Internet to research adaptations in plants and animals in the desert and polar regions
- Activity Resources 3.1–3.3, which could be used with some children needing specific support.

dictionary skills to define this word, and also adaptation. Now ask them to discuss how the invertebrates they studied are 'adapted' to their habitat.

- They should write two sentences using each word to show that they have understood its meaning, using invertebrates as examples.
- Use PowerPoint Slide 7 which shows different invertebrates and ask children what adaptations they have, e.g. snails have a shell to keep their soft bodies safe from predators, and their eyes are on two stalks that can be retracted for safety. Worms have a streamlined shape with no skeleton so that they can easily burrow through soil. they do not have a skeleton so that they can move easily in soil.
- Show children the video clip which shows how plants in arctic regions adapt to living in cold habitats (see Useful Website list).
- Now use the 'Lolly Choice Stick' approach and get one person from each group to choose a lollipop stick, on which is written the name of an animal or a plant. Use Slide 8 which indicates that children should research the following information about the animal or plant on their stick.
  - What kind of habitat does the plant or animal live in?
  - What are the conditions like?
  - How is the plant or animal adapted to living in its habitat?
  - How many different ways is the animal adapted to their habitat?
  - Why does it need those adaptations?
  - Produce an annotated drawing of their animal or plant to show its adaptations.
  - Explain the link between their habitat and their adaptation.
- Children could be asked to research, for example:

Arctic Fox	Frog	Cactus	Penguins	Camels
Meerkats	Crabs	Antarctic Seals	Flamingos	

- When children have researched their information, they could produce a poster on their plant or animal which can be displayed around the classroom for other children to read and extend their knowledge about living things and adaptation.

ASSESSMENT

Subject Knowledge

- Em. Children can use a picture to talk about obvious adaptations of, for example, a camel.
- Exp. Children identify different ways that their animal or plant has adapted to survive in its habitat.
- Exc. Children recognise that they are using scientific evidence to prove that animals and plants are adapted to their habitat.

3.3 Evolution

GET STARTED

Give children dictionaries and access to the Internet so that they can look at different definitions of the word evolution. Challenge children to use these definitions to make their own to share with the rest of the class. Now agree on a class definition, you could choose one definition from the children or combine definitions. Display the definition in the classroom.

LET'S THINK LIKE SCIENTISTS

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

- What would happen if plants and animals did not adapt?
- Some plants eat meat. But how do they catch their prey? And how do they eat it without a mouth?

ACTIVITIES

1 HOW HAVE THEY CHANGED?

L.O. Identify how animals and plants are adapted to suit their environment in different ways and that adaptation may lead to evolution.

Identify scientific evidence that has been used to support or refute ideas or arguments.

- Explain to children that over time animals and plants have changed, they have adapted to suit their environment, sometimes this takes millions of years, sometimes this can happen over shorter periods of time. Of course this does not mean that the plants or animals have lived that long, it means that from one generation to another they passed on changes.
- Get children to carry out this simple activity. Give each child a sheet of white A4 paper and a pencil. Using the page landscape you draw a straight line on your piece of paper. Show the page to the child nearest you, take the paper back and ask them to copy what you have drawn. Then that child shows what they have drawn to the neighbour, then hides what they drew, their partner draws what they saw on their paper, and so on, until everyone in the class has drawn a line on their paper.
- Now take the class into the hall, and tell them to lay their paper down in order, yours first, then the first child, then second until the last child has laid theirs down.
- Tell the children to walk down the line, what do they notice? Is the last line the same as the first line? What has happened? Over time the copy has changed, little by little the last line is different to the first, each change has been passed on and eventually the last change looks very different to the first line. This is like evolution, little changes over time can result in huge change in animals and plants.

YOU WILL NEED

- PowerPoint Slide 10
- Activity Resource 3.4 and 3.5

ASSESSMENT

Subject Knowledge

- Em. Children can describe how the line changed and what evolution means
- Exp. Children explain the definition of evolution.
- Exc. Children use the definition of evolution to explain how the line changed or an animal evolves.

Working Scientifically

- Em. Children know that Charles Darwin was a scientist.
- Exp. Children know that Charles Darwin could prove how animals evolved.
- Exc. Children know how to use ideas from Charles Darwin to help explain how animals and plants change (evolve) over time.

- Explain to children that the Theory of Evolution was developed by Charles Darwin. Their task is to research the work of Darwin and to find out what he meant by the 'Survival of the Fittest'. Show children Activity Resource 3.4 and explain that they are going to make a presentation or poster on Darwin's life and his theory 'survival of the fittest'. Give children Activity Resource 3.5 to help them plan their presentations and allow to do extra research. You can also show Slide 10 which shows a photograph of Darwin and provides question stems that children can use to plan their questions to research.

2 NATURAL SELECTION

L.O. Identify how animals and plants are adapted to suit their environment in different ways and that adaptation may lead to evolution.

Record data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs.

Identifying scientific evidence that has been used to support or refute ideas or arguments.

- Have a quick-fire session where children 'shout out' facts about Charles Darwin. Ask children to discuss the idea of natural selection and for children to share their ideas. Use Activity Resources 3.4 and 3.5 to consolidate knowledge,
- Explain Darwin's theory about finches (see Teacher Subject Knowledge, page 33), which we can apply to birds we know already. Look at the interactive activity online and consolidate knowledge. Use the CPD video 'Evolution and Inheritance' so that children see how their peers work and record the outcomes of this activity.
- Explain to the children that the chopsticks and tweezers represent different bird beaks. One bird with a long thin beak and one bird with a short beak. Birds beaks have adapted to be best at eating particular types of food. In groups children can play the 'Beaks and seeds' game:
  - Ask the children to see which 'beak' is best for eating seeds – the long thin chopsticks or short stubby tweezers. Starting with the chopsticks, the 'bird' has one minute to pick up as many sunflower seeds as it can and put them into the plastic cup (its stomach!). At the end of one minute, they can count up how many seeds have been collected and record them using mini whiteboards.
  - Repeat with the tweezers, then swap round so each child has a go.
- Bring the class together to share results. Which beak was the best for eating the sunflower seeds? Why? Over time what will happen to the type of birds with beaks that are not adapted to eating the seeds? How many do you think will live to have offspring? If they do not have offspring what will happen to this species of bird? (They will become extinct.)
- What would happen if some of the birds with normally long beaks had slightly shorter ones and so could eat some sunflower seeds? Discuss the idea of only the birds with the shorter beaks would survive, they would breed, and pass on their shorter beak trait. Their offspring would inherit this, pass it on to their offspring, etc. Survival of the fittest.

YOU WILL NEED

Each group will need:

- Plastic cup
- Bowl with sunflower seeds
- Stop clock
- Chopsticks
- Tweezers
- Mini whiteboards
- PowerPoint Slides 11–18
- Activity Resources 3.4 and 3.5
- CPD video 'Evolution and Inheritance'

ASSESSMENT

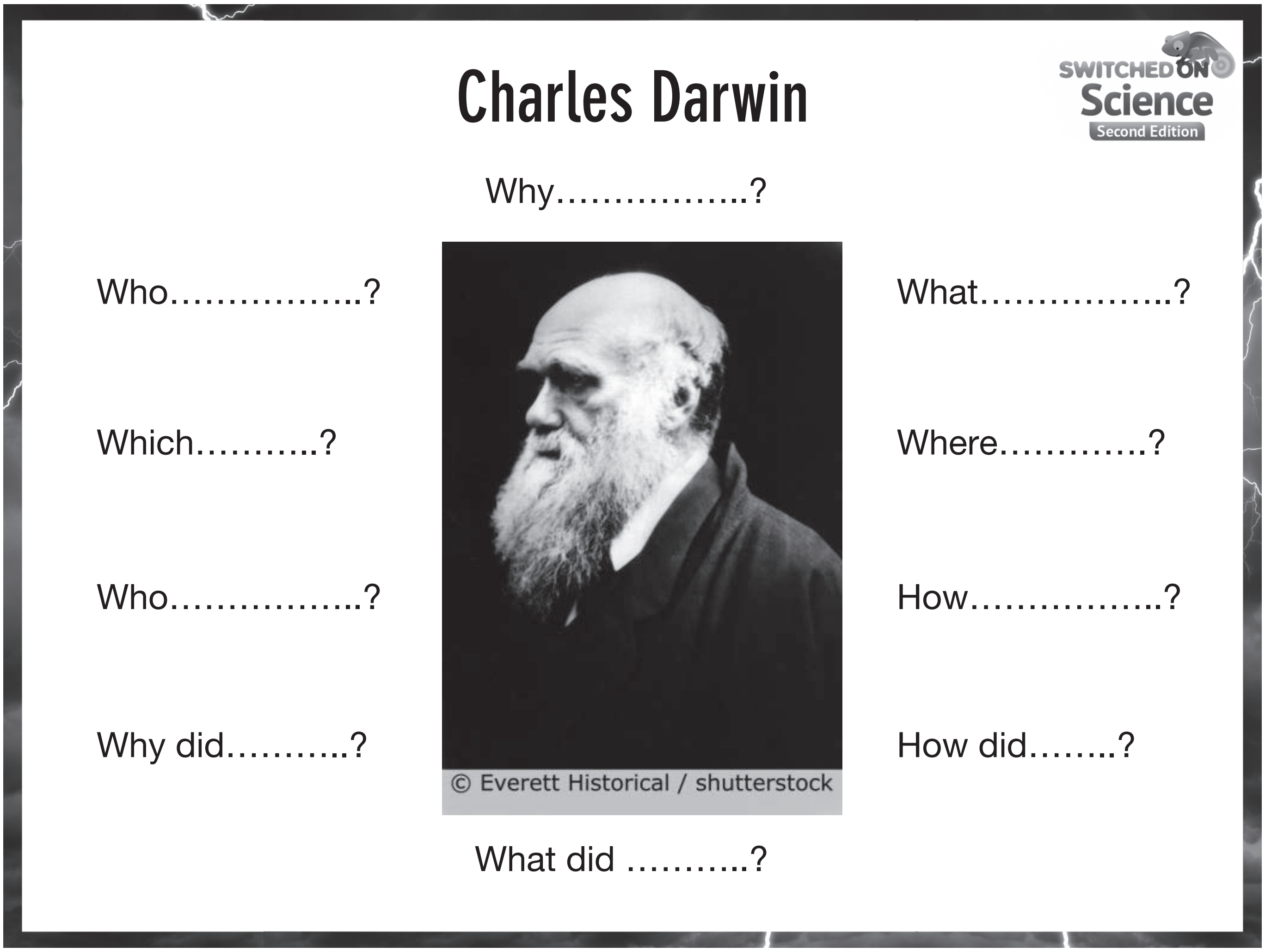
Subject Knowledge

- Em. Children describe how they carried out their test and which beak was the best.
- Exp. Children use their data to prove that birds that are adapted to their environment will survive and evolve.
- Exc. Children use their data to explain how it demonstrates Darwin's theory of survival of the fittest and know how this happens over long periods of time.

- What kind of birds do they see in the garden that eats seeds? Do they have long or short beaks?
- Would there be certain types of food where a long beak might be better? Think of a bird like a heron with a long, thin beak like chopsticks – how do they catch their food? (Spearing fish.)
- Ask children to explain how Darwin used this information to come up with his theory about the finches on the Galapagos Islands.
- Show children Slide 18 before getting them to research different birds, such as ducks, eagles, flamingos and hummingbirds, to find out how their beaks are adapted to suit the foods they eat.
- You could use Slides 11–17 to further discuss adaptations in different animals. For example, you could give each group a copy of one slide and ask them to discuss the animal and how it is adapted, or research the animal and then share their information with other children.

Working Scientifically

- Em Children carry out the test and record results.
- Exp. Children choose the way to record their data.
- Exc. Children choose how communicate their data in a way that suits their audience.



TOPIC 4 Light

About this topic

Curriculum link: Year 6, Light

SUMMARY:

The topic introduces the concept of light travelling in straight lines. It starts by looking at beams of light and how light travels to enable children to understand how we see things. This understanding is then applied to the production of shadows and starts to look at how light is reflected. The topic then takes the learning into the realm of coloured light and rainbows, using scientific skills to raise and answer questions. It builds on the work carried out in Year 3 on light, shadows and reflection.

UNITS:

4.1: Shadows
4.2: Reflection
4.3: Bending light

ACTIVITY RESOURCES:

4.1 My investigation
4.2 Making a periscope
4.3 Mirror writing
4.4 Bending light
4.5 Where's the coin?
4.6 Bendy pencil
4.7 Pouring light

ONLINE RESOURCES:

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

Learning objectives

This topic covers the following learning objectives:

- Recognise that light appears to travel in straight lines.
- Use the idea that light travels in straight lines to explain that objects are seen because they give out or reflect light into the eye.
- Explain that we see things because light travels from light sources to our eyes or from light sources to objects and then to our eyes.
- Use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them.

Working scientifically

This topic develops the following working scientifically skills:

- Plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary.
- Take measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate.
- Record data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs.
- Use test results to make predictions to set up further comparative and fair tests.
- Report and present findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations.
- Identify scientific evidence that has been used to support or refute ideas or arguments.
- Gather and record data to help in answering questions.

CROSS-CURRICULAR LINKS

This topic offers the following cross-curricular opportunities:

English

- Root words and prefixes relating to light.
- Using new scientific vocabulary correctly.
- Draft and re-draft script for a shadow puppet play.
- Preparing poems and plays to perform, showing understanding through intonation, tone and volume so that the meaning is clear to an audience.
- Video instructions for a kaleidoscope or periscope.
- Plan questions for research on scientists.
- Research Hans Christian Anderson, which famous stories did he write?
- Read a Hans Christian Anderson story, write a 'story review'.
- Create mnemonics for the order of colours in a rainbow.

Numeracy and mathematics

- Measure distances accurately.
- Measure angles.
- Measuring light in lux.
- Using data logger, creating and reading line graphs.
- Reflective symmetry.

Computing / ICT

- Create a video clip.
- Use a data-logger light meter.
- Changing camera light to create effects such as sepia.
- Photographing scenes, light and shadows.

Art and design

- Explore light and shade in greyscale.
- Use of light in famous artists' work, e.g. Vermeer.
- Look at images of search lights in the night sky and representing them.
- Look at Hans Christian Anderson silhouettes, and make silhouettes.
- Self-portraits using mirrors.
- Painting Northern Lights patterns.
- Researching Lumiere installations e.g. Lumiere Durham.
- Look at how mixing colours in art is different to mixing coloured light.

Design and technology

- Design and make a Lumiere installation.
- Create silver foil shadow people.
- Create shadow puppets.

Drama

- Explore darkness and light in dance.
- Write a script and perform a shadow play for younger children.

Outdoor learning

- Explore shadows outside, position and length across the day.
- Reflections outdoors.

STEAM (SCIENCE TECHNOLOGY ENGINEERING ART AND MATHS) OPPORTUNITIES

Invite into class

- A photographer to share how they use light.
- Shadow puppet theatre group to give a performance and explain and explore how shadow puppets work and effects are created.
- An artist to work with children to create silhouettes.

Visit

- Local secondary school to use light meters, light ray boxes, prisms, etc.
- Local planetarium to learn about how telescopes work, and find out about light from sources other than our own sun.
- Local lighting shop to find about different kinds of lights.

TEACHER SUBJECT KNOWLEDGE

Light

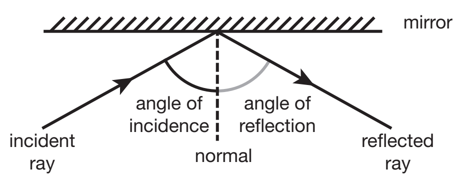
Visible light is a member of a family of waves known as the electromagnetic spectrum.

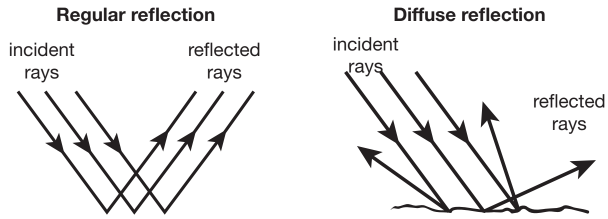
All waves behave similarly. They all trvel in straight lines. Light travels faster than sound, (330m/s), which is why we see lightning before we hear thunder and why, when we look at someone hitting something from a distance, we see them make the action before we hear the sound.

Because light travels in straight lines, the edges of light beams are straight and shadows are the same shape as the object casting them.

If the light source is small, the edges of the shadows are sharp. If a large light source is used, the edges of the shadow are blurred.

All objects reflect a small amount of light. Both Plato and Ptolemy developed theories which stated that we see things because the eyes emit rays. Superhero comics often show rays being emitted from the hero's eyes, which helps to generate the misconception that children may have about light coming from our eyes. The law of reflection states: 'The angle of incidence equals the angle of reflection'. The children don't need to be able to draw or use this at this stage, unless they notice this as part of their investigations. However, it will help you if they are struggling to work out how to position their mirrors in the activities. It also helps with the fact that all materials reflect light.





When light passes from one material into another, it changes direction. The change in direction is known as refraction. When it passes from air into a more dense material, such as glass, Perspex or water, it changes direction towards the normal. When it passes from a more dense material into air, it changes direction away from the normal.

CHILDREN'S MISCONCEPTIONS

Children may believe...

- That light comes out of our eyes.
- That we can see the features on shadows.
- That light bounces from our eyes to the object (this is illustrated in their diagrams rather than their speech).
- That light is made up of a single colour.
- That they can see round corners.

Children already know...

- That they see with their eyes.
- That light can be reflected from some surfaces.
- How to make a shadow.
- About transparent, opaque and translucent objects.

SCIENTIFIC VOCABULARY: LIGHT

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

cornea: the outer clear covering over the eye

iris: the coloured part of the eye

lens: the part of the eye that focuses the light

light ray: the path light takes

pupil: the black hole in the centre of the coloured part (iris) that lets light into the eye

rainbow: occurs when sunlight hits rain, splitting the light into its colours

reflection: light bouncing off the surface of an object

symmetry: when one shape becomes exactly like another if you flip, slide or turn it. The simplest type of symmetry is 'reflection' (or 'mirror') symmetry

4.1 Shadows

GET STARTED

Use PowerPoint Slide 5 and challenge children to think about what would happen if light could travel round corners. Ask children to discuss the things that would be positive, minus (negative) and interesting about this.

LET'S THINK LIKE SCIENTISTS

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

- Light is part of a range of waves. What do these waves look like?
- The Moon goes through phases because of a shadow. How is the shadow caused?
- Eclipses are also caused by shadows. What is causing the shadow?

ACTIVITIES

1 HOW DOES LIGHT TRAVEL?

L.O. Recognise that light appears to travel in straight lines.

Use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them.

Take measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate.

Recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs.

- Show children Slide 6 and ask them to explain what they think is happening in the diagram. Now get them to set up the same activity to test the idea and to find out if it works. What does this help to prove?
- Provide children with torches, an object such as a wooden block or plastic building blocks, some black card or sugar paper, white paper and some white chalk. Show them Slide 7 so that they know what they are going to be doing. Dim the room.
- The children should:
  - Lay the torch on the black paper and shine it at the object.
  - Place the white card behind the object leaving a gap of about 3 cm.
  - Use a pencil to draw round the torch and the object.
  - Use chalk to draw and colour in the path that the light travels on the paper. Continue to draw the light that goes past the object, until it reaches the white screen where the shadow is.
  - Remove the torch and look at the image that has been made.
- What can the children say about the light coming out of the torch?
- Was there any light behind the object?

YOU WILL NEED

- PowerPoint Slides 6–8
- Hole punches
- Adhesive putty
- White card
- Black sugar paper
- Small torches to make a small light source and a sharp shadow
- Chalk, several colours
- Pencils
- Rulers / tape measures
- A blank picture frame
- Wooden blocks or plastic blocks

ASSESSMENT

Subject Knowledge

- Em. Children require help to carry out this activity and make links between what they do and what happens.
- Exp. Children make links between what happened and the idea that light travels in straight lines and when blocked a shadow is made.
- Exc. Children are able to apply the idea that light travels in straight lines to other contexts.

- Elicit from the children that the light can't go round the block as it travels in straight lines.
- Discuss the pictures they have produced and whether they show that light travels in straight lines. Ask them to now talk about how the shadow is made, use slide 8 to support children developing an explanation using the following words:

  LIGHT RAYS BLOCK OBJECT OPAQUE
  STRAIGHT LINE TRAVELS WHITEBOARD
- Ask them to draft and redraft an explanation on their whiteboard on how a shadow is made.
- Once children have completed their draft they should swap it with another group so that the class uses their literacy skills in peer assessing written work, to check the sense of the explanation, grammar, spelling, etc. along with checking the scientific content.

2 INTRODUCTION TO PUPPETS

Recognise that light appears to travel in straight lines.

Use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them.

Take measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate.

Recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs.

- Introduce the children to Hans Christian Anderson. Show them Slides 9, 10 and 11. They might know him from his stories such as '*The Ugly Duckling*', but not know his work creating silhouettes.
- Ask groups to discuss how the silhouettes were made and how they could, working in a small group make their own. Before they begin, explain that they are going to set up a test to find out how the distance between the person and the light source affects the size of the silhouette (shadow) and to collect data.
- When they have finished collecting their data, they should represent it as a line graph. Remind them what they changed goes on the x axis (horizontal) and what they measure goes on the Y axis (vertical).
- Get them to use this data to decide the best distance for creating their silhouette to fit into a frame that you have provided on the wall. This could happen over three sessions and may not fit into one science lesson.

YOU WILL NEED

- PowerPoint Slides 9–11
- Torches
- Paper and crayons

ASSESSMENT

Subject Knowledge

- Em. Children describe the direction of the torch beam; they describe how to make a silhouette.
- Exp Children describe that light travels in straight lines, and why their silhouette is the same shape as themselves.
- Exc. Children explain that light rays travel in straight lines and how to use their data to create a correct size silhouette of themselves and explain why it is the same shape.

Working Scientifically

- Em. Children make and record measurements.
- Exp. Children take and record measurements and can communicate their data.
- Exc. Children apply their data to making new shadows / silhouettes.

3 PATTERN SEEKING FROM SHADOWS

L.O. Recognise that light appears to travel in straight lines

Take measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate.

Recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs.

Use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them.

- Take children out and play a shadow tag game where children try to stand on or tag someone's shadow.
- If the person's shadow has been tagged they must stand still, until there is only one person left. Bring children together, give them some chalk and in small groups get them to write on the playground surface an explanation of how shadows outdoors are made and why they take the shape of the object.
- Otherwise, have them record their thoughts on mini-whiteboards or orally. Remind them of key language to use.
- Explain to the children that they are going to plan a pattern-seeking activity to find out if and how shadows change through the day, using themselves to create the shadow. Explain that they will carry out this activity over a day and that they should decide which role each person will take for this activity.
- Discuss what they need to think about when planning and then they should use the planning investigation framework on Activity Resource 4.1.
- Given that this activity takes a day to collect the data, this second part of this activity should be completed on a different day. Ask children what kind of graph the should draw using their data, remind them of the rule that number and number is usually a line graph.
- Once the graph is completed they should discuss the pattern of their data and their conclusion, making sure that they use appropriate language.
- Finally, using their graph ask children to discuss where they think the line of the graph would go prior to the investigation start time and where would the line go after their finish time and ask them to explain why.

YOU WILL NEED

- Tape measures
- Chalk
- Activity Resource 4.1

ASSESSMENT

Subject Knowledge

- Em. Children can show that light travels in straight lines using e.g. a torch.
- Exp. Children can say that light travels in straight lines and that the shape of shadows is the same as the objects that made them.
- Exc. Children can apply what they know about how shadows are made to explain why the length of shadow changes during the day.

Working Scientifically

- Em. Children are able to describe the pattern in the data.
- Exp. Children are able to explain, using their data, the pattern of the shadow across the day.
- Exc. Children are able to explain the pattern in their data in relation to the angle of the Sun in the sky.

4.2 Reflection

GET STARTED

Show some writing that has been written in a mirror and explain that Leonardo Da Vinci used to use this as a secret code. Can the children work out what it says?

LET'S THINK LIKE SCIENTISTS

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

- An eye is like a camera. Can you spot the similarities? How are they different? Compare and contrast them.
- Some animals have much larger eyes than humans. Why is this?
- Light can go round corners! But it needs a helping hand to bend.
- What can be used?

ACTIVITIES

1 MIRROR IMAGE

L.O. Recognise that light appears to travel in straight lines

- Give children a range of objects and challenge the children to group them as shiny or not. Ask children if it is easier if they shine a torch on them? Ask them to order them by how shiny they are.
- Consolidate the use of symmetry from maths to use the idea of mirror writing from the 'Get started' activity, and see if the children can write their own messages, and decipher others. They could decipher the messages on Activity Resource 4.3.
- Provide mirrors to the children and discuss if they are shiny or not. What do you see when you look in them? (A reflection.) How is shininess related to a reflection? (Very shiny things have better reflections.)
- Challenge the children to use the mirrors to explore how they can see behind themselves and to see round corners, use Slide 12 as a starting point for discussion. Then ask them to use their experience to change where the beam of a torch goes using three mirrors. For more of a challenge, get the children to make the light go through a maze. Lay the torch on black sugar paper, and stand the mirrors up to reflect the light. They should then draw along the beam in white chalk to show the path of the light. If they take away all the mirrors, what shape have they made? What has happened to the beam?
- With the class, produce a class definition for reflection based on the light hitting the surface of the mirror and bouncing off again, so that it changes direction, or is bent.

YOU WILL NEED

- PowerPoint Slide 12
- Torches with black card and a small hole, to keep the beam small
- Assorted objects, with a varying degree of reflective surface
- Mirrors
- Black sugar paper
- Chalk
- Activity Resources 4.2 and 4.3

ASSESSMENT

Subject Knowledge

- Em. Children make the periscope and need help to describe how the light is reflected.
- Exp. Children can describe how light travels and use this knowledge to explain what happens when light is reflected in the periscope.
- Exc. Children provide additional information, applying terms such as 'angle of incidence' and 'reflection'.

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- Use the idea of the light travelling in straight lines and using mirrors to change the direction of it to make a periscope to see over the heads of the rest of the class, they can use the template and instructions on Activity Resource 4.2.
- When they have made their periscope and explored using it, they could take a photograph of it being used and annotate it showing how light is reflected using arrows and draft and redraft an explanation before writing it alongside their photograph.

2 SEEING IS BELIEVING

L.O. Use the idea that light travels in straight lines to explain that objects are seen because they give out or reflect light into the eye.

Explain that we see things because light travels from light sources to our eyes or from light sources to objects and then to our eyes.

- Turn the lights off and make it as dark as possible. Can you see each other's eyes? Do they have light coming out of them?
- Explain that a long time ago, people thought that we saw things because rays were emitted from our eyes. Now ask them to draw a picture of how they think we see things, for example a book, using arrows to show the light rays.
- Use Slide 13 to show how to set up this activity. Ask children to describe what the diagram shows. Explain that they are going to set up the same model in the diagram on the slide and that they should leave lots of wool at the mirror.
- Give them time to set this up and then ask:
  - What should you do with the extra wool?
  - What happens to the light at the mirror?
- The children should tell you it is reflected from the mirror. Give them another piece of wool, twice as long to set up the same model as you. Now ask them to stick arrows on this piece of wool to show which direction it is travelling in.
- Where does the light go after that? Discuss with the children how the light will get to our eyes so we can see it. Use a large cut-out face for the wool to be stuck on the eye.

YOU WILL NEED

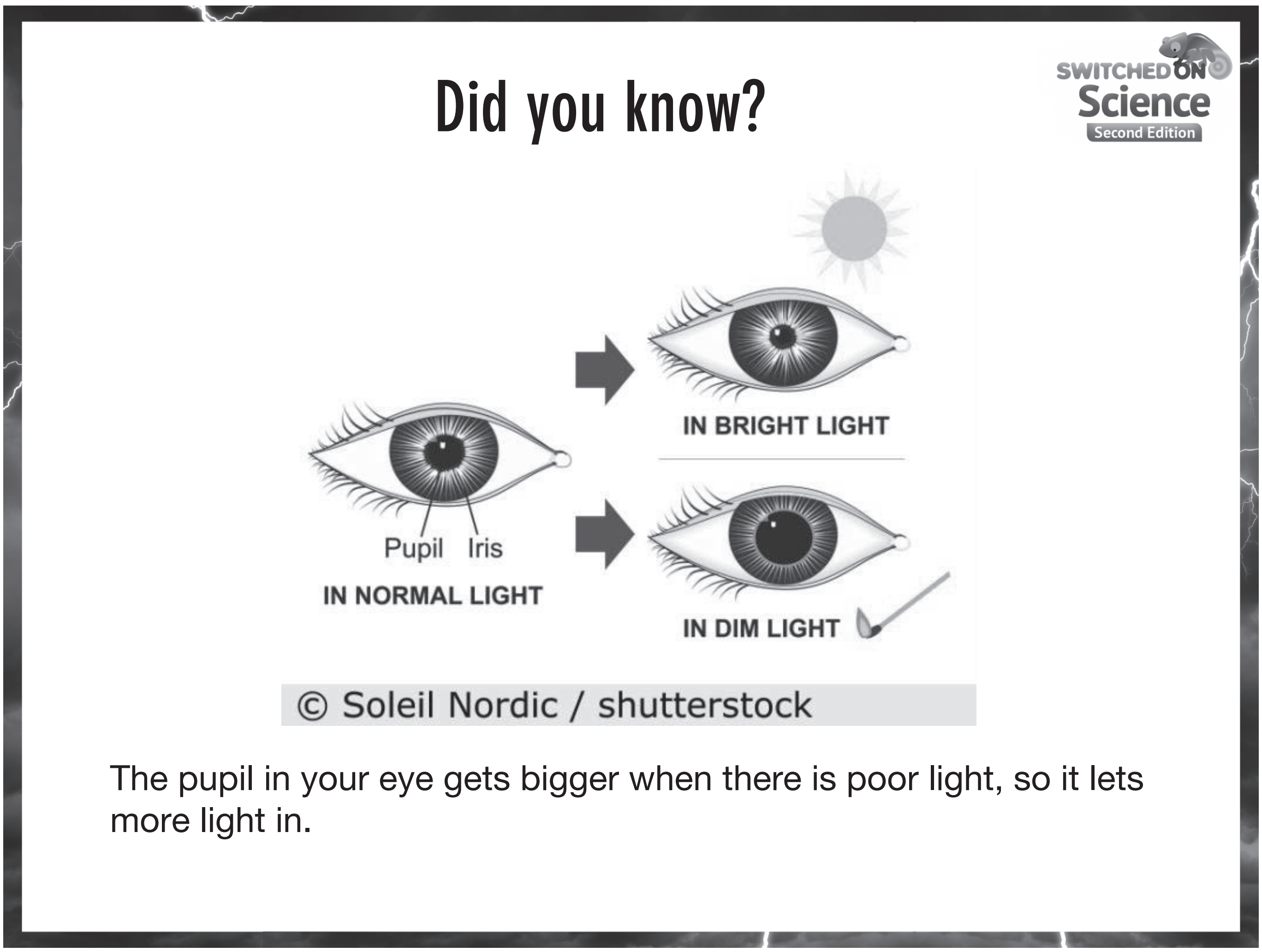
- Torches with black card and a small hole
- Powerpoint Slides 13–16
- Mirror
- Coloured wool
- Arrows on sticky card or sticky notes
- Model face with large eyes
- Video clip of how the eye works (see Useful Websites list on *My Rising Stars*)

ASSESSMENT

Subject Knowledge

- Em. Children need support to describe how light is reflected from objects into our eyes, using a given diagram.
- Exp. Children are able to draw a correct diagram and explain what happens when light is reflected from objects into our eyes.
- Exc. Children are able to apply their understanding to a range of objects and contexts.

- Turn this into a diagram on the board, with arrows on it. Ask children to now complete the three-dimensional model of how we see by creating a face and showing where the light goes from the mirror.
- Explain to children that this is a model of how we see. That light is reflected off an object into our eyes and our brain makes sense of the object and we know that it is, for example, a book.
- Ask them to look at the diagram they drew at the beginning of the lesson, how correct do they think it is, and what changes could they make for it to be scientifically correct? Give children time to discuss their first diagram with their partner and decide what changes to make, and then to check each other's second diagram to see if it is scientifically correct.
- Use Slides 14 and 15 to reinforce the concept of how we see. Show children Slide 16 which illustrate how the pupil enlarges (dilates) and then the video clip. 'The human eye and how it works' on the Useful Websites list on *My Rising Stars*. This shows children how the eye works.
- Ask children to discuss if this statement is true or false. 'All objects reflect light – true or false?' Ask the children to explain. It is true, otherwise we couldn't see anything!



4.3 Bending light

GET STARTED

Show children the activity on the Switched on Science 'Let it shine' video. As you show it reinforce the explanation given, show it again and give children prisms and a torch to try it for themselves, marking with adhesive putty where the light enters the prism and exits, to show that light is bent. To make a small, sharp beam of light get children to use a piece of card with a slit and stick it over the torch to make a more focussed beam.

LET'S THINK LIKE SCIENTISTS

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

- Who discovered the rainbow of colours and realised how they got there?
- What is a prism and how does it make a rainbow?

ACTIVITIES

1 OBSERVING THE UNEXPECTED

L.O. Use the idea that light travels in straight lines to explain that objects are seen because they give out or reflect light into the eye.

Explain that we see things because light travels from light sources to our eyes or from light sources to objects and then to our eyes.

Report and present findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations.

- Explain to children that sometimes things do not appear as they should and that they are going to carry out some activities where the everyday objects they look at aren't as expected. Children do not need to be able to explain refraction, although there is no reason why children should not be given an explanation. For example, when light travels from air through water, glass or anything that lets light through, it gets bent, it can make objects look strange. This bending is called refraction.
- Copy the activities on Activity Resources 4.4 to 4.7 and set up the activities as a circus with activities on different tables for the children to explore. Get them to work in pairs and ask them to discuss:
  - What did you expect to see?
  - What did you see instead?
  - How was it different to what you expected?
  - Try to explain it.
  - Draw what you saw
  - Where could this be useful in everyday life?

YOU WILL NEED

- Activity Resources 4.4–4.7
- Rectangular Perspex or glass block
- Torch
- White paper
- Clear plastic tumbler
- Jug of water
- Pencil
- Bowl
- PowerPoint Slide 17
- Opaque cup or mug
- 2p coin
- Adhesive putty
- Clear water bottle
- Black paper

Bending light

- This is a simple illustration of the way light bends as it travels through different materials. It slows down as it goes into the plastic block.

Where's the coin?

- The children step back until they cannot see the coin. As water is poured into the cup the coin reappears because the water bends, or refracts, the light travelling from the coin so that it can now reach the eye.

Bendy pencil

- Light cannot travel as quickly in the water as it does in the air, the light bends around the pencil, causing it to look bent in the water. It makes the pencil look bigger and makes the angle appear bigger than it actually is, causing the pencil to appear crooked.
- Show children Slide 17 which illustrates refraction.

Pouring light

- When the torch is shone almost all the light from the torch is reflected when it hits the edge of the stream of water, the light follows the path of the water and so you see a spot of light where the water hits the sink.
- You could use the CPD video (available online) to help children understand what is happening in each of these activities.

ASSESSMENT

Subject Knowledge

- Em. Children carry out the instructions and can say what they see.
- Exp. Children are able to say that refraction makes things look different.
- Exc. Children are able to suggest what happens to the path of light when it travels through water and glass.

Working Scientifically

- Em. Children can demonstrate and describe what is happening.
- Exp. Children can choose how to record and communicate their tests.
- Exc. Children can choose how to record and communicate their tests according to their audience.

2 RAINBOWS

L.O. Report and present findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations.

- Show children the short video clip about how rainbows are formed (see Useful Website List).
- Then, working in pairs children use a prism, a white card screen and torch, to explore making rainbows. Encourage children to explore creating rainbows by moving the torch closer and further away from the prism and at different angles. Children note what happens when they move the torch to the prism and explore whether the rainbow effect is clearer when the prism is made bigger or smaller, or how close the screen is to the prism.
- Make a note of the colours in the rainbow and challenge children to make a fun mnemonic to remember the colours.

YOU WILL NEED

- Video clip (see Useful Websites list on *My Rising Stars*)
- Torches with a black card over the light and a slit cut into it
- White card
- Glass or Perspex prisms
- Bubble mixture
- Sweet cellophane wrappers
- Coloured objects
- Electrical circuit components including motors

Bubbles

- Give children bubble mixture to blow bubbles and explore the colours they can see.
- Observe a rainbow in their bubbles. Which colours are the most common?
- Explore how changing the soap solution affects the colours in the bubbles.
- Find out if colours in the environment, e.g. green grass is reflected in the bubbles.
- Challenge children to use their knowledge of prisms to explain why rainbows can be seen in bubbles.

Make a colour spinner

- Children make a circle of card or thick paper and make seven equal segments in rainbow colours.
- Children make an electrical circuit and place it on the spindle of a motor in the circuit. When the card spins the colours merge to form white showing that white light is made up of the colours of the rainbow.

Colour filters

- Children use sweet wrappers and make rainbow glasses, so that when they turn a wheel they observe the effect that looking through different colours has on what they see.
- Children could look through these at different coloured objects and record what they see. What colour does the white card look like? What colour does an object of the same colour as the wrapper look like? (It should appear black!)
- Discuss what has been found out and what questions they also explored.

ASSESSMENT

Working Scientifically

- Em. Children use their observations to name the colours of the rainbow.
- Exc. Children use their observations to draw conclusions.
- Exp. Children use their observations and conclusions to ask and answer new questions.

TOPIC 5 Electricity

About this topic

Curriculum link: Year 6, Electricity

SUMMARY:

This topic builds on the Year 4 work on electricity, taking it into the scientific use of symbols for components in a circuit, as well as considering the effect in more detail of changing components in a circuit. The children have the opportunity to apply their learning by creating an electronic game.

UNITS:

5.1: Think like an electrician
5.2: Changing circuits
5.3: Build your own

ACTIVITY RESOURCES:

5.1 Circuit symbols
5.2 Circuit diagrams

ONLINE RESOURCES:

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

Learning objectives

This topic covers the following learning objectives:

- Associate the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit.
- Compare and give reasons for variations in how components function, including the brightness of bulbs, the loudness of buzzers and the on / off position of switches.
- Use recognised symbols when representing a simple circuit in a diagram.

Working scientifically

This topic develops the following working scientifically skills:

- Plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary.
- Take measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate.
- Record data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs.
- Use test results to make predictions to set up further comparative and fair tests.
- Report and present findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations.
- Identify scientific evidence that has been used to support or refute ideas or arguments.

CROSS-CURRICULAR LINKS

This topic offers the following cross-curricular opportunities:

English

- Write instructions for making a circuit.
- Research scientists and write biographies, e.g. Edison, Volta.
- Research daily life prior to electricity.
- Write a leaflet, text for packaging and an advert for a circuit game.
- Plan and give a talk in assembly to explain a new ‘Switch it off’ campaign for using less electricity.
- Research alternative energy sources, e.g. solar and wind power.
- Research modern inventors, e.g. James Dyson.

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Numeracy and mathematics

- Practise multiplication for voltage in a circuit related to the number of batteries.
- Reading and calculating electricity bills.
- Reading the school electricity bill.

Computing / ICT

- Play interactive electrical circuit activities.
- Use the Internet safely for research.
- Take photographs and create video clips of circuits.

Design and technology

- Design and make, test and evaluate an electrical device that warns a sight-impaired person when water in a cup gets to a certain point.
- Design, make, test, evaluate and advertise an electrical game.
- Design and make a working model using an electric circuit.

History

- Research scientists discovering electricity and inventing electrical appliances.
- Timeline of electrical appliances.
- How has electricity impacted on modern life, e.g. light and noise pollution, pollution from power stations, life-saving medical equipment?

Drama

- Role-play a famous scientist.
- Script and perform a play for younger children about being safe around electricity.

HEALTH AND SAFETY

Remind children how to stay safe when using mains electricity and that used batteries should not be placed in the bin but put in a special container so that they can be taken to a local supermarket to be recycled.

STEAM (SCIENCE TECHNOLOGY ENGINEERING ART AND MATHS) OPPORTUNITIES

Invite into class

- An electrician to talk to children about their job, health and safety, training.
- An elderly person to discuss changes over the years relating to electricity e.g. appliances.
- Someone involved in renewable energy sources or conserving energy.

Visit

- Local energy centre.
- Wind turbine industry.

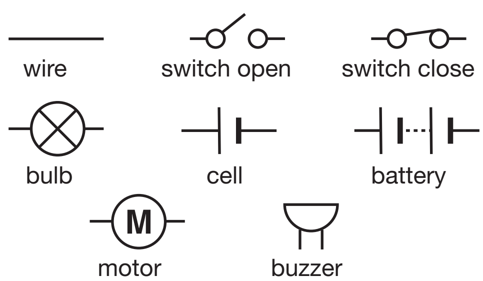
TEACHER SUBJECT KNOWLEDGE

Circuits

Before you start any work on circuits with the children, it is crucial that you test that all the batteries work, as well as the bulbs. A simple circuit will allow you to do this. Ensure you have plenty of spare batteries and bulbs handy as they do run out and blow respectively during lessons! Also ensure that the bulbs and batteries are rated correctly so the children don't blow too many or will not be able to see the light.

A current will only pass around the circuit if it is complete. Any break in the circuit will reduce the current to zero throughout the whole circuit.

To make representation of circuits easier and clearer, symbols are used, such as these:



When getting the children to draw circuits, these should be completed with a ruler to make square circuits, rather than free-flowing wires. The positive end of the cell (single battery) is the longer line. A series of single batteries (cells) makes a 'battery'.

Resistors

Resistors restrict or limit the flow of current in a circuit. Resistance is how easily electricity can pass through a material in a circuit. Different materials have different levels of resistance and this can be used to change the resistance in a circuit and change the brightness of a bulb. Good conductors, e.g. metals have a low resistance, they allow electricity to move through more easily than, for example, plastic, which therefore has high electrical resistance.

Changing the length and the thickness of wire in a circuit will change the resistance. The thinner the wire the harder it is for electricity to move through, the thicker the wire the easier. The shorter the wire the less resistance, the longer the wire the greater the resistance.

CHILDREN'S MISCONCEPTIONS

Children may believe...

- That a wire isn't a component.
- That if a bulb isn't working, it is a flat battery, but sometimes it is the voltage of the bulb compared to the battery that is wrong, or the blub that is blown.

Children already know...

- That a complete circuit is required for a bulb to light.
- That batteries produce electricity.
- That an electric current passes through a circuit.
- That metals are good conductors.
- That some devices run off mains and some off batteries.
- That batteries have two ends.

SCIENTIFIC VOCABULARY:ELECTRICITY

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

battery: a series of cells

blow: what happens when a bulb has too much electricity going through it

cell: a single battery that supplies power to the circuit

complete: something (a circuit) that doesn't have any gaps in it

component: something that makes up part of a circuit such as a bulb or wire

electrons: what makes up electricity: negatively charged particles

filament: the very thin wire, like that in a fuse, and that is inside a bulb

fuse: a safety device that will melt and make a break in a circuit if there is too much electricity

5.1 Think like an electrician

GET STARTED

Give children components for making a circuit, set a timer, and challenge them to make a circuit that lights a bulb in the shortest time. Get them to record their time and then let children have another go and see if they can beat their record.

LET'S THINK LIKE SCIENTISTS

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

- Michael Faraday made some of the first batteries and made frogs' legs twitch. What did he use and how are these similar to modern batteries?
- There are lots of other symbols used by electricians. What are they?
- There are some materials other than metals that conduct electricity. Can you find out what they are?

ACTIVITIES

1 LIQUORICE ALLSORTS CIRCUIT DIAGRAM

L.O. Use recognised symbols when representing a simple circuit in a diagram.

- Use Slide 6 which shows a convoluted circuit. Ask children to discuss whether they think it will light the bulbs and give them time to make it.
- Ask the children what they found difficult about trying to follow the drawing on the slide.
- Give each group a bag of liquorice allsorts and some liquorice laces. Explain to the children that they are going to use the sweets to make a circuit diagram. The sweets will represent different components in a simple circuit that makes a bulb light. For those children who are unable to visualise how this would work you could show them Slide 7.
- They should place their circuit diagram on a piece of card and use it to check that it works if followed. Tell them they must include a key to show which components the sweets represent.
- Children swap places with another group to use their circuit diagram to make a working circuit and leave a constructive comment on a sticky note.
- How much easier was it to follow the liquorice allsorts symbols than the first diagram? Explain that scientists all use symbols. Use Slide 8 which shows the international symbols.
- Give pairs the circuit symbols on Activity Resource 5.1. Tell them to cut out the symbols so that they are small symbol cards, and using a large sheet of paper (or using dry wipe markers on the desk top) they use the symbols to show a simple circuit by joining the symbols with a straight line to represent wires. Explain the convention shown on Slide 9 that the circuit is not drawn as a circle but as a rectangle.
- Next children make a variety of circuits using a selection of circuit components. One member of the pair uses the symbols cards to create a circuit diagram and the other must build it.

YOU WILL NEED

- PowerPoint Slides 6–9
- Whiteboard or other for display
- Electrical resources, wires, bulbs, bulb holders, switches, motors and batteries, for each child
- Activity Resource 5.1
- Liquorice allsorts and liquorice laces
  - Sheets of card
  - Pens or pencils
  - Sticky notes

ASSESSMENT

Subject Knowledge

- Em. Children can draw a picture of a circuit and name the components.
- Exp. Children use the circuit symbol cards to draw a circuit.
- Exc. Children move from using circuit symbol cards to using the symbols to draw their own circuits.

2 IT'S FAULTY

L.O. Use recognised symbols when representing a simple circuit in a diagram.

- Use PowerPoint Slide 10 and ask the children to discuss in their groups which is the odd one out in question 1 and then in question 2 and why.
- Give children Activity Resource 5.2 and ask them to predict which of the circuits will work and why? Then they should make each circuit to test whether or not their prediction was correct and explain why.
- Working in pairs, children create their own circuit diagrams page for others to use drawing five circuit diagram pictures where some circuits will work and others will not. They then swap their circuit diagrams page with another pair and firstly read the diagram and predict if the circuit will work and why and then make each circuit to test their prediction. Each group assesses the others' responses.

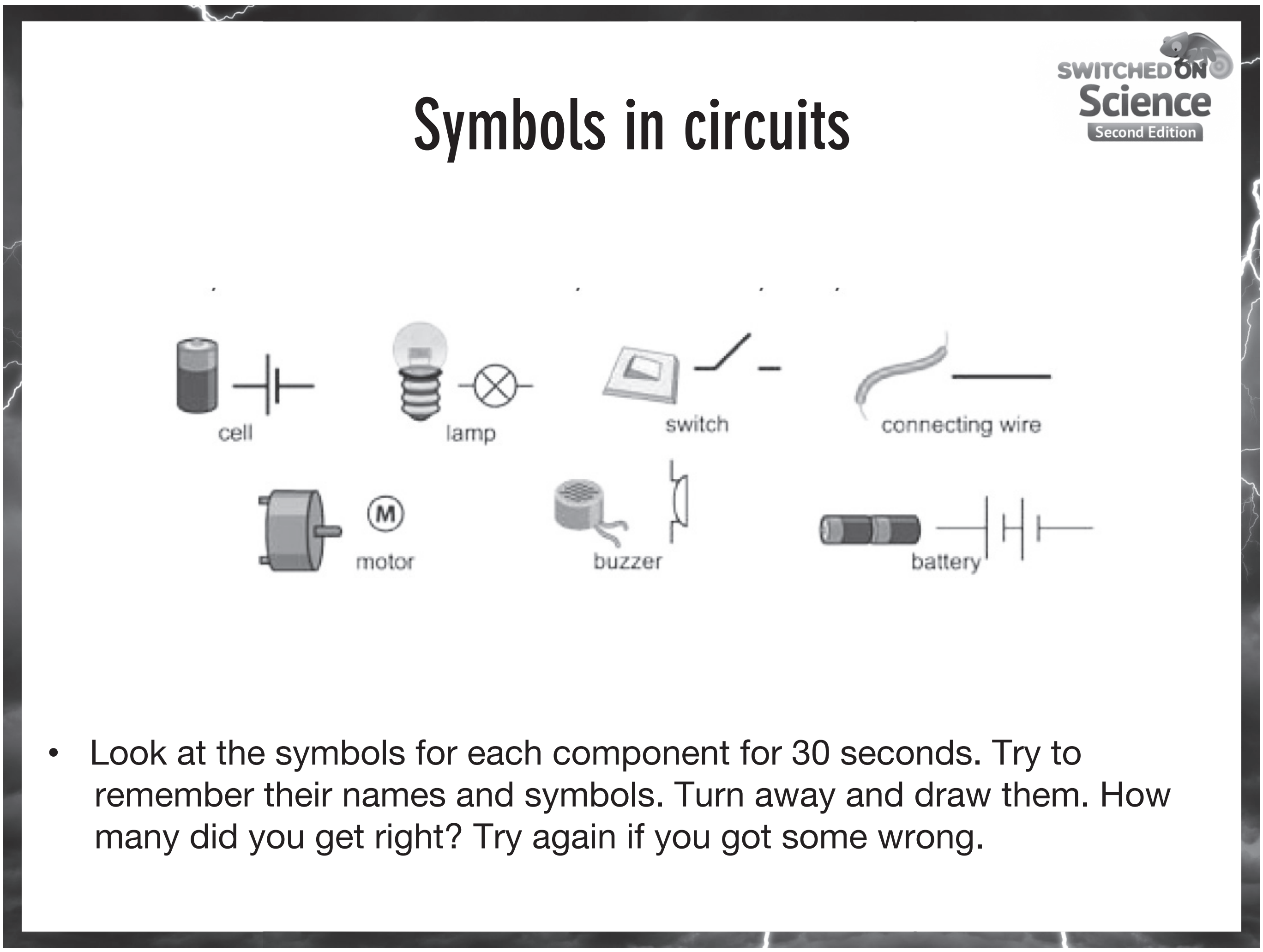
YOU WILL NEED

- PowerPoint Slide 10
- Activity Resource 5.2
- Electrical components: batteries, bulbs, buzzers, motors, wires

ASSESSMENT

Subject Knowledge

- Em. Children require support to read the circuit diagrams, they may require a circuit picture alongside to correspond to the symbols.
- Exp. Children read and make the circuits diagram and can explain why they do and do not work.
- Exc. Children apply their knowledge of, for example, volts and increase the battery volts and symbol so that the light blows.



5.2 Changing circuits

GET STARTED

Challenge children to write down as many words as they can with the root word 'electricity'. Give children two minutes on a timer to complete this task. Then create a long list of the words from children's responses.

LET'S THINK LIKE SCIENTISTS

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

- How do you think a dimmer switch works? Find out.
- How many different kinds of light bulbs are there?
- How have light bulbs changed over time?
- Why do some light bulbs get hot when they are switched on?

ACTIVITIES

1 HOW BRIGHT?

L.O. Associate the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit.

Compare and give reasons for variations in how components function, including the brightness of bulbs, the loudness of buzzers and the on / off position of switches.

Report and present findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations.

- Show children Slide 11. Discuss how to be scientific about the way of testing. For example, what evidence could they collect? How will they measure the brightness of the bulb?
- If you have data loggers these could be used, or devise a way of seeing through a certain number of pieces of paper. The children may have their own ideas.
- Working in pairs, the children plan how they will investigate answering the questions on Slide 11.
- When they have planned their investigation, the children should draw circuit diagrams of the circuits they will use and carry out their investigation. They should also consider how best to present their results, e.g. bar chart, table, line graph, photographs, etc.
- Next show children Slide 12 and ask children to investigate the statements. Once again they should work scientifically and collect evidence and record their results appropriately.
- Remind them that the proper name for one battery is a cell and each cell has a voltage of 1.5 V. Ask what voltages can be obtained from up to five cells.
- Bring the class together and ask them to summarise in statements what they have learned from these activities, for example:
  - Increasing the number of components and keeping the battery the same.
  - Adding more batteries (increasing the number of volts) to the circuit.
  - Increasing the number of volts (cells) but keeping only one bulb in the circuit.

YOU WILL NEED

- PowerPoint Slides 11 and 12
- Electrical components: batteries, bulbs, buzzers, motors, wires
- Paper and pencils or pens

ASSESSMENT

Subject Knowledge

- Em. Children are able to describe what happened. They need support to explain what caused the changes.
- Exp. Children make links between what they changed and the results.
- Exc. Children apply what they know to manipulate circuits and test their own ideas.

Working Scientifically

- Em. Children can draw a picture of a circuit and name the components.
- Exp. Children use the circuit symbol cards to draw a circuit.
- Exc. Children move from using circuit symbol cards to using the symbols to draw their own circuits

2 CHANGING LIGHT, SOUND AND MOVEMENT

L.O. Compare and give reasons for variations in how components function, including the brightness of bulbs, the loudness of buzzers and the on / off position of switches.

Plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary.

Report and present findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations.

- In this activity children explore how using resistance wire can change the brightness of a bulb, speed of a motor and sound of a buzzer.
- Give children different kinds of resistance wire and ask them to place a length of the wire in a circuit to see if it conducts electricity. Explain that the wire is a conductor and it is also called an electrical resistor. Good resistors allow electricity to pass through easily; the resistance wire is a good resistor.
- Now ask children to think about the wires on their table and what kind of questions they could ask and test. Tell them that all of their questions should begin with 'How does….?' They may ask questions such as:
  - How does the length of the wire affect the component/s in the circuit?
  - How does the thickness of the wire affect the component/s in the circuit?
  - How does the thickness and length of the wire affect the component/s in the circuit?
- Show children Slide 13 which shows how a test can be set up using resistance wire. Ask the children to suggest why the wire has been wrapped around some card and each row of wire is numbered. How might this help them to gather and record evidence?
- Challenge them to design a symbol to show that resistance wire has been used in a circuit.
- Now give children time to plan, carry out and record their results. Ask them to think about how they could measure, e.g. brightness of bulbs, speed of the motor and sound of the buzzer. Give them the opportunity to create a short video clip on the effect of using resistance wire in a circuit making sure that they have written their script first so that their explanation is correct and uses scientific vocabulary.

YOU WILL NEED

- PowerPoint Slide 13
- Batteries, buzzers, bulbs, motors, switches, crocodile clips
- Wires including resistance wire of different thicknesses

ASSESSMENT

Subject Knowledge

- Em. Children can describe what happens when they use resistance wire in a circuit.
- Exp. Children know that changing the wire in a circuit can effect the brightness of a bulb or loudness of a sound.
- Exc. Children can suggest reasons why changing the wire has an effect on the brightness of a bulb or loudness of a sound.

Working Scientifically

- Em. Children can use resistance wire in their circuit and observe changes.
- Exp. Children carry out fair tests to answer their questions and give reasons for their results.
- Exc. Children use their results to explain the relationship between changing variables and their results. They research why resistance wire is used in fuses.

5.3 Build your own

GET STARTED

Use the Pupil video 'Electricity' to show children a range of games that they can make using circuits. You could also use PowerPoint Slide 14. Give children time to discuss other ideas and share them with the rest of the class.

LET'S THINK LIKE SCIENTISTS

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

- Who discovered electricity?
- Which electrical appliance do you think most people could not live without today?
- Who is James Dyson? What has he invented that uses electricity?

ACTIVITIES

1 GAMES GALORE

L.O. Associate the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit.

Compare and give reasons for variations in how components function, including the brightness of bulbs, the loudness of buzzers and the on / off position of switches.

Use recognised symbols when representing a simple circuit in a diagram.

Plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary.

- Tell the children they are going to be designing their own game, similar to those in Slide 14 and in the video clip they have just seen.
- Challenge children to use what they have learned in this unit about changing the brightness and volume of components and ensure that they create circuit diagrams of the circuits in their game.
- As part of this activity children should:
  - Design, make, test and evaluate their game.
  - Use their knowledge of maths nets to create a box for their game.
  - Use literacy skills to write an instruction leaflet for their game which includes a circuit diagram.
  - Use literacy skills to create an advert for their game, e.g. poster or video clip.
- As a class, produce a point-scoring system on the games so they can be peer assessed, e.g. how hard or easy it is to do, how well it is made, originality of design, correct circuit diagrams, packaging and instructions and advert.

YOU WILL NEED

- Buzzers, wire, bulbs, batteries, swtiches, card
- Foil
- Crocodile clips

ASSESSMENT

- Em. Children are supported to make their own game or work with others and can draw a picture of their circuit.
- Exp. Children apply their knowledge of circuits including circuit diagrams to make their game and can use standard symbols to draw their circuit.
- Exc. Children problem solve and research additional information / approaches, e.g. parallel circuits and use standard circuit symbols to show new circuits.

2 ELECTRICITY PAST AND PRESENT

L.O. Report and present findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations.

- Invite a visitor into the classroom, for example an older person who can talk about the changes in electricity and electrical appliances in their lifetime. Prepare children beforehand so that they are able to ask a range of interesting questions. The person might be willing for children to video the interview.
- This activity is one which could be carried out across the length of the topic as an on-going project which culminates at the end with presentations. Explain to children that they are going to work in groups to research the history of electricity and the work and importance of the scientists involved. They should:
  - Decide what questions they want answered.
  - Which sources of information they could use, e.g. the interview, websites, books.
  - How they are going to share the tasks amongst their group.
  - How they are going to record their information, e.g. notes.
  - How they will present their research, e.g. PowerPoint, video, timeline, Infographic, newspaper article, poster.
- Prior to their research, ask children to produce a set of criteria against which the children will peer assess each other's work.
- When they have completed their work, children will present their research to either another group or to the rest of the class. This is best done over several days so that children do not become disinterested. Children peer assess and give constructive feedback to each group – the aim is not to create a winner, but for children to develop their ability to peer assess and give and receive feedback.

YOU WILL NEED

- Pens and paper
- Video
- Camera

ASSESSMENT

Working Scientifically

- Em. Children contribute to the work of the group.
- Exp. Children work independently to research and communicate their work.
- Exc. Children are able to delegate in their group and work collaboratively to present their research and check their work against the criteria.

TOPIC 6 The Titanic

About this topic

Curriculum link: Year 6, Working Scientifically Skills

SUMMARY:

Children engage in a different approach to their science in this topic. They use their science and link it to an historical event in context; the sinking of the *Titanic*. This topic is based around applying the working scientifically skills that they have learned so far in their science lessons, to explore some of the scientific concepts behind the *Titanic*, e.g. floating and sinking. It can be used as a good opportunity to embed, assess and observe working scientifically skills, as well as laying foundations for transition to KS3 science.

UNITS:

6.1: Keeping it afloat
6.2: Sinking the unsinkable
6.3: Staying alive

ONLINE RESOURCES:

Teaching slides (PowerPoint): The *Titanic*
CPD video: The *Titanic*
Pupil video: The *Titanic*
Interactive activity: The *Titanic*
Word mat: The *Titanic*
Editable Planning: The *Titanic*
Topic Test: The *Titanic*

Working Scientifically

This topic develops the following working scientifically skills:

- Plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary.
- Take measurements, use a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate.
- Record data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs.
- Report and present findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations.

CROSS-CURRICULAR LINKS

This topic offers the following cross-curricular opportunities:

English

- Research the story of the *Titanic*; ask questions as part of planning and make notes.
- Read newspaper articles, e.g. about sinking of the *Titanic*.
- Draft and re-draft a newspaper article about the sinking of the *Titanic*. Use main and subheadings, quotes, eye-witness accounts.
- Send an SOS signal giving news about the *Titanic* in six words.
- Research an individual passenger from the *Titanic*'s passenger list – write their autobiography.
- Based on research, design an advert for sailing on the *Titanic.*
- Read survivors' testimonies and use in role-play.
- Research and describe one room on the *Titanic*.
- Role-play interviewing survivors, developing character, emotion.
- Write a letter or post card, found in personal belongings.
- Debate alternative reasons for the *Titanic* sinking.
- Write a scientific report on reasons for *Titanic* sinking based on investigations.

Numeracy and mathematics

- Create a display of the '*Titanic* by numbers', e.g. calculate percentage of survivors from each deck, speed, time to sink, amount of wine, fruit, meat, miles travelled, time for hypothermia to set in.

- Work out how to show the size of the *Titanic,* e.g. whole ship, to scale.
- Explore angles of list in sinking of the *Titanic.*
- Compare the cost of holidays now and in 1912.
- Create line graphs of temperature over time.

Computing / ICT

- Create an infographic showing statistics from '*Titanic* by numbers' maths activities.
- Use the Internet safely to research the *Titanic.*
- Create newspaper front page article.
- Video role-play an interview with a *Titanic* survivor.
- Use digital thermometers.
- Use tablets or video cameras to record science activities, e.g. icebergs.
- Create a picture collage about the *Titanic.*
- Design and make a *Titanic* travel ticket.

Design and technology

- Design, make, test and evaluate model boats.
- Design and make a 3D display of key information about the *Titanic.*
- Design, make and test a model *Titanic* made from recyclable materials.

Geography

- Locate on a map or globe the key cities on the journey of the *Titanic.*
- Use longitude and latitude to plot the route and position the *Titanic* sank.
- Locate Harland and Wolff shipyard.
- Locate and map icebergs today.
- Compare number of icebergs today with 1912.
- Find out about shipping regulations today.

History

- Research the story of the *Titanic.*
- Research the lives of a person or people from different classes in 1912.
- Create a timeline from the building of the *Titanic* to sinking.
- Research posters for travel for the *Titanic.*
- Research arguments for and against who was responsible for the *Titanic* sinking.
- Research other maritime disasters in history e.g. the rescue of the SS Forfarshire and Grace Darling.

Art

- Paint the *Titanic,* e.g. at sea.
- Create a travel poster for the *Titanic.*
- Create a diorama of the sinking of the *Titanic.*
- Create sepia portraits of people who could have been passengers or crew.

Outdoor learning

- Activities using water could be carried out in the school grounds.

STEAM (SCIENCE TECHNOLOGY ENGINEERING ART AND MATHS) OPPORTUNITIES

Invite into class

- STEM engineers – to set STEM challenges and work with children.
- Historian, e.g. from local University to talk about society around 1912.
- Reporter from local newspaper to give a masterclass in writing a newspaper article.
- Writer to provide creative writing workshop linked to the *Titanic*.

Visit

- RNLI to interview lifeboat crew members.
- Maritime museum.
- Visit local radio, TV or newspaper to learn about reporting news.

TEACHER SUBJECT KNOWLEDGE

Floating and sinking

Floating, sinking and density is a topic that children will work on in more detail in secondary school. In this topic children will begin to develop and explore some basic ideas. Covering the *Titanic* also brings opportunities for activities in other curriculum areas.

Some objects like wood, sponges and unpeeled oranges are less dense than water, so they will float. Hollow objects such as balloons, empty plastic bottles will float. These things float because they have air in them, and air is less dense than water; we say that these things are buoyant. The shape of an object can be changed so that even though the mass has not changed the increase in volume makes it less dense. For example, a plasticine ball placed in water, will sink, but flatten the plasticine and make it into a bowl shape and the volume is increased so it will float. This is the science behind why such a huge ship as the *Titanic* could float.

Hypothermia

Hypothermia is a potentially dangerous drop in body temperature, and is usually caused when someone is exposed to cold temperatures for a period of time, such as when someone is in the sea or, for example, when a hiker gets lost or has an accident in poor weather. In water hypothermia can set in very quickly. On land it will be longer but the results are the same: their core temperature drops, the person tires, becomes confused and drowsy, and if they fall asleep may die. If rescued in time the person may be wrapped in a blanket and a foil blanket to conserve heat, provided with warm drinks and taken to hospital.

CHILDREN'S MISCONCEPTIONS

Children may believe ...

- That heavy objects sink and light objects float.
- That only something that is above the surface can be said to be floating.

Children already know ...

- That some things float and some things sink.

SCIENTIFIC VOCABULARY : THE *TITANIC*

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

buoyancy: the ability of an object to float in water

density: how much matter (stuff) an object has to its volume

floating: when an object stays on the surface of a liquid

hypothermia: occurs when there's a dangerous drop in body temperature

iceberg: large pieces of ice broken off from a glacier or large areas of floating ice

sink: go below the surface of water

thermal insulation: a material that decreases the flow of heat from a hot area to a cooler one

upthrust: the force that pushes an object up and makes it seem to lose weight in a water

6.1 Keeping it afloat

GET STARTED

Read ‘Jack Thayer’s story’ (see the Useful Website list on *My Rising Stars*) a survivor’s account from the *Titanic*. Jack Thayer was a 17-year-old who was in a lifeboat and watched the *Titanic* sink.

‘From the icy water, Jack looked up to see *Titanic*’s second funnel topple into the sea close by, creating suction that pulled Jack underwater.’

Ask children to discuss how such a huge ship, which was meant to be indestructible, could be sunk by an iceberg.

LET’S THINK LIKE SCIENTISTS

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

- How do boats float?
- How can you make things that sink float?
- Why did so many people die in the *Titanic* disaster?

ACTIVITIES

1 FLOATING AND SINKING

L.O. Plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary. Use test results to make predictions to set up further comparative and fair tests.

- In this set of activities, children explore floating and sinking. As part of each activity, children plan their comparative tests and use their results to make new predictions to check with further tests.
- Give children two small oranges. Ask the children for predictions about what they think will happen when they put both oranges in the water. Will they both float, or both sink? Something else? Use Slide 5 to show children how to set up the activity. They should place the first one into their bowl of water and observe the outcome. Then, the children *peel* the second orange and place it into the water and compare both; what are the similarities and differences? What ideas do they have to explain why the unpeeled orange floats but the peeled orange sinks? The unpeeled orange floats because the rind is filled with tiny pockets of air. Even though you’re removing mass when you peel the orange, the peeled orange is more dense and sinks in the water.
- Show Slide 6. Give children aluminium foil and tell them to tear or cut two pieces of the same area. They could apply their maths knowledge to check this. The children scrunch one of the pieces of foil and then put it in the water. They do the same with the other piece of foil, but this time they scrunch the second piece of foil under the water and compare the results.

YOU WILL NEED

- Small oranges / satsumas
- Bowls
- Aluminium foil
- Household candles
- Plasticine or clay
- PowerPoint Slides 5–7

ASSESSMENT

Working Scientifically

- Em. Children carry out comparative tests and describe what happened.
- Exp. Children describe what happened in comparative tests and test additional questions.
- Exc. Children carry out further comparative tests and make links between each one to draw conclusions.

What ideas do they have to explain that the foil scrunched underwater sinks but the other piece floats? The foil scrunched under the water does not contain air, whereas the one above water does, so the latter floats.

- Use Slide 7. Give children a household candle and a piece of clay or plasticine that is rolled up into a ball. Tell them to hold one in one hand and one in the other and compare them; does one feel heavier than the other? Now tell them to put both in their bowl of water and compare what happens. What ideas do they have to explain that the candle floats whilst the ball of plasticine sinks?
- Bring the class together to discuss what they found out from these activities, what other comparative tests they could set up and to share explanations of their results. The key idea is that the peel has air in it and so keeps the orange afloat (it makes it less dense than the water). When the aluminium foil is scrunched out of the water there is air trapped in the foil. The candle, although bigger that the ball of plasticine, is less dense and therefore floats. At this stage children do not need to fully understand the idea of density, this is a concept they will come across again at KS3. More important is that the children are able to carry out comparative tests, suggest and set up new tests and make links to draw conclusions.

2 WATER AS A FORCE

L.O. Use test results to make predictions to set up further comparative and fair tests.

Report and present findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations

- Show PowerPoint Slide 8 which gives the dimensions of The *Titanic*: it was 882 feet 9 inches (269.06 m) long with a maximum breadth of 92 feet 6 inches (28.19 m). The total height, measured from the base of the keel to the top of the bridge, was 104 feet (32 m). The dimensions on the PowerPoint are in feet and inches. Challenge the children to convert to metres and centimetres then take the children outside to draw the *Titanic* on the school playground using chalk. They could take photographs of their chalk *Titanic* and put detail on it for other children in the school to see. Children could annotate with information about the *Titanic*.
- Give each group a deep bowl or aquarium of water and an inflated balloon.
- Ask the children to explore where the balloon floats in the water and then what they can feel and what happens when they push the balloon down into the water and let go.

YOU WILL NEED

- Chalk
- Bowls or aquariums
- Balloons
- Balloon pumps
- Force meters
- PowerPoint Slide 8

ASSESSMENT

Subject Knowledge

- Em. Children describe how they feel the water pushing the balloon up.
- Exp. Children carry out repeat readings and graph their data.
- Exc. Children explain why they can trust their results and conclusions.

- Give children time to explore this exercise, they could also carry out comparative tests with balloons of different sizes. They will observe that all of the balloons will float on top of the water because it has air in it and is less dense than the water.
- When children push the balloon down in water, they will feel the force of the water pushing back on the balloon and their hand. If they compare balloons inflated to different sizes, they will find that the bigger the balloon, the more force (upthrust from the water) they will feel pushing back on the balloon.
- To help children understand that, when an object is in water, the water has an upward force on the object, the children should use a force meter to measure the object in the air and then measure the object when it is placed in water. They will notice that the object appears to weigh less when placed in the water than when it is weighed in the air.
- Ask the class if they will have more confidence in their results taking one set of readings or if they repeated readings, and why.
- Ask children to suggest how they can prove that this happens with other objects and to carry out their ideas in a way that they would have confidence in their results, i.e. collecting repeat readings.
- Tell the children to graph their data and to use their data to make links with their experience of the pushing the balloon down in the water and the idea that water has an upward force. Support the children to create a bar or line graph with the findings. You might want to record results and plot a graph first together as a class, then children can continue the investigation.

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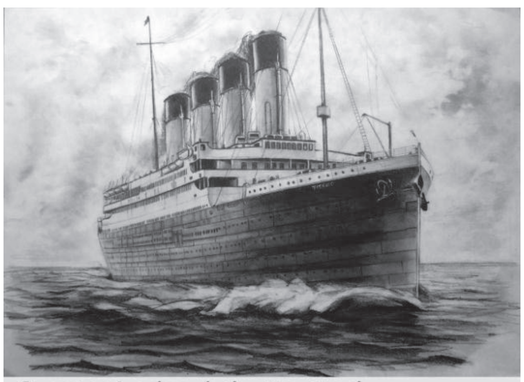

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The *Titanic* was to be the biggest, fastest and most luxurious liner ever to be built.

It was 882 feet, 9 inches long with a maximum breadth of 92 feet, 6 inches Her total height, measured from the base of the keel to the top of the bridge, was 104 feet.

After just three years, The *Titanic* was finished - a floating city, ready to set sail on her maiden voyage from Southampton to New York

3 BOAT BUILDING

L.O. Plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary.

Report and present findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations.

- Show children the short video sequence illustrating the launch of the *Titanic* (see the Useful Website link on *My Rising Stars.)*. Discuss the pictures and ask questions such as, ‘How do you know this is a huge boat?’ ‘What were people wearing?’ ‘Why did it have scaffolding?’ ‘How did they think such a huge boat could float?’ Remind children that this boat was advertised as being ‘unsinkable’.
- Remind children of what they learned in the previous activity. Give children some plasticine and tell them to put it into the water to find out what will happen. The plasticine sinks, so ask them to change the shape of the plasticine so that it floats, then see if they can make a plasticine boat to hold the greatest weight.
- Ask children what they changed to make the plasticine boat (the shape).
- Set children the challenge to work in pairs and, using their knowledge of making a plasticine boat, use only one piece of aluminium foil (the same size for everyone) to design, make and test a boat that can float and hold the greatest weight. They should add weights until the boat sinks and record their results, they can make changes to the boat to make it hold more weights but they cannot have another piece of foil.
- When the children have completed their task, bring the class together to look at the designs and test each boat. Engage children in discussion which compares and contrasts each boat and challenge them to identify what makes some boats better than others. Discuss the idea of maximising the surface area of the boat.

YOU WILL NEED

- Plasticine
- Kitchen foil for each group
- Small weights
- Video clip of ‘Launch of the *Titanic*’ (see Useful Websites list on *My Rising Stars*)

ASSESSMENT

- Em. Children can talk about how they made and tested their boat
- Exp. Children link changing the shape of the plasticine and foil to how successful their boat was and talk about if repeat readings were required.
- Exc. Children use the causal relationships in their data as the basis of additional tests to ensure that they can trust their results.

6.2 Sinking the unsinkable

GET STARTED

Show the video clip from the previous unit where the *Titanic* was being launched 'Launch of the *Titanic*' (see Useful Websites list on *My Rising Stars*). Discuss with children the sequence (which has been speeded up). What would they have felt like as a passenger? Where would they have needed to go to be safe on the *Titanic*? Ask the children to research passenger statements of what they saw as the *Titanic* sank.

LET'S THINK LIKE SCIENTISTS

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

- The *Titanic* was supposed to be unsinkable, what happened to it?
- How long did it take for the *Titanic* to sink?
- What happened to the *Herald of Free Enterprise* on 6th March 1987?

ACTIVITIES

1 SINKING THE TITANIC

L.O. Plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary.

Report and present findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations.

- Show children Slide 9 which illustrates how the *Titanic* sank, and Slide 10 which shows an illustration of how they will make and test their *Titanic* ship using a 2 litre plastic bottle. When the children sink their model, they should take a series of photographs or a video clip so that they can observe and analyse how the ship sank, for example, answering questions such as:
  - How quickly did the ship sink?
  - What was the path of the water, did the ship sink evenly? Why?
  - How high the water was before it began to sink?
  - At what angle did it go under?
- Tell the children that they are going to create a piece of extended writing as an eyewitness who saw the *Titanic* sink from a lifeboat. Give children time to review their photographs and video clip of their model and also to discuss what it must have felt like to be in the lifeboat, how they felt, the cold, the fear, etc. They could read survivor accounts and also find out the correct names for parts of the boat e.g. *hull, stern, aft, port, bow*. Children can also look at 'How *Titanic* sank' (see Useful Websites list on *My Rising Stars*).
- They should discuss their writing and then draft and redraft their work and share their writing as part of peer assessment prior to writing their final version.
- As an alternative, children could repeat the sinking and video it, describing how it sank using intonation to indicate fear and horror at the sinking.

YOU WILL NEED

- Video clip: 'How *Titanic* sank' (see Useful Websites list on *My Rising Stars*)
- 2 litre plastic bottles, e.g. empty soda or milk containers
- Bowls or aquariums
- Camera or tablet to record evidence
- PowerPoint Slides 9 and 10

ASSESSMENT

- Em. Children describe what happened to the boat when it sank.
- Exp. Children describe the sequence of events explaining how and why the ship sank.
- Exc. Children use their model to explain how and why the *Titanic* sank and talk about whether the results from their model can be trusted.

2 ICEBERGS

L.O. Take measurements, use a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate.

Report and present findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations

- Show children the video clip of an iceberg calving (see Useful Websites list on *My Rising Stars*). Explain to children that is how the iceberg that sank the *Titanic* was created. What clues in the video clip suggest that this is a large piece of ice?
- Prior to this lesson, create an iceberg for each group by filling a balloon with water and freezing it. Each group should have a bowl or aquarium of water into which their iceberg is placed.
- Set the challenge to find out as much as they can about their icebergs. Use Slide 11 to support children's thinking, Tell the children that they will be given an 'iceberg' and bowl or tank of water to find out as much as they can by observations about the iceberg and surrounding sea. Here are some of the things that children might observe:
  - The sound the iceberg makes when it is placed in water.
  - How it floats.
  - What the iceberg looks like, e.g. transparent, translucent, shiny.
  - The percentage of ice above and below the surface?
  - How the temperature of the surrounding water changes when the iceberg is placed into the water.
  - How long it takes for the iceberg to melt.
- Key to this activity is that children have to provide proof of what they have found out and use ICT to provide evidence so that they can create a presentation on icebergs to other children in their class. They should use:
  - Photographs – of how the iceberg floats in water.
  - Video clips – e.g. pushing down on the iceberg, and effect of letting go.
  - Microphones – to record observations.
- All children should use digital or spirit thermometers to gather data recording the change in temperature of the surrounding water over time. Children will need to decide the frequency of observations, e.g. every minute, ten minutes or 20 minutes over a period of about 30 minutes to an hour. If using a computer package digital thermometer, the result will be a line graph. If they are using a spirit thermometer, children should take and record regular readings which they then use to create a line graph. Children may require support in working out the scale on both the horizontal and vertical axis prior to plotting their data.

YOU WILL NEED

- Video clip 'Iceberg calving' '(see Useful Websites list on *My Rising Stars*)
- Ice balloons
- Bowls or aquaria
- Digital thermometers
- Spirit thermometers
- Cameras or tablets
- PowerPoint Slide 11

ASSESSMENT

Working Scientifically

- Em. Children describe how the iceberg changed.
- Exp. Children describe what they have found out about their iceberg, they can talk about how the temperature of water changes over time due to the temperature of the iceberg.
- Exc. Children use their observations and data to explain changes in the temperature of the water over time due the iceberg.

6.3 Staying alive

GET STARTED

Read this part of a statement from Elizabeth Shutes who was a governess on board the *Titanic*. She managed to get into a lifeboat and describes the chaos and says that 'Two oars were soon overboard. The men's hands were too cold to hold on…'.

Give an ice cube to children and ask them to hold it in their hand, and time how long they can hold it for. Then ask them to imagine how the people on the boat and in the water might feel in freezing temperatures.

LET'S THINK LIKE SCIENTISTS

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

- What is hypothermia?
- What is the normal body temperature of a human?
- Why did passengers on the *Titanic* get cold so quickly in the sea?
- Today, how do divers survive cold conditions in the water?

ACTIVITIES

1 BEATING HYPOTHERMIA

L.O. Plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary.

Take measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate.

Report and present findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations.

- Before children begin their activity on thermal insulation, ask them to use their dictionaries to find out what the word 'hypothermia' means. Why was hypothermia dangerous to the people on the *Titanic*? Use Slide 12 to discuss the issues surrounding hypothermia. You could also link it to problems where people have an accident when climbing mountains in winter weather or elderly people who live on their own during the winter months.
- Remind children about thermal insulators, materials that do not let heat travel through them easily. In this activity, the children are going to find out which materials are the best thermal insulators. Show children a range of resources and ask them to work in their groups to plan a fair test to answer a question about which material is the best thermal insulator. Get them to mind map their plan on a large piece of paper, so that you can assess their ideas. At this point children could also engage in peer assessment where children visit another group's plans and offer suggestions.

YOU WILL NEED

- Small water bottles with a hole in their lid
- Digital or spirit thermometers
- Variety of materials, e.g. aluminium foil, cotton cloth, plastic sheeting etc.
- PowerPoint Slides 12 and 16

ASSESSMENT

- Em. Children carry out a comparative test between two materials and can say which material keeps the water warmest.
- Exp. Children carry out a fair test, produce a graph of their choosing and use their results to draw conclusions about which material is the best thermal insulator.
- Exc. Children complete their test and use their results to explain what they did to ensure that their results can be trusted.

- The easiest way to set this up is using small plastic water bottles with a hole in the top of the lid for the thermometer with a material wrapped around the bottle. The children will need to:
  - Take the temperature of the water in each bottle at the beginning and at regular intervals.
  - Discuss how they will know which material is the best thermal insulator.
- Some children might think that these results are the final temperature; this is not necessarily so since the water in each bottle might be a different temperature at the beginning so they will have to calculate the difference between start and end temperatures.
- Since this is an activity which provides continuous data, the children should produce a line graph for each material; these can be placed on one graph with different coloured lines representing different materials. See Slide 16.
- Finally, children use their data to write their conclusions. Make sure that children use scientific language i.e. *data, thermal insulator, graph*. They should then write a statement about how their research can be applied to the problem of passengers on the *Titanic* suffering from hypothermia.

LET'S THINK LIKE SCIENTISTS

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

- What did the first life jackets look like and what were they made from?
- Why is the life jacket only for the upper part of the body?
- What does the law say about life jackets for boats and airplanes?
- Why do some people who have life jackets still die in the water?

2 DESIGN AND MAKE A *TITANIC* LIFE JACKET

L.O. Report and present findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations.

Identifying scientific evidence that has been used to support or refute ideas or arguments.

- Borrow a life jacket or use Slide 13 to discuss how life jackets work and the similarities and differences between the two types. Ask children to think about the work they have done so far (i.e. hypothermia) and ask children to think about why for some passengers from the *Titanic* the life jackets did not save them from drowning.
- Explain to children that they are going to design, make and test a life jacket. Show children Slide 14 and discuss their design brief. Children should use Design and Technology skills and make sure that they:
  - Use research.
  - Work to the design criteria.
  - Ensure that the design is fit for purpose.
  - Communicate their ideas through discussion, annotated sketches, cross-sectional and exploded diagrams, prototypes, pattern pieces.

YOU WILL NEED

- A range of waterproof and non-waterproof materials
- Fluorescent and reflective materials
- Polystyrene or foam blocks
- Tin cans or dolls (which could be borrowed from reception and nursery)
- Water tray or aquarium
- PowerPoint Slides 13 and 14

- Children could use an unopened tin can to model a person. Dolls could be used but some of them will float without a life jacket. This activity links Science with Design and Technology. One of the aims is to show children how important it is to bring together scientific knowledge about floating and sinking with the design process.
- Give children time to carry out the design element of this task. They might need to have test runs to find out if their ideas work and, where appropriate, modify their design. Provide time for children to share their ideas with others so that they consider the views of others. When they test their life jacket, they should make sure that they evaluate their work against the original design criteria.
- As part of this activity, children should communicate their design and test results, using their subject knowledge to explain how the life jacket works and any special features. They could create a PowerPoint presentation (limit them to six slides), a video demonstration with commentary or, a report to the shipping company.

ASSESSMENT

Working Scientifically

- Em. Children make and test their life jacket and can talk about how it works.
- Exp. Children use their knowledge of materials to make and test their life jacket, report findings and use evidence to support their arguments for how successful their life jacket is
- Exc. Children research life jackets and apply their knowledge to designing and testing the life jacket. They are able to present their findings including the science behind their designs and justify their arguments for the use of fluorescent or reflective materials.

3 RAISING THE *TITANIC*

L.O. Plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary.

Taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate.

Report and present findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations.

- As a class, watch the video clip for this activity ‘Helicopter rescue and the science of floating’ (see Useful Websites list on *My Rising Stars*) which shows how a group of children raised a 25 kg box from the floor of a swimming pool using scientific knowledge. The video also demonstrates the science they have learned and used during this topic. Explain to the children that they are going to use the video to help them raise the *Titanic* from the seabed.
- After watching the video clip, ask children to carry out the activity where they collect evidence to show how much air is needed to lift an object, e.g. a lemonade bottle filled with sand, and to see if there is a pattern in their results. Use Slide 15 to show a diagram of how this is done and also how to record results if children need support.
- To avoid unnecessary mess children should complete this activity outside in the school grounds. They should take all their equipment

YOU WILL NEED

- Large containers or aquariums filled with water
- Plastic tubing
- Transparent plastic bottles
- Sand or small stones
- Video clip: ‘Helicopter rescue and the science of floating’ (see Useful Websites list on *My Rising Stars*)
- PowerPoint Slides 15–16

out with them and make sure that they mark their bottles to show the amount of air (this is equivalent to the amount of water, e.g. 200 ml, 400 ml) on the side of their bottle using a waterproof marker.

- Working in groups the children must create a *Titanic* for the bottom of their aquarium, by filling a plastic bottle with sand or small stones and replacing the lid. Each group should use a different material inside their boat so that they weigh different amounts to the others. Now the children will need to weight their *Titanic* model and use their graph to work out the amount of air they will need to lift their *Titanic*.
- Once children have their data they should transfer it to a graph (see Slide 16), since the results are both continuous numbers then it should be a line graph. Ask children to use their graph to answer questions such as:
  - What is the pattern in your data?
  - How could you use this information to raise the *Titanic*?
- Children could video and take photographs of this event and use it as a TV news item or a newspaper article about the science behind raising the *Titanic*.

ASSESSMENT

Working Scientifically

- Em. With support, children carry out this activity and can describe what happened.
- Exp. Children carry out this activity using appropriate measurements, produce a line graph and use it to raise the *Titanic*.
- Exc. Children are able to use their line graph to calculate how much air is required to raise their *Titanic* model and use the science to explain how the model is lifted.

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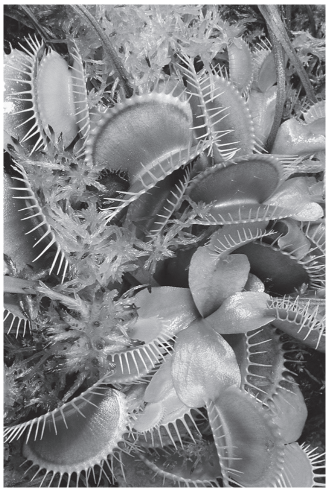
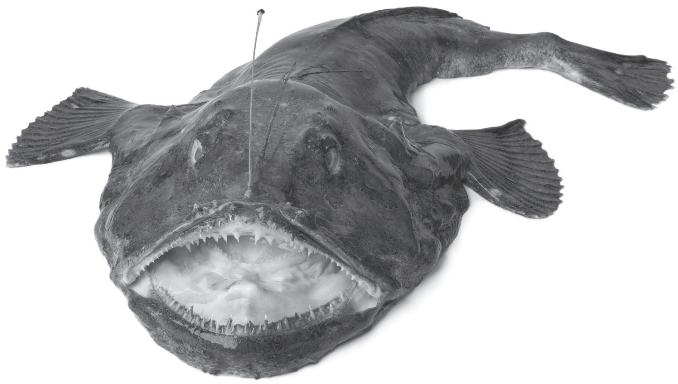
492 - the number of ***Titanic* passengers** who survived.
37% - the percentage of passengers who survived.
61% - the percentage of First Class passengers who survived.
42% - the percentage of Standard Class passengers who survived.
24% - the percentage of Third Class passengers who survived.

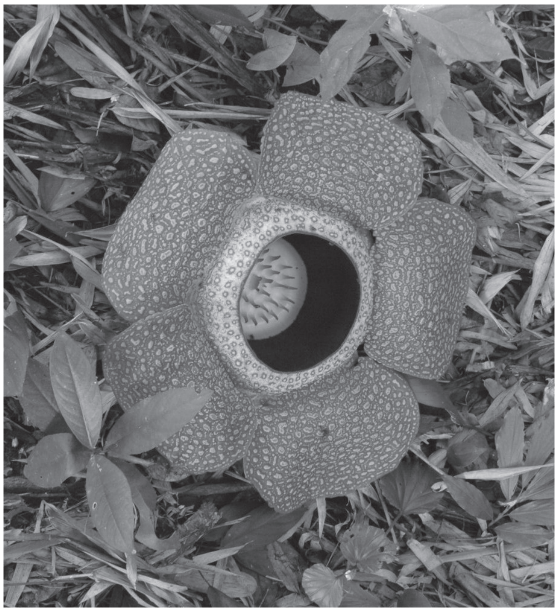
Source:
http://www.titanicfacts.net/titanic-survivors.html

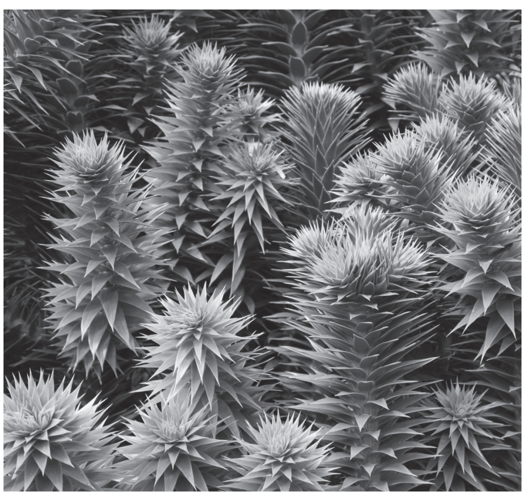
Are we able to use this data?

1.1 Animal, vegetable or mineral?









1.2 Looking at leaves

1.3 Leaf record sheet

Name: ____

Name of plant	Picture of leaf	Two features of the leaf
		1. ____________________ 2. ____________________
		1. ____________________ 2. ____________________
		1. ____________________ 2. ____________________
		1. ____________________ 2. ____________________
		1. ____________________ 2. ____________________
		1. ____________________ 2. ____________________
		1. ____________________ 2. ____________________

1.4 Carl Linnaeus cards

1. Carl Linnaeus started the modern system of putting animals and plants into certain groups and giving them scientific names using Latin words, so that the same name can be used all over the world by scientists, gardeners, zoo keepers and anyone interested in plants and animals.

2. In 1739 Carl Linnaeus married Sara Lisa Moraea and they had six children.

3. Carl Linnaeus taught botany (the study of plants) and, zoology (the study of animals), natural history, and other subjects.

4. Carl Linnaeus studied different habitats and the needs of animals and plants. He also studied the feeding habits of insects and animals with hoofs.

5. Carl Linnaeus believed that to control plant pests, for example, greenfly (aphids) we must understand their life cycles so that we know how to stop them reproducing and eating plants. Today farmers and gardeners know about plant pests so they can protect their crops e.g.wheat, cabbages, and fruit.

6. Carl Linnaeus was born on May 23rd 1707 in Råshult, southern Sweden. Carl was the eldest of five children.

His father, called Nils, was a minister and a keen gardener. He taught Linnaeus about botany (the study of plants). By the age of five, Carl had his own garden. Carl's father taught him that every plant had a name.

7. Linnaeus developed the scientific system of classifying plants and animals that we use today. It is called the binomial (two-name) system. Each living thing has a special name which is made up of two Latin words. Using Latin means that all scientists can use the same language.

8. Carl Linnaeus studied medicine, first at the University of Lund and then at the University of Uppsala. Medicine at this time was based on herbalism, so he also studied plants.

9. In 1735, Carl Linnaeus published his book 'Systema naturae' about a new way of classifying living things.

In the 18th century, scientific names for plants were written in Latin, but were long and hard to remember. The tomato plant was called *Solanum caule inermi herbaceo, foliis pinnatis incisis, racemis simplicibus*.

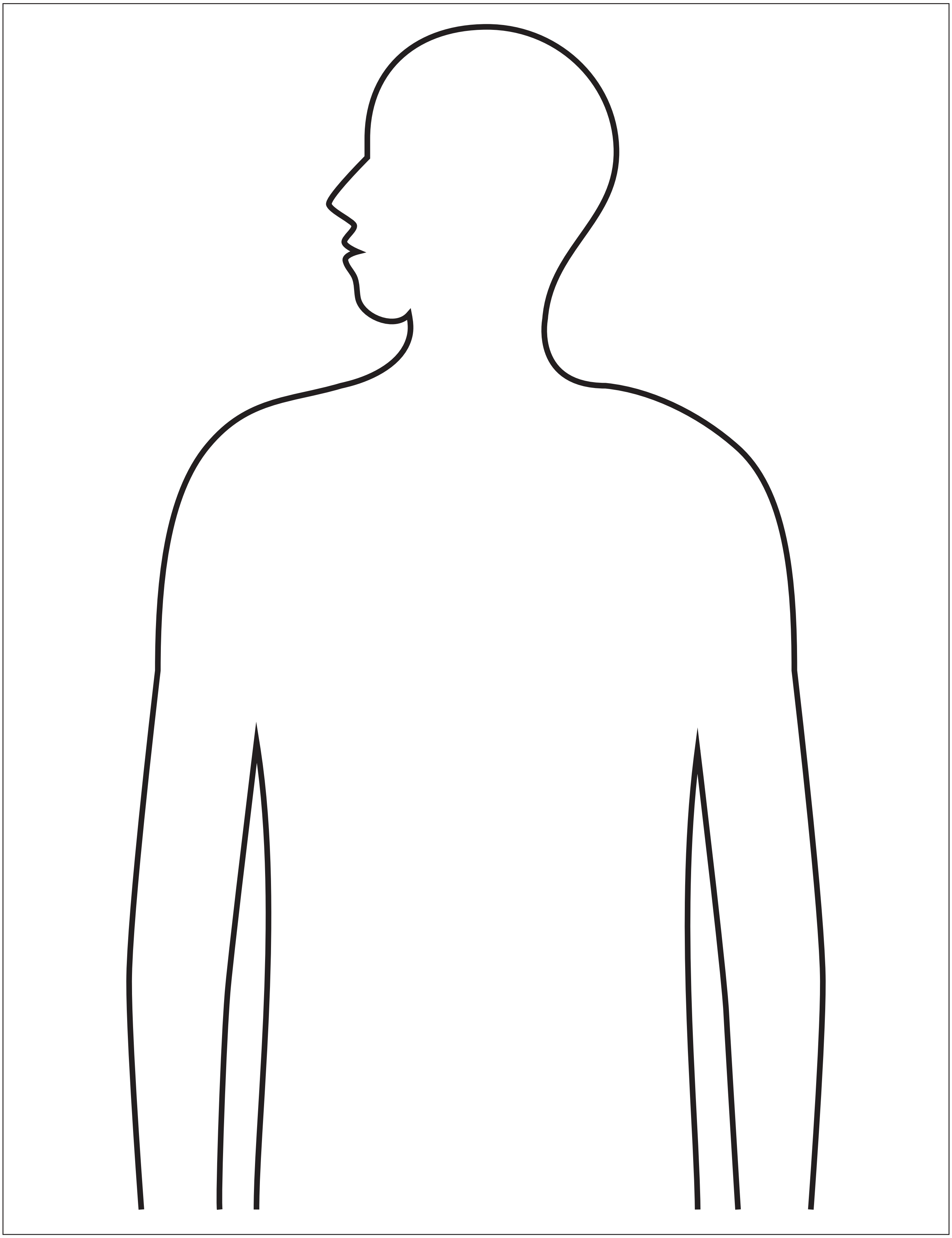
Carl Linnaeus helped to make it more simple by using only two words, The tomato became *Solanum lycopersicum*.

10. Carl Linnaeus retired in 1774 because he had a stroke, He then suffered another stroke and died in 1778.

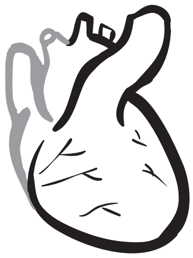
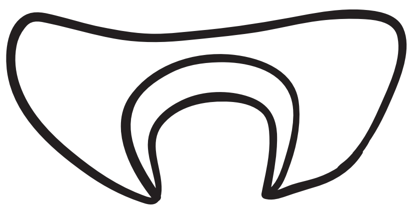
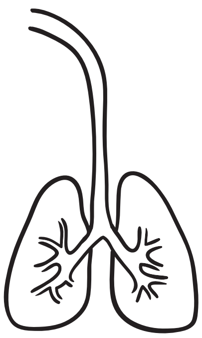
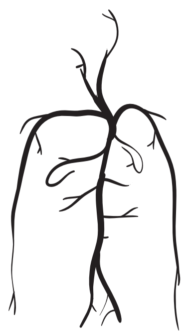
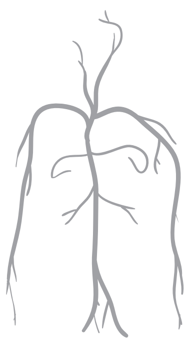
11. Carl Linnaeus was one of the first scientists to describe food chains, something that we learn about in science today.

12. Carl Linnaeus' idea was to divide nature into groups. He began with the 3 **kingdoms** known as plants, animals and minerals. Today most scientists group living things into 5 kingdoms.

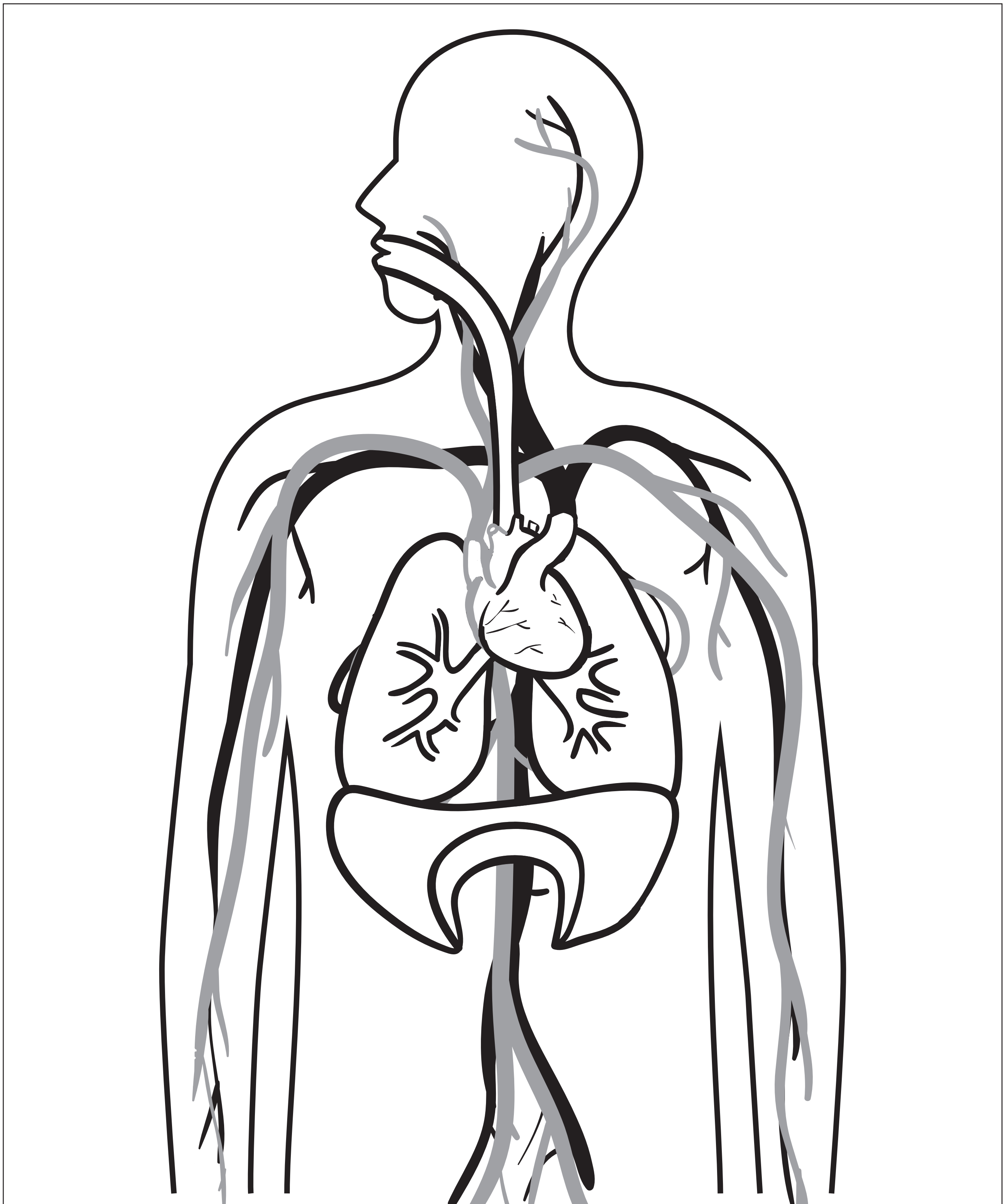
2.1 Is your heart in it?



2.1 Is your heart in it?

2.1 Is your heart in it?



2.1 Is your heart in it?

Oxygen	**Carbon dioxide**
Nutrients	**Water**

2.2 Race against time

To measure breathing rate:

- Place your hand on your chest.
- Have your partner start the stopwatch and time for 30 seconds.
- Count how many times you breathe out.
- When 30 seconds is up, your partner tells you to stop.
- Double the number of breaths you have taken to give the number of breaths in a minute.

	You	Your partner
Breathing rate at rest		
Breathing rate immediately after 2 mins of exercise		
Breathing rate after 2 mins of rest		

1. What happened to your breathing rate after exercise?

____

____

2. Why did this happen?

____

____

3. What happened to your breathing rate after exercise?

____

____

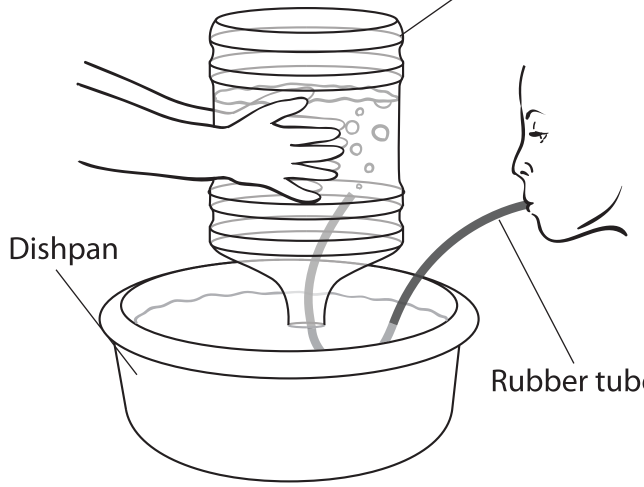
4. Why do you think this happened?

____

____

2.3 Out of puff

- Clean the end of the tube with disinfectant wipes.
- Fill the bottle with water.
- Hold it upside down in the bucket of water.
- Put the plastic tube inside the bottle, keeping hold of the other end.
- Take a very deep breath, put the tube in your mouth and blow as hard as you can until your lungs feel totally empty.
- Mark the side of the bottle where the water level now is.



	You	Your partner
Lung Capacity /cm3		

Collect the results for your class:

1. What was the largest lung capacity?

____

2. What was the smallest?

____

3. Can you work out the average lung capacity?

____

Challenge

Can you come up with a method to accurately measure the volume of the air in the bottle?

____

____

____

2.4 Reading the label

1. Use the labels on food to complete the table below and then answer the questions below.

Food – 1 serving	Calories	RDI	Fat	RDI	Sugars	RDI	Salt	RDI
Baked beans	162	8%	0.4g	1%	9.8g	11%	1.2g	21%

** RDI – Recommended daily intake

Why is it important to read the percentage of the Recommended Daily Intake (RDI)

Which food surprised you the most? Why?

Which food had the highest % of salt per portion?

Which food had the highest % of sugar per portion?

Which food would you eat less of? Why?

How could you use the information on foods to make healthy choices about what you eat?

2.5 Deaths from smoking

Source : http://www.mortality-trends.org

Lung Cancer Deaths in the UK (35-69 year olds)			
	Deaths per 100,000 people		
Year	**Male**	**Female**	**Total**
1950	118	17	
1955	142	18	
1960	172	20	
1965	181	21	
1970	183	32	
1975	179	39	
1980	162	43	
1985	150	51	
1990	130	55	
1995	101	46	
2000	79	41	
2005	70	42	
2010	62	43	

1. Complete the table to calculate the total deaths each year.
2. Plot these results as a line graph.
3. In what year did the most people die from lung cancer? ____________________
4. In the past, men started to smoke at an earlier age and would smoke more heavily than women. How do the figures on the graph agree with this?
5. More women are taking up smoking than in the past. How is this reflected in the graph?
6. The number of men smoking in the UK has dropped in the last 20 years. How has this affected the number of deaths due to lung cancer?
7. As well as causing lung cancer, what other health problems can be caused by smoking?

2.6 Dangers of smoking

Can you answer these questions about the dangers of smoking?

1. How many different chemicals are there in cigarette smoke?

____

2. Why are these chemicals bad for your lungs?

____

____

____

____

3. Give two ways that tar can damage your lungs.

____

____

4. What other effects does smoking have?

____

____

____

5. Why do people who smoke find it hard to give up?

____

____

____

____

2.7 Milking it

In Britain in the early 1900's the diet of many people was very bad, especially among the poor. Foods that we consider normal today such as milk and fresh fruit were not commonly eaten. As a result, many people, especially children, suffered from malnutrition. They didn't grow enough, were underweight and had weak bones.

In the 1930's a scientist called John Boyd Orr led an experiment to look at how he could help these children. One group of children were chosen to be sent extra food and each child was given a small bottle of milk every day to drink at school. He also studied another group that didn't get any extra food or milk. This experiment lasted a year. He measured how their height and weight had changed over the year. Here are his results:

Average gain in height /cm		
age	Group given extra food and milk	Control group not given extra food and milk
2	8.9	7.6
3	7.3	6.8
4	7	6
5	6.5	5.8
6	6.2	5.7
7	5.8	5.5
8	5.6	5.3
9	5.6	5
10	5.6	5.1
11	6	5.4
12	5.9	5.7
13	5.6	4.8

Gain in weight /kg		
age	Group given extra food and milk	Control group not given extra food and milk
2	2.2	1.7
3	1.8	2.4
4	2.2	1.8
5	2.3	1.9
6	2.7	2.2
7	2.8	2.4
8	3.1	2.5
9	3.9	3
10	3.9	3.4
11	5.1	4.2
12	5.5	5.2
13	6	4.3

1. Plot these results as a line graph.

2. Which group grew taller the most each year? ____________________

3. Which group increased in weight the most each year ____________________

4. On what age group did you see the biggest effect on height?____________________

5. Were there any results that didn't match the pattern? ____________________

6. Why was one group not given food and milk? ____________________

John Boyd Orr wants the Government to give all schoolchildren a bottle of milk every day at school because he believes it will help them to be healthier.

7. Imagine you are John Boyd Orr. Write a letter to the Neville Chamberlain, the Prime Minister. Describe what you want to do. Explain using evidence from the experiment why you think this is a good idea.

2.8 Milking it

Dear Mr Chamberlain

1. A lot of our children are suffering with

____

2. This is caused by

____

3. I carried out an experiment which looked at

____

4. I found out that

____

____

5. So to solve the problem of

____

____

6. I think we should give

____

____

7. The effect I believe this will have is

____

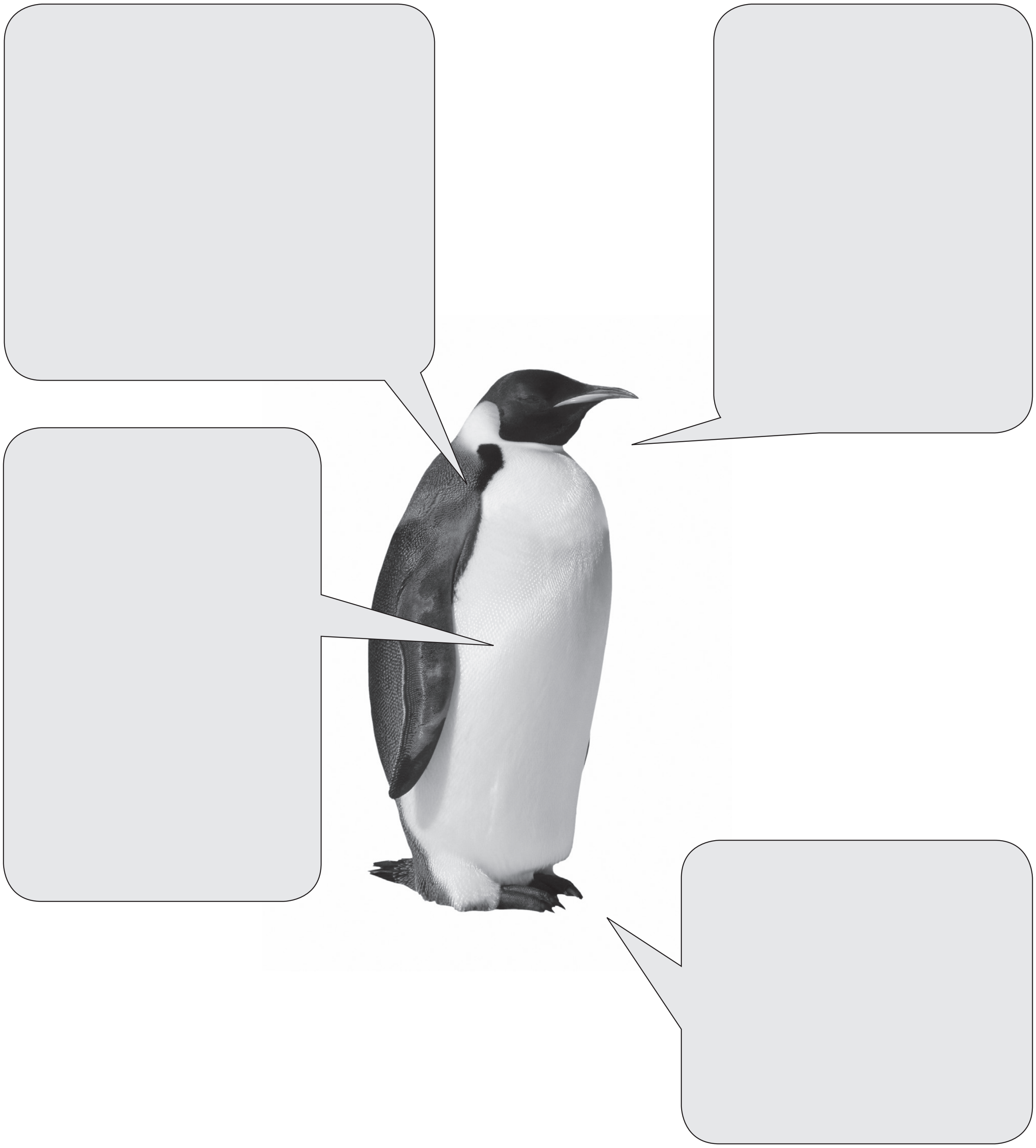
____

Yours sincerely

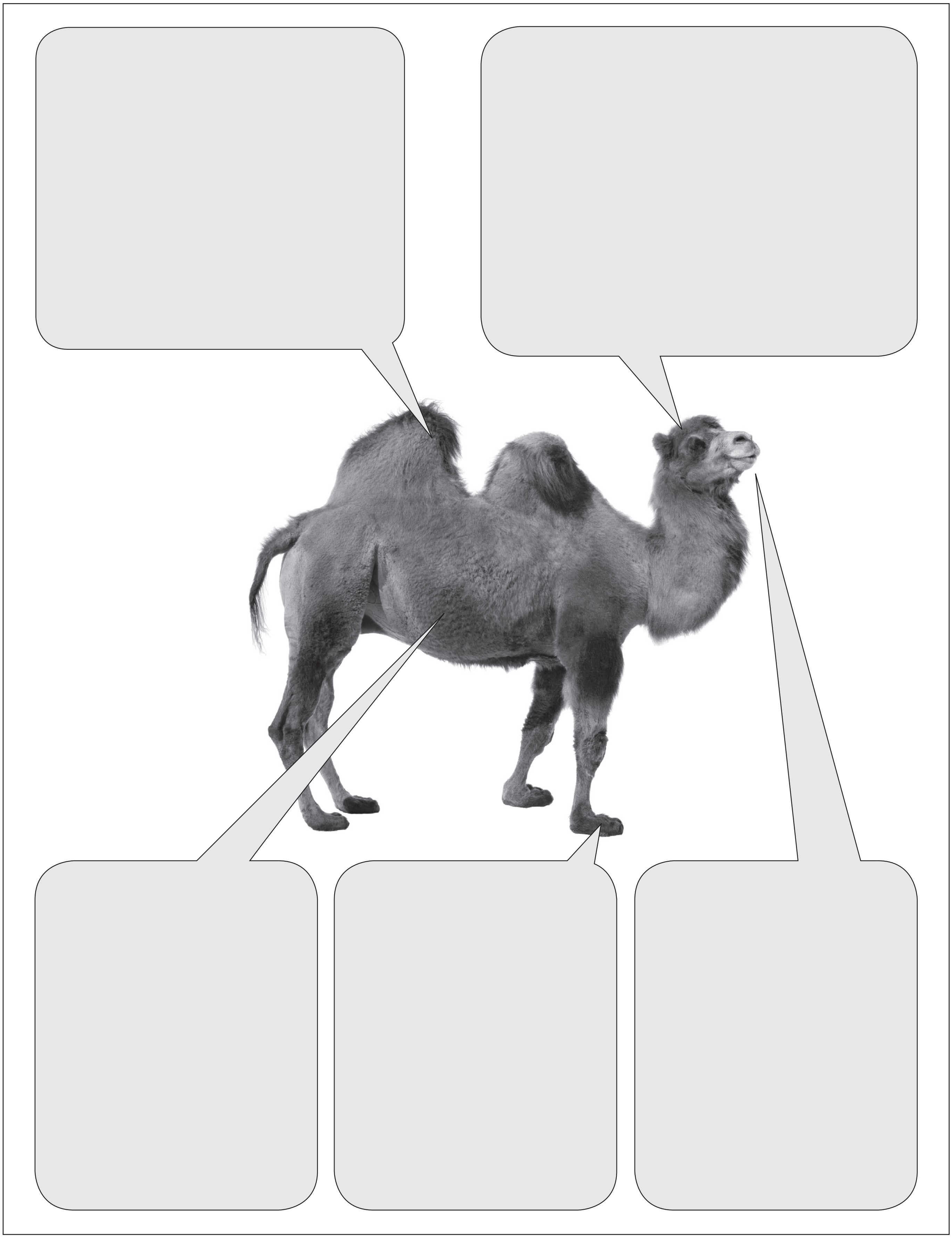
John Boyd Orr

3.1 Adaptation – penguin

What are the adaptations of this penguin to help it survive in its habitat?

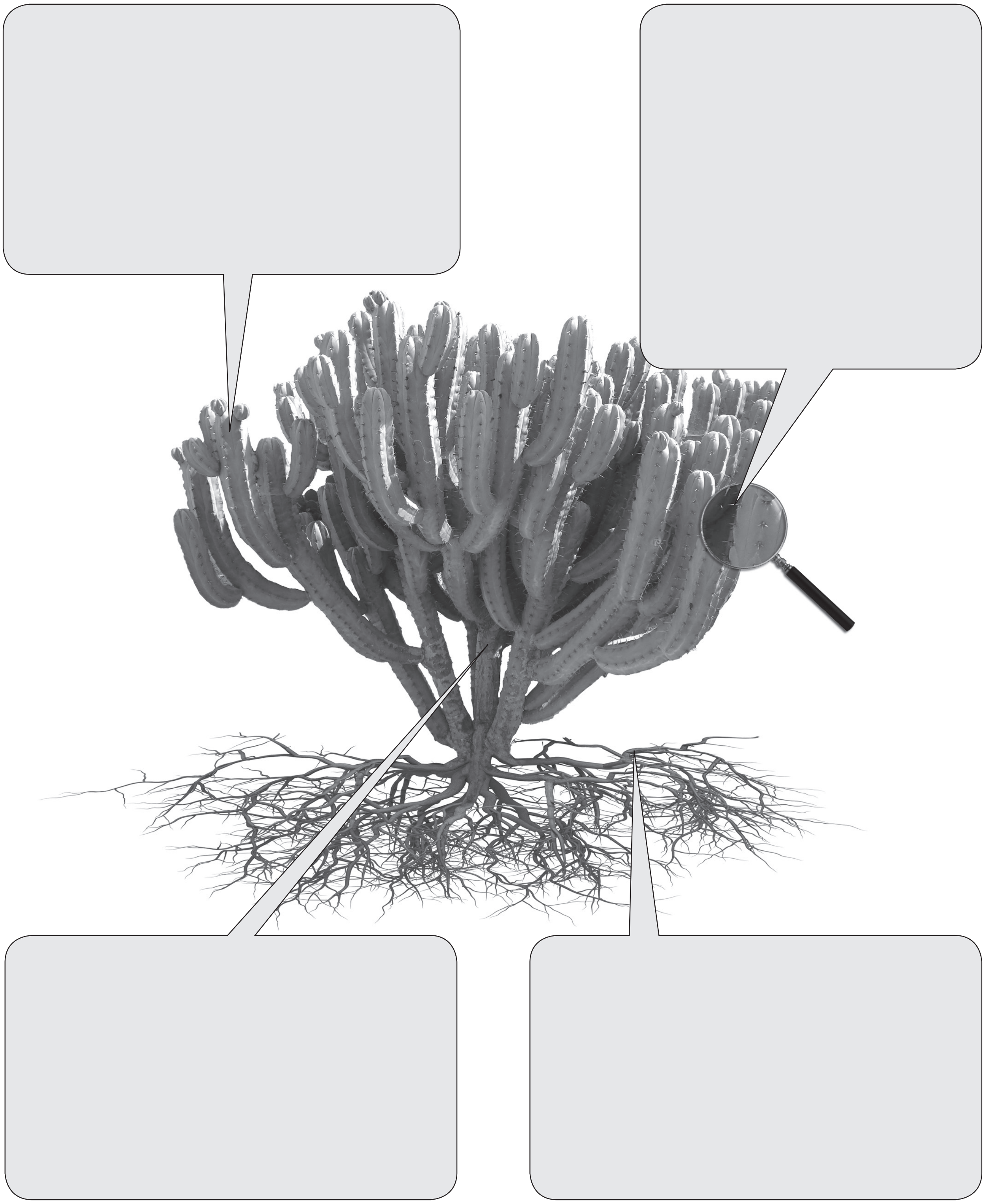


3.2 Adaptation – camel



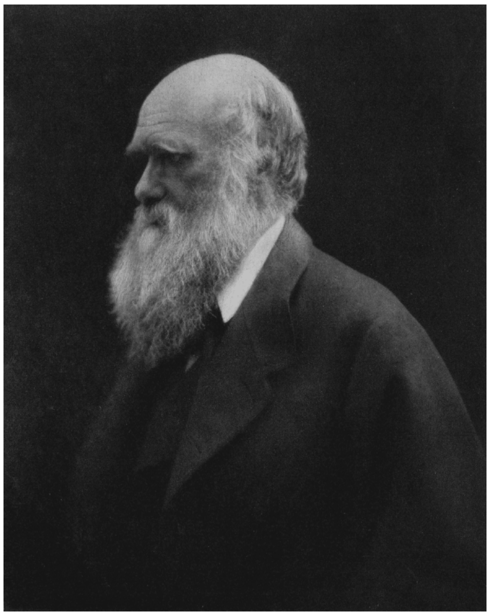
3.3 Adaptation – cactus

What features of this cactus help it to live in the desert?



3.4 Charles Darwin

Charles Robert Darwin (12 February 1809 – 19 April 1882) was an English scientist. He is famous for his work on the theory of evolution by natural selection.



Darwin was born in Shrewsbury, Shropshire into a wealthy and well-connected family. Darwin originally planned to become a doctor but he was always more interested in nature.

In 1831, he joined a five year scientific expedition on the survey ship HMS Beagle. The boat was to travel to South America, Australia, New Zealand and South Africa. Darwin's job was to collect specimens of animals and plants and study them.

The Galapagos Islands fascinated Darwin and he noticed that the islands had many different types of animals and plants, some that were not found anywhere else. Darwin noticed that each island supported its own form of finch which were closely related but differed in important ways.

Darwin returned to England in 1836 and spent the next 20 years trying to explain how these finches could be related. He wanted to find out how new species could have evolved. He also carried out many experiments at his home, Down House in Kent.

Darwin came up with his theory of "natural selection". The animals (or plants) best suited to their environment are more likely to survive and reproduce, passing on the characteristics which helped them survive to their offspring. Gradually, the species changes over time. Darwin used the term "survival of the fittest".

Darwin worked on his theory for 20 years. In 1859 Darwin published his ideas in a book called 'On the Origin of Species by Means of Natural Selection'. This book was controversial, because it went against the teaching of the church that God had made every living thing. It also suggested that Human beings were just another animal, and related to the apes. This upset a lot of people.

Darwin died on 19 April 1882 and was buried in Westminster Abbey.

3.5 Charles Darwin presentation

Use this sheet to plan your presentation about Charles Darwin

For information you could look at : http://simple.wikipedia.org/wiki/Charles_Darwin
or www.bbc.co.uk/history/historic_figures/darwin_charles.shtml

Introduction Explain in one sentence why Charles Darwin was famous.
Childhood Where was he born? What was his family like?
The Beagle What was The Beagle? Where did it go? What did he find out on The Galapagos Islands?
Theory of Natural Selection What was the big idea that he discovered? Why did his theory upset some people?
And finally Why was Darwin's theory so important?

4.1 My investigation

What are you going to investigate?

____

Draw a diagram of how you will set up your equipment at the start.

What will you keep the same?

____

What will you change?

____

What will you measure?

____

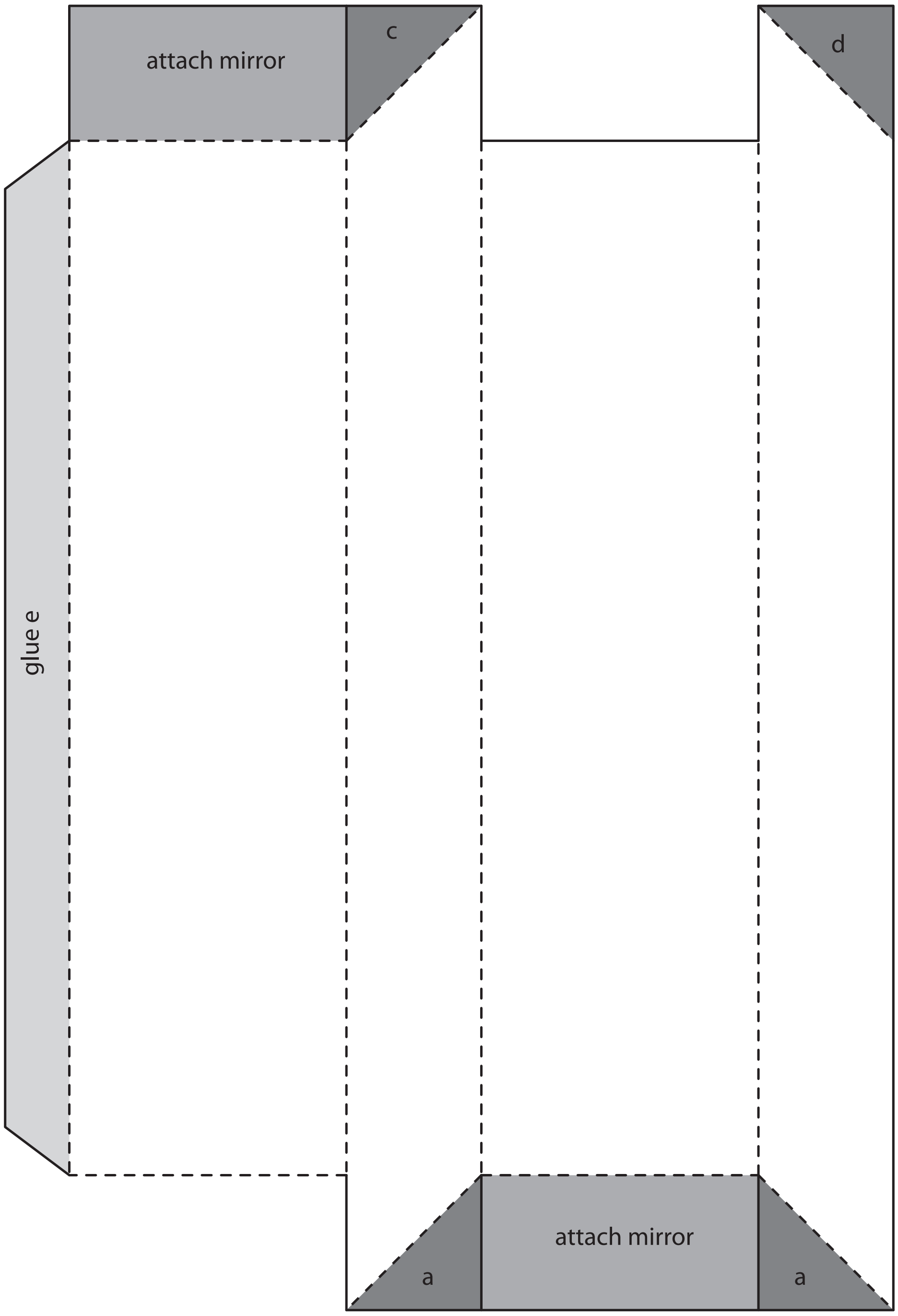
How will you record your results?

____

What have you found out?

____

4.2 Making a periscope



1. Cut along all solid lines.
2. Glue the mirrors into place. You may need to cut out your own mirrors from aluminium foil.
3. Fold towards you along all dotted lines.
4. Glue tabs A and B to the back of the mirror.
5. Glue tabs C and D to the back of the other mirror.
6. Glue tab E to complete the periscope tube.
7. What could you use your periscope for?

4.3 Mirror writing

Work out what the mirror writing says then try your own.

What does it say?	What does it say?
This is an example of mirror writing.	____________ ____________ ____________
You need a mirror to help you read it.	____________ ____________ ____________
Put ____________ ____________	Put the mirror above or to the side.
____________ ____________ It's	It's easy if you try hard.

4.4 Bending light

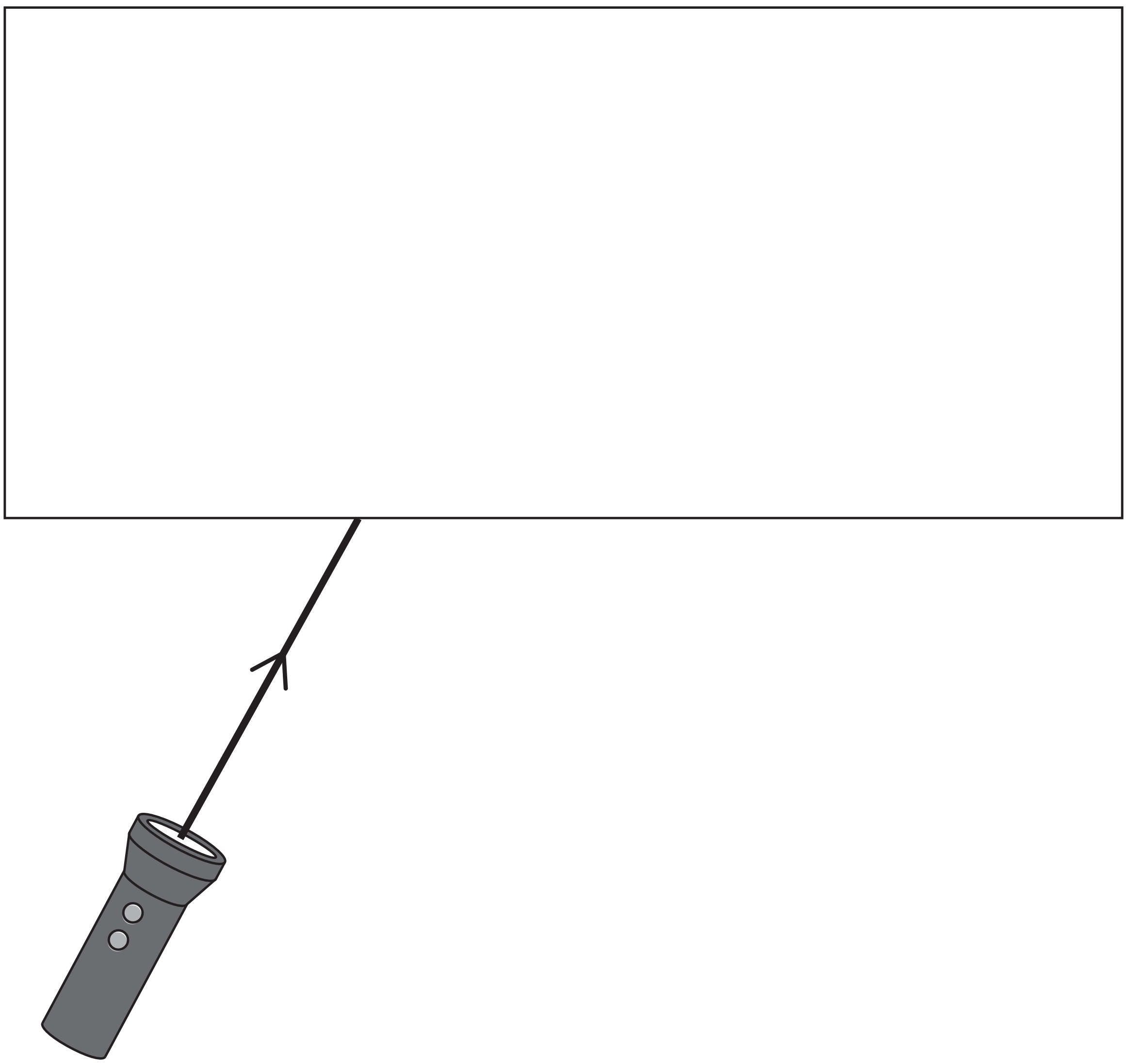
1. Place the plastic block onto a sheet of white paper.

2. Shine the torch along the paper at an angle towards the block.

3. Look at the path of the light as it passes through the block.

4. Write about what you have done.

5. Copy and finish the diagram to show what you have seen.



4.5 Where's the coin?

1. Place a two pence coin in the bottom of a cup.

2. Stick the coin to the bottom of the cup.

3. Place the cup on the table.

4. Move away from the table until you just cannot see any of the coin.

5. Stand very still; do not peer into the cup.

6. Ask your partner to slowly pour water into the cup.

What happens?

7. Write about what you have done.

---

8. Draw diagrams to show what you have seen.

4.6 Bendy pencil

1. Slowly lower a pencil into a tumbler of water.

What happens?

2. What happens to the pencil at the surface of the water?

3. Write about what you have done.

4. Draw a diagram to show what you have seen.

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4.7 Pouring light

This activity should be done in a dark part of the room.

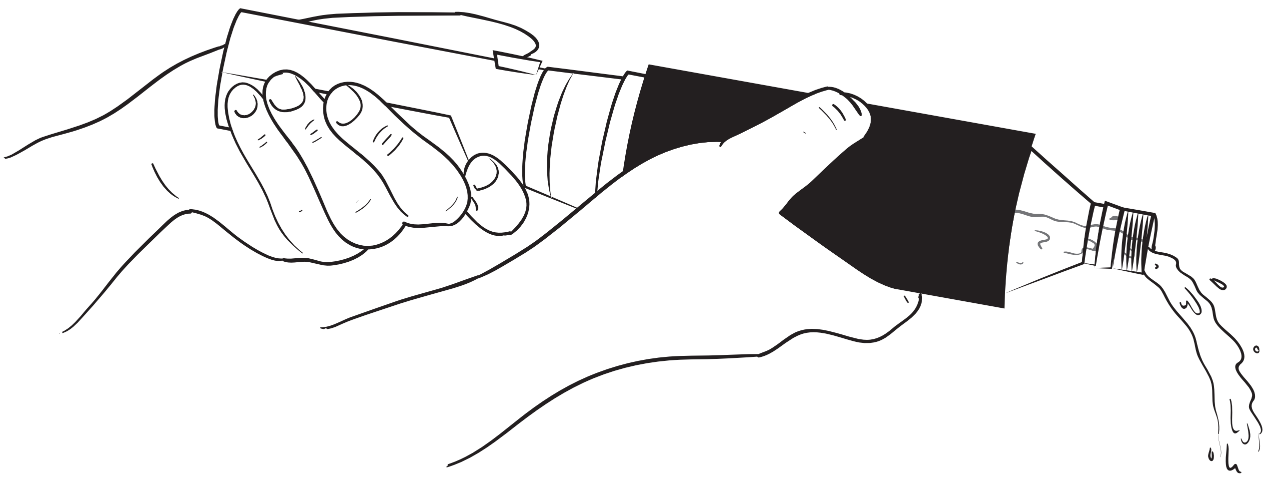
1. Wrap black paper around a clear drinks bottle. Do not cover the bottom of the bottle.

2. Fill the bottle with water.

3. Shine a torch through the bottom of the bottle.

4. Pour the water slowly into a bowl. Keep shining the torch through the bottle.

5. Look at the water as it goes into the bowl.



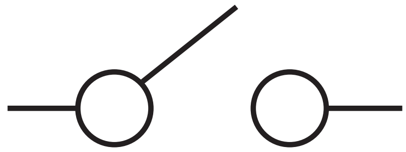
What happens?

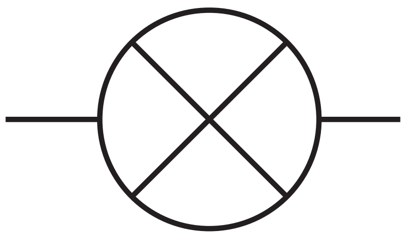
6. Write about what you have done.

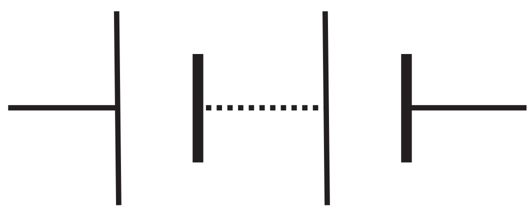
---

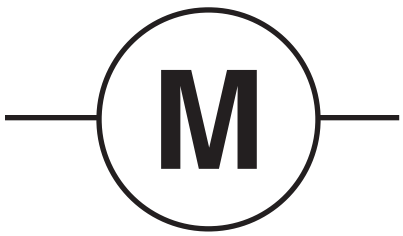
7. Draw a diagram to show what you have seen.

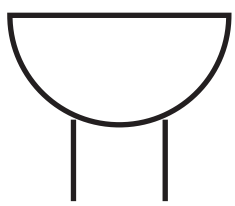
5.1 Circuit symbols











5.2 Circuit diagrams

Describe the components of the circuits, and whether the bulb will light and why.