RISING STARS

SWITCHED ON Science

Second Edition

Teacher's Guide

4

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Contents

How to use Switched on Science, Second edition

HOW THE YEAR 4 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.

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

What's that sound?

About this topic

Curriculum link: Year 1, Sound

SUMMARY:

Children will already know many things about sound, even without any formal teaching of it. They will encounter how sounds are made on a variety of instruments and how they can be changed in volume, pitch and over distance. They will explore making sounds on a range of objects that aren't instruments, in order to investigate how sounds are created to make music.

UNITS:

1.1: How are sounds made?
1.2: Sound travelling

ACTIVITY RESOURCES:

- 1.1: What a racket
- 1.2: Can you hear it?
- 1.3: Moving data from a table to bar graph
- 1.4: Make a string telephone
- 1.5: My own questions
- 1.6: Let's make it louder! Investigation

ONLINE RESOURCES:

PowerPoint presentation: What's that sound?
Interactive activity: What's that sound?
CPD video: What's that sound?
Pupil video: What's that sound?
Word mat: What's that sound?
Editable Planning: What's that sound?
Topic Test: What's that sound?

Learning objectives

This topic covers the following learning objectives:

- Identify how sounds are made, associating some of them with something vibrating.
- Recognise that vibrations from sounds travel through a medium to the ear.
- Find patterns between the pitch of a sound and features of the object that produced it.
- Find patterns between the volume of a sound and the strength of the vibrations that produced it.
- Recognise that sounds get fainter as the distance from the sound source increases.

Working scientifically skills

This topic develops the following working scientifically skills:

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

CROSS-CURRICULAR LINKS

This topic offers the following cross-curricular opportunities:

English

- Perform a poem or a story using the voice expressively accompanied by sound effects.
- Write a story and set it to music or sound effects.
- Develop children's understanding of onomatopoeia.
- Listen to and recite the poem *'The Sound Collector'*, by Roger McGough (see Useful Websites list)
- Rewrite *'The Sound Collector'* putting in new verses about rooms around the house or school

- Identify and use vocabulary related to everyday sounds
- Descriptive writing about life without sound.
- Write lyrics for a song.

Numeracy and mathematics

- Draw and use tables, plot data on graphs.
- Measure distance.
- Read a line graph produced by sound data logger.
- Measuring decibels.

Geography

- Learning about music from around the world.
- Using plants and vegetables from around the world for music, e.g. gourds, bamboo.

History

- Research inventions related to sound, e.g. musical instruments, television, radio, telephone.
- Create a timeline of inventions, include recent inventions such as mobile phones, electric guitar.

Design technology

- Design, make, use and evaluate a musical instrument.
- Research how musical instruments are made.
- Make and paint Australian Aboriginal clapsticks.

Art

- What does sound look like?
- Research Australian Aboriginal art.
- Illustrate sounds using paints or sculptures, e.g. bang, whisper
- Show children oscillation – sound patterns how can children use these in art?
- Look at cartoon sound images, e.g. bam, kapow, boom. wham, bang, whizz.

Music

- Stomp music – using different objects, e.g. broomsticks, saucepans to stomp out a rhythm.
- Body music.
- Explore how to make different notes in order to compose a tune.
- Making musical instruments, e.g. pan pipes, xylophone, shakers, drums, box guitars.
- Changing volume and pitch in different musical instruments.
- Learning to play an instrument.

PSHE

- Discussing understanding of hearing impairment.
- Communicating with hearing impaired people – search for British Sign Language sign of the day.

STEAM (SCIENCE TECHNOLOGY ENGINEERING ART AND MATHS) OPPORTUNITIES

Invite into class

- Musicians. e.g. member of staff, parent, local musician / band to tlak about their instrument and music and to create music with the class.
- Sound recordists / technologist from local radio station.
- Audiologist to explain about how to test hearing.
- Carpenter to help make wooden instruments.
- Request a STEM ambassador with knowledge and skills relating to the physics of sound, musical instrument maker.
- Parent who works with loud noises and required to use ear defenders.
- Artist to develop sound paintings or sculptures.

Visit

- Large buildings, e.g. cathedral, railway station, football stadium where sound is affected by the building.
- Theatre or concert hall to learn about the acoustics and play their own instruments.
- Radio station.
- Music rehearsal room.
- Local environment to carry out a sound survey.
- Local environment to find out about sound pollution, e.g. taking sound readings near road traffic, building sites.

TEACHER SUBJECT KNOWLEDGE

Vibrations

Sound is produced by vibrations, even when it is hard to see them. The vibrations travel through the air and are detected by our ears. Within the ear is an ear drum which vibrates and turns the vibrations into signals to the brain, which then 'hears' the sounds.

The speed of sound in air is approximately 340 m/s (metres per second). The denser the medium, the faster sound travels: for example, it travels faster through liquids than air, and even faster through solids.

Sound will not travel through a vacuum, because sound needs particles to make the vibrations. No-one can hear anything in space.

There is often a misconception regarding the terms 'sound' and 'noise'. Noise can be defined as unwanted sound.

Volume

The loudness (volume) of a sound depends on the size of the vibration: the bigger the vibration, the louder the sound. The greater the volume of air vibrating, the louder the sound will be. A large drum struck with the same force as a small drum will sound louder because the bigger drum can make more of the air move, simply by have a bigger 'skin' to vibrate. A vibrating tuning fork cannot be heard until the stem is placed on a table. This causes the table to vibrate very slightly, but there is a large volume of air in contact with it compared to the small volume of air in contact with the prongs of the tuning fork.

Pitch

Pitch refers to how high or low a sound is.
A high-pitched sound has a high frequency.
A low-pitched sound has a low frequency.
Frequency is the number of vibrations per second.

The pitch of a vibrating string depends on:
The length of the string – the longer the string, the lower the pitch.
The tension of the string – the tighter the string, the higher the pitch.

The pitch of a vibrating air column (e.g. a bottle) depends on:
The longer the air column, the lower the pitch.
Whether the air column is open at one end or both ends.

Other vibrations related to pitch:
For striking a length of tubing, the shorter the tubing, the higher the note.
For striking a glass bottle with different amounts of water in: the more water in the bottle, the more glass that can vibrate, so the lower the note.

HEALTH AND SAFETY

Too much sound can damage our ears. Examples of when ear defenders might be worn include: using electric drill, tree-cutting, driving a tractor, airside workers at an airport, disc jockeys, workers in noisy factories.

Use the opportunity to emphasise the damage that can be caused by listening to personal music players if the volume is too loud.

In this topic you will:

- observe and name a variety of sources of sound
- find out how sounds are made
- find patterns between the volume of a sound and how it is made
- notice that sounds get fainter as they move away from you
- explore how to change the pitch of a sound.

CHILDREN'S MISCONCEPTIONS

Children might think…

- That 'noise' and 'sound' are the same.
- That 'volume' means how much liquid is there. It has two meanings, and this needs to be clarified with the children.
- That 'pitch' is related to a football playing field, or even a road covering.
- That 'volume' and 'pitch' are the same thing.

Children already know…

- That we hear with our ears.
- How to make loud noises.

SCIENTIFIC VOCABULARY

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

pitch: how high or low a note is

sound source: something that makes a sound

vibration: when something moves up or down, backwards and forwards or from side to side quickly

volume: how loud a sound is

1.1 How are sounds made?

GET STARTED

Begin by showing children PowerPoint slides 1–4 to introduce the topic of sound. Then use the video clip 'How are sounds made?' (see Useful Websites list on *My Rising Stars*). First, use only the audio and ask the children to work in groups to guess what is making the sound and write it down. Then, show the video so that children can mark their own or another group's work. Which group scored the highest? Which sounds did the children find easiest / hardest to recognise?

The Pupil video 'What's that sound? introduces how sounds are made and explores volume and pitch control in musical instruments. This is another useful video to kick off the topic. The children can discuss which instruments they know and how they think their sounds are made.

LET'S THINK LIKE SCIENTISTS

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

- Find out about the pitch of sounds that different animals hear. Who can hear the highest and lowest notes?
- When you hit a glass bottle with lot of water in, it makes a low note. But when you blow it, it is a high note. Why do you think this is?

ACTIVITIES

1 SOURCES OF SOUND

L.O. Identify how sounds are made, associating some of them with something vibrating.

- Refer back to the Get started activity. Explain to the children that objects that make a sound are called 'sources of sound'. When children talk, they are sources of sound. When a door bangs shut, the door is making the sound, so it is the source of the sound. Take children on a sound walk around the school. Tell children to listen for sounds, identify the source of the sound and write it on their mini whiteboard.
- Back in the classroom, ask children to decide which the most unusual sound source was and which the one they heard the most often.
- As a home / school activity, challenge the children to find more than 20 sources of sound at home,–they could bring the list or photographs to school and put them on a working wall or in a 'Big Book on Sound'.
- Give children access to the Interactive Activity.

YOU WILL NEED

- Video clip 'How are sounds made?' (see Useful Websites list)
- Pupil video
- Interactive activity

ASSESSMENT

Working Scientifically

- Em. Children name the sound, e.g. dog barking, and need support to say what the source of the sound is, i.e. the dog.
- Exp. Children are able to name the sound and then say what the source of the sound is.
- Exc. Children name the source of the sound immediately.

2 LET'S MAKE A SOUND

L.O. Identify how sounds are made, associating some of them with something vibrating.

- Begin by having a fun session with the children making sounds by using their bodies for example, whispering, shouting, singing, whistling, humming, clapping, stamping, clicking fingers.
- Ask the children to place their fingers at the front of their neck over the voice box (you might need to show them) and hum quietly, then share with their partner what they feel. What kind of words can they use to describe what they feel? Talk to children about the word 'vibrate'. Explain that a vibration is when something moves up or down, backwards and forwards, or from side to side quickly.
- Introduce the words *vibrate*, *vibration* and *vibrated* and ask them to work with their partner to write three sentences, one for each word which shows how it should be used.
- Use Slide 5 and ask children to suggest what is vibrating to make sound in each picture.
- Next invite children to make a list of everyday objects that make a sound and write down what vibrates to make the sound.

YOU WILL NEED

- PowerPoint Slide 5

ASSESSMENT

Subject Knowledge

- Em. Children need to handle the object to say which part vibrates.
- Exp. Children say which part of objects vibrate to make the sound.
- Exc. Children recognise that several parts of an object may vibrate to make the sound.

3 FEELING AND SEEING THE VIBRATIONS

L.O. Identify how sounds are made, associating some of them with something vibrating.
Set up simple practical enquiries, comparative and fair tests.
Use straightforward scientific evidence to answer questions or to support their findings.

- Show children the video clip which shows in slow motion what happens when a tuning fork is struck, vibrates and is placed in water. Ask children to describe and explain the sequence and why the water splashes out of the glass.
- This set of activities is designed to consolidate the idea that when something makes a sound it must be vibrating:
  - **Feeling the vibrations with a tuning fork** – Children strike the tuning fork and place it on their cheek, the tingling feel is the tuning fork vibrating, they will also hear a sound.

YOU WILL NEED

- Video clip: 'Tuning forks hitting water in slow motion' (see Useful Websites list)
- PowerPoint Slides 5 and 6
- Tuning fork
- Drums
- Birdseed or something similar

- **Watching the vibrations** – Children carry out the activity they saw in the video, they strike the tuning fork and then place the tip into a container of water and watch the water vibrate.
- **Birdseed on a drum** – Take the whole class outside, preferably onto the grass, each pair has a drum, drumstick and a container of birdseed. One person holds the drum and places a small amount of birdseed on the drum skin. The other person strikes the drum, they both observe what happens to the birdseed. Ask children to think about what is making the birdseed move?
- **Jumping birdseed** – Ask children to find out what happens when they hit the drum hard, and then softly, what do they hear and what happens to the birdseed? Now ask them to talk about the word volume, what does it mean, what happens to the birdseed when they strike the drum and the volume is loud? What happens to the birdseed when they strike the drum softly and the volume is quiet?
- **Feel the vibration** – Working in pairs, one person places their hand just above the drum skin whilst the other hits the drum skin. What can the other person feel? They swap over and repeat; both should feel the air tickle (vibrate) against their hand. Making sure that they don't hit their partner, they repeat the activity but this time hit the drum hard to make a loud sound, then hit the drum gently to make a quiet sound. What do they notice about the air?
- Back in the classroom, use Slide 6 to support the children in drawing conclusions about sound and vibrations and making links between the size of the vibration and volume. Children should also be able to talk about the air around the drum vibrating.

ASSESSMENT

Subject Knowledge

- Em. Children say what happens when they strike something but need support to link it to the concept of vibration and sound.
- Exp. Children make links between sound and vibration.
- Exc. Children apply their experience and knowledge to say that the air vibrates and may suggest this is how we hear.

Working Scientifically

- Em. Children carry out simple comparative tests.
- Exp. Children carry out a comparative test and use the results to draw a conclusion.
- Exc. Children carry out tests and use the results to test new ideas of their own.

4 PERCUSSION SOUNDS

L.O. Identify how sounds are made, associating some of them with something vibrating.

Find patterns between the volume of a sound and the strength of the vibrations that produced it.

Set up simple practical enquiries, comparative and fair tests

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

- Put out for children a range of percussion instruments or use Slide 7 and ask them explore the instruments to find out what vibrates to make the sound.
- Give the children time to explore the percussion instruments available in your school to identify how the sounds are made, so that children apply and extend their understanding of sound and vibrations. They could use Activity Resource 1.1 to record their observations.

YOU WILL NEED

- Percussion instruments
- Objects such as plastic and cardboard containers to make percussion instruments
- Activity Resource 1.1
- PowerPoint Slide 7

- Working individually or in pairs, ask the children to choose an instrument that they think they could make and use from objects and materials available in class. They should first design their instrument and could share it with someone else in the class for feedback and ideas.
- Children could use plastic bottles for shakers, ribbed bottles for a Guiro, plastic or cardboard tubing for claves or chime bars and tins with lids, or a plastic skin for drums.
- When children have made their instruments, make sure that they test them to make sure that they work out how the instrument works, find patterns between the size of the vibrations and the volume of the sound they make. Children could:
  - Demonstrate them to the rest of the class or a group of children and explain what vibrates and how to change the volume.
  - Use them to accompany a song.
  - Compose and play a rhythm.

ASSESSMENT

Subject Knowledge

- Em. Children make their instrument and can change the volume; they require help to talk about vibrations and how to change the volume.
- Exp. Children explain what vibrates and the link between size of vibration and volume of sound.
- Exc. Children apply their knowledge of vibrations and volume when designing their percussion instrument.

Working Scientifically

- Em. Children carry out simple comparative tests.
- Exp. Children carry out a comparative test and use the results to draw a conclusion.

5 HOW DOES A GUITAR WORK?

L.O. Identify how sounds are made, associating some of them with something vibrating.

Find patterns between the volume of a sound and the strength of the vibrations that produced it.

Find patterns between the pitch of a sound and features of the object that produced it.

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

- Ask a member of staff or local musician to give children a 'masterclass' on how a guitar works to change the volume and pitch. You could also watch the section showing a guitar being played on the CPD video: 'What's that sound?'
- Show children Slide 8 and discuss how each guitar has been made. Explain that they are going to make their own box guitar using shoe or cereal boxes and elastic bands. When they have made it, they use what they know about real guitars to make a sound, i.e. make the strings vibrate, and then change the volume. Refer children back to their understanding from percussion instruments, the bigger the vibration the louder the sound; the smaller the vibration the quieter the sound.
- The new idea is pitch: how high or low a sound is. Some children confuse these with loud and quiet. One way to help children is to engage the whole class in changing pitch when talking. Ask them to talk in a quiet and then loud voice, then a high and low voice, then mix, e.g. quiet low voice, high and loud voice.

YOU WILL NEED

- Boxes, e.g. empty cereal boxes
- Elastic bands
- Guitar
- CPD video: 'What's that sound?'
- PowerPoint Slides 8 and 9

ASSESSMENT

- Em. Children can demonstrate how they change the volume of the guitar and, with help, may be able to show how to change the pitch.
- Exp. Children can describe how to change the volume and pitch of the sound.
- Exc. Children use scientific language to explain how changing the vibration affects volume and pitch.

Working Scientifically

- Em. Children require support to recognise patterns.
- Exp. Children use the data from tests to draw conclusions.
- Exc. Children carry out tests and use the results to test new ideas of their own.

- Give children time to explore plucking the guitar string to make high and low sounds and ask them to write a set of rules for changing the pitch, e.g.:
  - The tighter the elastic band the higher the sound.
  - The slacker the elastic band the lower the sound.
  - The longer the elastic band the lower the sound.
  - The shorter the elastic band the higher the sound.
- Show children Slide 9 so that they can apply what they have learned from their own guitar to a real guitar.
- Challenge children to compose a tune on their box guitar where they change the volume and pitch and to share it with others in the class.

6 GLASS BOTTLE ORCHESTRA

L.O. Identify how sounds are made, associating some of them with something vibrating

Find patterns between the pitch of a sound and features of the object that produced it.

Set up simple practical enquiries, comparative and fair tests

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

- Show children the video clip on how to make a glass xylophone. What is vibrating? How is the volume and pitch changed?
- Give children the opportunity to make their own; glass bottles are best, and safe to use as long as children act responsibly and change the amount of water to find out what effect that has on the pitch when they tap the bottles.
- Now instead of tapping the bottles with a pencil, children blow across the top of the glass bottles. What do they think is vibrating this time? Blowing across the top of the bottle makes the air in the bottle vibrate, this is what causes the sound (not the water). The water is there to change how much air is in the bottle (column of air) the longer the column of air, the lower the pitch of the sound, the shorter the column of air the higher the pitch of the sound.
- Use Slide 10 and tell children that they are going to carry out the comparative test, they will find out that the pattern of the pitch of the sounds is the opposite in blowing compared with tapping.
- Show children Slide 11 so that they can apply what they have learned from this activity to a trumpet.

YOU WILL NEED

- 'Glass bottle orchestra' video clip (see Useful Websites list)
- Glass bottles
- Water
- Pencils
- PowerPoint Slides 10 and 11

ASSESSMENT

Subject Knowledge

- Em. Children can describe what happens to the sound.
- Exp. Children describe how the sound is made and how to change pitch.
- Exc. Children apply their experience and knowledge to say that the air vibrates to change volume and pitch.

Working Scientifically

- Em. Children carry out the comparative test and describe what happens.
- Exp. Children carry out and describe the patterns in their observations.
- Exc. Children can explain why the patterns of pitch are different in their comparative test.

7 MAKE YOUR OWN PAN PIPES

L.O. Identify how sounds are made, associating some of them with something vibrating

Find patterns between the pitch of a sound and features of the object that produced it.

Set up simple practical enquiries, comparative and fair tests

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

- Use pan pipes from the school's music collection. Play them or show children a video of them being played.
- Examine the pan pipes to show the differences between the pipes that make low or high sounds.
- Pan pipes are very easy to make. Show children Slide 12 which illustrates pipes make from plastic straws and plastic tubing from DIY stores.
- Set this activity as a challenge for children to make their own set of pan pipes and use them to play a tune. As they make their pan pipes, ensure that they apply what they have learned about sound so far.
- To record their work, make links with literacy, for example, storyboarding and making a short video clip of playing their pipes and explaining the science of changing the volume and pitch. Or they could take photographs and create an instruction booklet for another group of children to use, which includes the science behind the pipes.
- Whichever way children communicate this activity, they should use scientific language and evidence from their musical instrument to explain:
  - What is vibrating.
  - How to change the volume and pitch of the sound.
  - At the end of this activity, children will have made several instruments. Show the video 'What's that sound?' to reinforce what they have learned about sound and musical instruments. Then give each group the opportunity to compose and play some music, or use their musical instruments to provide the soundtrack for a poem or a two-minute story that they have written.

YOU WILL NEED

- Pan pipes (or video clip of pan pipes being played)
- PowerPoint Slide 12
- Plastic straws or pipes, sticky tape and cardboard
- CPD video: 'What's that sound?'

ASSESSMENT

Subject Knowledge

- Em. Children make their own pan pipes and demonstrate how to change the sound they make.
- Exp. Children communicate how they made their pan pipes and how to change the pitch and volume.
- Exc. Children apply what they know about pitch and volume to make their pan pipes and can apply this knowledge to other wind instruments.

Working Scientifically

- Em. Children explore the sounds made with pan pipes and can say what happened.
- Exp. Children test, for example, different lengths of pipe and use the outcomes to make their instrument.
- Exc. Children carry out different tests and apply their findings to change their instrument

1.2 Sound travelling

GET STARTED

Share with children the video clip from the Useful Websites site which shows an alarm clock and explains how sound gets fainter as the distance from the sound source increases. Ask children to discuss why this happens and how the sound changes. Does the sound change in any other way apart from volume?

LET'S THINK LIKE SCIENTISTS

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

- Can you hear louder underwater or in the air?
- Is there any other way of hearing things louder without increasing the volume?
- Where do people need to wear ear protectors in everyday life? What are they made of? Why?
- Is it better to have protection that covers the entire ear or goes inside the ear, like a plug? What are they both designed to do?
- Research how different animals can hear sounds. Do they all have ears?
- Why do some animals have very large ears? Can you carry out an experiment to find out why?

ACTIVITIES

1 HOW FAR AWAY CAN YOU HEAR IT?

L.O. Recognise that sounds get fainter as the distance from the sound source increases.

Set up simple practical enquiries, comparative and fair tests.

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

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

- Discuss with children how they can work like scientists with this test to see if there really is a pattern in how the sound changes with distance. Show children Slide 13 and discuss how they think they could test this idea.
- In groups, children plan a pattern-seeking investigation to find out how far away from a sound source they can hear the sound. Most children will suggest the idea of walking away from the sound, and finding out at what point it becomes inaudible. Tell children that that should plan to do their test outside. If a sound level meter or data logger is available, they could investigate how the loudness of sound changes with distance.

YOU WILL NEED

- Source of sound e.g. musical or percussion instruments
- Pedometer or trundle wheel to measure distance
- Sound level meter or data logger (if available)
- PowerPoint Slide 13
- Activity Resource 1.2

ASSESSMENT

Subject Knowledge

- Em. Children describe how the sound is louder or quieter.
- Exp. Children describe how the sound changes and use scientific vocabulary e.g. sound source.
- Exc. Children apply their knowledge to different contexts e.g. plane passing over.

- Check that children have planned to:
  - Use a sound source such as a triangle or tambourine.
  - Measure and record regularly the distance from the sound source and how the sound changes until they can no longer hear the sound, using either a pedometer as they go, or a trundle wheel.
  - You will need to be sensitive to whether there are any hearing-impaired children.
  - Some children might benefit from using the planning framework on Activity Resource 1.2.
  - Once children have completed their planning, they should collect their equipment and carry out their pattern seeking activity outdoors. Back in the classroom, pair different groups so that they can share their results to see if there are any similarities and differences in the pattern of their data.
  - Support children in composing and rehearsing their conclusions orally prior to writing their conclusions. Challenge them to use key words such as *distance, sound, source of sound, measurement, conclusion, data*. Children could draft and redraft on their mini whiteboards prior to using joined handwriting in their science books.

Working Scientifically

- Em. Children can describe the activity and what they found out.
- Exp. Children use the data from their activity to conclude that sounds get fainter as the distance from the sound source increases.
- Exc. Children make suggestions why the sound gets fainter as they move away from the source

2 MEASURING SOUND

L.O. Make systematic and careful observations and, where appropriate, take accurate measurements using standard units, using a range of equipment, including thermometers and data loggers. Record findings using simple scientific language, drawings, labelled diagrams, keys, bar charts and tables

- Put a scale on the whiteboard 1–6, and explain that 1 is the quietest and 6 the loudest. Play recorded music, sounds or different musical instruments at different levels of loudness. Each time ask children to write a number to say how loud they think it is on their mini whiteboard. The children then hold them up so everyone can see, usually there are a range of numbers. Discuss with children why we cannot use these numbers or words like loud and quiet to reliably measure sound.
- Decibels are used to measure the volume of sound. Use Slide 14 to introduce children to the decibel measurement for different sounds. You could ask these questions:
  - Which sound is the loudest? How do you know?
  - Which sound is 60 dB?
  - Which sounds are between 60 dB and 120 dB?
  - How many decibels do you think a vacuum cleaner would measure?
  - Which sounds could damage your hearing?

YOU WILL NEED

- PowerPoint Slides 14 and 15
- Data loggers or apps for measuring decibels
- Range of recorded musical and non-musical sounds
- Musical instruments
- Activity Resource 1.3

- Using data loggers or a dB meter app on tablets, children could take dB readings around the school to find:
  - Which are the quietest and loudest places around the school? Use Slide 15 as a starter for discussion – you could put a picture of your school in the slide.
  - Which are the quietest and loudest classes in the school?
  - Which playtime is the loudest?
  - How does the sound level change during the day around the school or in your classroom?
  - Children collect the data using a table and then transfer the data to a bar graph.
  - They may need some support to transfer their data to a bar graph, children could use Activity Resource 1.3.
  - Ask children how they could reduce the sound level, for example, in the classroom or dining hall over a week and how they would carry out this activity?

ASSESSMENT

Working Scientifically

- Em. Children can work with someone else to measure and record sound in a table.
- Exp. Children record dB in a table and transfer data to a bar graph and can answer questions using the data.
- Exc. Children use the data in the bar graph to suggest new questions and collect data to answer them.

3 SOUNDS TRAVELLING THROUGH DIFFERENT MATERIALS

L.O. Recognise that vibrations from sounds travel through a medium to the ear.

Set up simple practical enquiries, comparative and fair tests.

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

Identify differences, similarities or changes related to simple scientific ideas and processes.

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

- Ask children to find out ways to prove to someone else that sound can travel through different materials, before they begin they should use their mini whiteboard or a large sheet of paper to record their ideas. Children might try the following, working in pairs:
  - Place their hands over their ears. Can they still hear, for example, their partner playing a triangle or other instrument?
  - Stand either side of a door, can one person hear the sound the other is making?
  - Wear earmuffs and with their back turned, listen for the sound their partner is making.
  - Bring children together to share what they did and their conclusion, can sounds travel through a medium (material) to the ear?

YOU WILL NEED

- Mini whiteboards or pens and paper
- Activity Resource 1.4
- Musical instruments, e.g. triangle
- Earmuffs or headphones

ASSESSMENT

Subject Knowledge

- Em. Children follow the instructions and can describe what happens.
- Exp. Children are able to describe how the sound travels through different materials from one person to the other.
- Exc. Children explain how vibrations travel through different materials from one person to the other.

- Children make their own string telephone using the instructions on Activity Resource 1.4. Outdoors is the best place for this activity, where children have lots of space. Ask children to think about how the sound from one person gets to the other person. Scaffold by encouraging children to think about what is vibrating, for example, the air in the phone cup, then the string to the plastic and air of the other person's phone cup. The vibrations travel down the wool, or string from one cup to the other; the other person hears the sound.
- Back in the class, bring children together to share what they did and their conclusion. In this activity what does the sound travel through, e.g. air, plastic, string or wool?

Working Scientifically

- Em. Children carry out a simple test and describe what happens.
- Exp. Children carry out a fair test and use their results to answer their question.
- Exp. Children apply their understanding of sound and materials to draw conclusions and suggest new questions to test.

4 MY OWN QUESTIONS

L.O. Recognise that vibrations from sounds travel through a medium to the ear.

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

Set up simple practical enquiries, comparative and fair tests.

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

- Challenge children to think about what else they would like to find out about their string telephones. Explain to them that they are going to ask questions and then decide which ones they want to answer.
- Working in groups, children write lots of questions on a large sheet of paper or an adult scribes them.
- Working in pairs, children plan and carry out either comparative or fair tests, for example:
  - Which type of line is the best?
  - Does the size of the cup affect how well you hear the other person?
  - Does the length of the line affect how well the telephone works? Would the telephone work using plastic tubing?
- Give children Activity Resource 1.5 which supports children in recording the questions about string telephones that they would like answered.
- Bring the children back to share their results with other pairs, groups or the whole class. Children should listen and ask questions about the other pair's activity and conclusions.

YOU WILL NEED

- Activity Resource 1.5
- Pens and paper
- String telephone made in activity 3

ASSESSMENT

Subject Knowledge

- Em. Children describe how they used the string telephone.
- Exp. Children describe how sound vibrations travel through the telephone.
- Exc. Children can explain how sound travels when they change their telephone.

Working Scientifically

- Em. Children require support to ask and answer their own question. They describe what they did and what happened.
- Exp. Children carry out their test, record results and use them to draw conclusions about how sound travels through materials.
- Exc. Children use their knowledge and ask questions to test an idea, e.g. Does the telephone work better if sound travels through a solid material like string or through the air in plastic tubes?

5 MUFFLE THAT SOUND

L.O. Recognise that vibrations from sounds travel through a medium to the ear.

Set up simple practical enquiries, comparative and fair tests.

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

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

- Show children the video clip which tells the story of someone trying to muffle sounds. Ask children to suggest what else he could have done to block the sound.
- Use Slide 16 as a prompt for children to share ideas about how sound can be reduced, encourage children to use their knowledge about sound, e.g. moving further away, or by putting something in the way, or with ear protectors.
- The challenge in this activity for children is to test materials to find out which material is the best sound insulator (a material that does not let sound vibrations pass through easily).
- Provide a range of materials and fabrics and get the children to handle them and see if they have any ideas as to which would be best. Children could be given an alarm clock or a tin with marbles in to shake and make a sound. So far children have developed the idea of sound travelling through different materials, in this activity the children think about blocking the sound, preventing the vibrations from travelling through the materials. They could use Activity Resource 1.6 to plan out their fair test.
- Challenge children to think about how they could use standard measurements when they carry out their test. For example:
  - Measure the thickness of the materials.
  - Measure the distance away that the sound cannot be heard.
  - Use a data logger or a sound meter app on a tablet.
- When they have completed their activity, and collected data ask them to think about whether they could use the data in their table to create a graph.
- Ask children to draw an annotated diagram to show how they set up their fair test and to draft and re-draft their conclusion to go with their diagram. Children should use scientific terminology, e.g. *sound, vibrations, travel, blocked, sound insulator, materials, sound meter, results, conclusions, data*.
- Use PowerPoint Slide 17 as an assessment discussion where children apply their understanding.

YOU WILL NEED

- 'Muffle that sound' video clip (see Useful Websites list)
- PowerPoint Slides 16 and 17
- Range of materials and fabrics to muffle sound
- Activity Resource 1.6
- Alarm clock or tin with marbles

ASSESSMENT

Subject Knowledge

- Em. Children describe what happened when they changed material.
- Exp. Children describe how vibrations travel through the different materials.
- Exc. Children use a wide range of scientific vocabulary to explain how sound travels through different materials.

Working Scientifically

- With support, children plan and carry out their test. They describe what they did and what happened.
- Exp. Children carry out their test, record results and use their data to draw conclusions about which is the best material to muffle sound.
- Exc. Children plan to use standard measurements to see if there is a pattern in their results. They transfer their data onto a graph and ask new questions about sound insulators.

6 EAR GONGS

L.O. Recognise that vibrations from sounds travel through a medium to the ear.

Set up simple practical enquiries, comparative and fair tests. Use results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions.

- Ask children to write down on a large piece of paper everything that they have learned about sound. Each group visits other groups and writes in a different colour anything that they feel the other group has forgotten. Children then go back to their own work and read the comments.
- Show children Slide 18 which illustrates what ear gongs look like and how to use them. Discuss the contents of the slide with children, and return to it later to scaffold further thinking about the ear gongs. The string is attached to the coat hanger and then the children hold it and put their fingers in their ears. When the coat hanger vibrates, the sound will travel up the string to their ears.
- This is a great activity for challenging children to apply what they have learned so far about sound. Give children time to make and explore their ear gongs and to think about:
  - Where does the sound start?
  - How is the sound being made?
  - What is vibrating?
  - How do the vibrations travel to the ear?
- Bring the class together and ask children to work in pairs, and describe what they heard and explain how the sound travelled to the ear. Listen to the pairs talking, this provides a good opportunity for assessment.
- Next ask children to use what they have found out and ask and write down new questions, and choose one and plan how to answer it. Children might ask:
  - What happens if I move the string on the coat hanger?
  - What happens if the string is longer or shorter?
  - What happens if I change the string?
  - Does a plastic coat hanger make the same sound as a metal coat hanger?
  - Will a metal spoon ear gong make the same sound as a coat hanger?
- Arrange for the class to visit another Year 4 class or year group, to demonstrate and show other children how to use the ear gongs and teach them how they work. Ask the receiving children to comment on how successful the Year 4s were in teaching about the ear gongs.

YOU WILL NEED

- Paper and pens
- PowerPoint Slide 18
- Plastic coat hanger; metal spoon
- Metal coat hangers
- String

ASSESSMENT

Subject Knowledge

- Em. Children show someone else how to use the ear gongs.
- Exp. Children teach someone else how to use the ear gongs and how they work.
- Exc. Children teach someone else how the ear gongs work and explain the science and encourage them to ask their own questions and try out ideas.

Working Scientifically

- Em. Children carry out a simple test and describe what happens.
- Exp. Children carry out comparative tests on different surfaces.
- Exc. Children use their conclusions to set up tests to answer new questions e.g. changing the ear gongs and surfaces.

TOPIC 2 Living things

About this topic

Curriculum link: Year 4, Living things and their habitats

SUMMARY:

This topic teaches the children to recognise that living things can be grouped in a variety of ways. They explore and use keys to identify and name a variety of living things. Finally, they look at how changes to habitats can pose dangers to living things.
Whilst most of the work for this topic can be carried out in spring and summer, it is important that children visit the local environment throughout the school year so that they continue to develop their understanding of seasonal changes and how these impact on living things.

UNITS:

2.1 Classifying and identifying
2.2 What's living in our school grounds
2.3 Saving bees

ACTIVITY RESOURCES

- 2.1: Animal cards
- 2.2: Skeleton key
- 2.3: Vertebrate key
- 2.4: Leaf keys
- 2.5: Leaf pictures

ONLINE RESOURCES:

PowerPoint presentation: Living things
Interactive activity: Living things
CPD video: Science in Action
Pupil video: Living things
Word mat: Living things
Editable Planning: Living things
Topic Test: Living things

Learning objectives

This topic covers the following learning objectives:

- Recognise that living things can be grouped in a variety of ways.
- Explore and use classification keys to help group, identify and name a variety of living things in their local and wider environment.
- Recognise that environments can change and that this can sometimes pose dangers to living things.

Working scientifically skills

This topic develops the following working scientifically skills:

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

CROSS-CURRICULAR LINKS

This topic offers the following cross-curricular opportunities:

English

- Show clips from films such as *A Bug's Life* use as starter for extended writing, what it is like to be an invertebrate.
- Research information about dog fouling, the law, etc.
- Research information about plants and animals in the local environment.
- Participate in PMIs (Positive, Minus, Interesting) about the local environment.
- Create an information leaflet, poster or blog to persuade people to clean up after their dogs.
- Research information to help classify mammals, reptiles, amphibians, birds, etc.

Numeracy and mathematics

- Use tally charts to collect information, e.g. about number of invertebrates in the school grounds.
- Create a database of invertebrates, in the school grounds.
- Interrogate animal and plant databases to answer questions.
- Collect holly leaves and count the frequency of the number of leaves that have 1, 2, 3, 4, 5 points and draw a bar graph.

Computing / ICT

- Use branching databases, e.g. FlexiTree.
- Use digital microscopes or visualisers to look at invertebrates and plants.
- Use Switch Zoo to create a new animal – www.switchzoo.com.
- Use www.buildyourwildself.com to build totally new vertebrates from the parts of other animals. Print out and use to classify new vertebrate into a group.
- Use digital or tablet camera to make recordings of types of leaves around the school. Print out and use for classification or for use in a Photo Story-style presentation.

Design technology

- Make a diorama of a school habitat, e.g. under a stone, hedgerow.
- Design a new animal or plant.

Geography

- Map minihabitats in school grounds.
- Locate different habitats across the world using an atlas or globe.
- Research where different animals from around the world live, e.g. scorpions.

History

- Research Carl Linnaeus.

Art

- Create leaf art, such as patterns using shape and colour, or create animals from leaves, e.g. butterfly.
- Make clay or salt dough imprints of leaves, colour them and use them for classification activities.
- Make leaf mobiles.
- Make observational drawings of plants and invertebrates.
- Model invertebrates using salt dough or clay.
- Use features from plants or animals for art, e.g. fish scales, feathers, tree silhouettes, leaf veins.

PSHE

- Discuss caring for the environment, and taking responsibility, e.g. for local environment, environmental issues.
- Participate in debate: listening to others, different points of view, respecting other people's ideas and beliefs, changing your own ideas.

STEAM (SCIENCE TECHNOLOGY ENGINEERING ART AND MATHS) OPPORTUNITIES

Invite into class

- Request a STEM ambassador with knowledge and skills relating to the animals and plants, e.g. biologist, botanist, zoologist, marine biologist from your local university or environmental organisation.
- Parent who keeps birds or reptiles.
- Representative from the RSPCA.
- Company to show children different animals, e.g. invertebrates.
- Veterinary nurse.

Visit

- Local pet shop.
- Local veterinary practice.
- Local zoo or animal centre.
- Woodland or other environment, e.g. beach to compare with their own local environment.
- Participate in a national event, e.g. Bug Watch, RSPB annual bird count.
- Artists, e.g. natural wildlife photographer or painter

Teacher subject knowledge

There are millions of different plant and animal species in the world. It's currently estimated that there are around 1.3 million animal species (of which 1 million are insects!) and 320,000 plant species. We use the word 'species' to describe a group of living things that are so similar that they are able to interbreed to create a fertile offspring.

Living things are divided into groups, with members of each group having similar features. The obvious first grouping is whether something is an animal or a plant (or fungus or microbe). Each time we divide the living things by particular characteristics, the groups become smaller, until we end up with the organism being identified.

The process of classification makes it easier to identify a species when it is discovered, and to see whether it is an existing species or a new species. It can also help to see which species are closely related in evolutionary terms.

The animal kingdom

The animal kingdom can be divided into two broad groups based on whether they have a backbone (vertebrate) or not (invertebrate). The plant kingdom can also be divided into two group: flowering and non-flowering plants.

Invertebrates

Invertebrates are animals without backbones. They range from totally soft-bodied animals such as sponges and jellyfish, shelled animals such as mussels and barnacles to complex spiders and insects.

Those with no skeleton at all and a body made of segments, e.g. earthworms, form part of a group called annelids. Other soft-bodied invertebrates are 'molluscs', which often have shells, such as mussels or snails. Some don't, such as octopus and squid.

Myriapods (meaning 'many legs') have long, thin bodies with many segments and a hard exoskeleton (exo- meaning 'outside'). Centipedes have one pair of legs per body segment and can have between 20 and 300 legs. Millipedes have two pairs of legs per segment and can have between 36 and 400 legs – not the million legs that children think they have!

The arachnids include spiders and scorpions. They have four pairs of legs and a two-part body. They have a hard exoskeleton which often forms lots of protective bristles.

Insects are one of the most numerous groups on the planet, with over a million known species. Insects have a three-part body and three pairs of legs. Insects are the only invertebrates who are able to fly. This has played a major role in their success.

Vertebrates

The five groups of vertebrates are fish, amphibian, reptile, bird and mammal.

Fish, reptiles and amphibians are cold-blooded. Amphibians have lungs which allow them to spend a lot of time out of water, but they return to water to lay lots of jelly-like eggs. Reptiles have dry scaly skin and live on land, where they lay their eggs – these look a lot like bird eggs.

Mammals and birds are warm-blooded. Birds are covered in feathers and lay eggs with a hard shell. Mammals all have fur (or hair) – even if it is very fine, as in the case of whales and dolphins. They all give birth to live young and female mammals produce milk to feed them.

Flowering and non-flowering plants

Non-flowering plants include plants such as ferns and mosses. Conifers do not produce true flowers so are also considered non-flowering. They produce cones, which produce pollen and seeds in the same way as flowers. They are wind-pollinated. Ferns and mosses do not produce seeds – they reproduce by making, spores which can grow into new plants.

Flowering plants include all other plants, including most trees, grasses and shrubs. They produce flowers, which produce pollen. Some flowers are adapted to attract insects for pollination, but other flowers use wind or water for pollination.

CHILDREN'S MISCONCEPTIONS

Children might think…

- That trees aren't plants.
- That insects aren't animals.
- That there are only two groups of living things: animals and plants.
- That all 'bugs' are insects.
- That all 'bugs' are small.

Children already know…

- That living things can be animals or plants.
- That a natural environment or the home of a variety of plants and animals is called a habitat.
- That living things can be divided into groups.
- The basic features of common animals and plants.
- That living things can be grouped based on their external features.

SCIENTIFIC VOCABULARY

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

bird: an animal that flies and has an internal skeleton

centipede: an animal with one leg to each body segment

classify: to group things so that that they can be identified

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

flowering plant: one that produces pollen and seeds

habitat: the place where something lives

insect: an animal with six legs

invertebrate: an animal without a backbone

key: a series of questions that helps identify or group / classify things

mammal: an animal that gives birth to live young

organism: a living thing, animal or plant

reptile: an animal with an internal skeleton that lays eggs, but lives on land

vertebrate: an animal with a backbone

2.1 Classifying and identifying

GET STARTED

Take the children outside and challenge them to quickly sort themselves into groups, e.g. into fair/dark hair, shoe size, have pets do not have pets. Then, for example, take the group that has pets and get the no pets group to ask questions, e.g. does it have four legs? and the children begin to separate out, then does it have fur? etc. until all pets have been sorted into groups.

LET'S THINK LIKE SCIENTISTS

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

- Can you classify the members of your class? How?
- Can you find out why spiders aren't insects and explain it to the rest of your class?
- Who was the first person to start classifying living things?
- What are the main differences between reptiles and amphibians? How would you describe them to someone who didn't know?
- Why is a flying fish called a flying fish – does it have wings?

ACTIVITIES

1 SORT ME

Recognise that living things can be grouped in a variety of ways.
Ask relevant questions and using different types of scientific enquiries to answer them.
Use straightforward scientific evidence to answer questions or to support their findings.

- Begin by showing children Slides 1–5 as an introduction. The aim of this activity is for children to develop their ability to sort according to criteria and to ask questions which will help to sort animals as a precursor to classification of living things. Use the words *sorting* and *classification* in tandem, tell the children that *classification is* another word for sorting things into groups.
- Give children the animal picture cards from Activity Resource 2.1 and ask the children to sort (classify) the animal picture cards different ways, and to make a list of how they sorted (classified) them, e.g. tails, feathers, carnivores.
- Now give children criteria to use to classify the cards to revise previous knowledge from earlier year groups, this will provide an assessment of how confident children are with the criteria. For example:

Carnivores	Herbivores	Omnivores
Birds	Mammals	Skeleton
Habitat	Reptile	Amphibian

YOU WILL NEED

- PowerPoint Slides 1–5
- Activity Resource 2.1

ASSESSMENT

Subject Knowledge

- Em. Children sort animal cards using obvious features, e.g. number of legs.
- Exp. Children sort according to a range of criteria and ask appropriate questions.
- Exc. Children sort according to scientific criteria and ask questions using scientific knowledge and language.

- Ask a volunteer to come to the front of the class and give him or her one of the animal cards. Tell the children that they must not say the name of the animal! The rest of the class picks up one of the animal cards and the whole class stands up and take it in turns to ask the person at the front questions about the animal they have been given. They can only be questions that can be answered 'yes' or 'no'. As each question is asked, members of the class who don't match that answer, sit down. Continue until there is only one or two children standing, they should have the same card as the person at the front. This helps practise the style of questions needed for keys.
- Working in groups the children could then repeat this activity with children taking it in turns to choose an animal (in their head) from the cards and the rest of the children discard the animals as their questions are answered.

Working Scientifically

- Em. Children sort the animals into groups, not necessarily using scientific knowledge.
- Exp. Children use scientific knowledge to sort animals into groups.
- Exc. Children can explain their classification using subject knowledge and a broader range of scientific vocabulary.

2 USING CLASSIFICATION KEYS

L.O. Recognise that living things can be grouped in a variety of ways.

- Provide each group with a range of eight different biscuits (a variety pack of biscuits is great for this). Get children to sort the biscuits using yes / no questions to group them according to their features, e.g. Does it have chocolate? Does it have layers? Is it round?
- Continue with the biscuit selection and introduce children to a simple classification key. Each child has one biscuit, make a giant key on the floor with arrows by asking the class to think of one yes / no question that could split the biscuits into two groups.
- Write the question on a sheet of A4 paper or, if doing this outside, use chalk. Lay it on the floor with the yes / no arrows coming off it. Children then move into the group according to their answer to the question, e.g. Does it have chocolate in it?
- For the 'yes' children, ask the class to think of another yes / no question to split the chocolate group, e.g. Is it round? And so on. This is repeated for the other group that answered No to Does it have chocolate? In each case the children move with their chocolate so that they are part of the classification key.
- This physically allows the children to engage with how a key works.
- Take photographs of this activity as children carry it out, to display on the interactive whiteboard to remind children what they did.
- Now move to a table top activity to classify the biscuits. There are several ways to do this, such as:
  - Give children wooden craft lolly sticks.
  - Give them strips of paper.
  - Allow them to use dry-wipe pens and write directly onto the table top.
- Show children Slide 6 which illustrates how a group has classified their biscuits.

YOU WILL NEED

- Selection box of biscuits
- PowerPoint Slide 6
- Pens and paper
- Lolly sticks or dry-wipe pens

ASSESSMENT

Working Scientifically

- Em. Children sort biscuits using obvious features, e.g. Does it have chocolate?
- Exp. Children sort according to a range of criteria and ask appropriate questions.
- Exc. Children use every day and scientific criteria, e.g. *opaque, hard, dissolve, melt* and ask questions using scientific knowledge and language.

- Each sort is based on a yes / no question until all of the biscuits have been sorted into just one remaining biscuit at the end of each sort.
- When children have completed classifying their biscuits, tell children to carefully remove each biscuit, leaving only the questions and place the biscuits in a pile next to their key. Then children go to another table and use the classification key to sort the biscuits on that table. If the key works, children will be able to sort the pile of biscuits.

3 CLASSIFY THE ANIMALS

L.O. Recognise that living things can be grouped in a variety of ways.

- Tell children to think back to the animal cards and discuss why it is important for scientists to be able to group things? How does it help them?
- Show children the video clip which teaches children how animals are classified into different groups, birds, mammals etc.
- Make sure that children have their animal cards (Activity Resource 2.1) and show the children the video clip again, this time after each classification, e.g. fish, ask the children to pick the animals from their cards that belong to that group. By the end of the video, the children should have classified the animals into the appropriate group, except the invertebrates, which you could talk about because this group will be used later in this unit.
- Explain that these groups are what scientists use to classify animals across the world, they look at each animal and its features to work out which group it belongs to, focus on naming those groups fish, mammals, birds, reptiles and amphibians.
- Use Slides 7–11 to reinforce the key features of different groups of animals.
- Give children Activity Resource 2.2 which is a skeleton key. Tell them to choose four different animals cards and use the skeleton key to create a classification key for their partner to use. When they have completed it, they swap keys and the four animal cards and check each other's key.
- Children could then use the key to help them create one of their own to classify the animals in question 1 on Activity Resource 2.3. Refer children back to Activity 2 where they chose to use lolly sticks, paper strips or dry-wipe on their table top. Again they peer assess with their partner to check that each other's keys work.

YOU WILL NEED

- 'Classification of animals' video clip (see Useful Websites list)
- PowerPoint Slides 7–11
- Activity Resources 2.1–2.3

ASSESSMENT

Working Scientifically

- Em. With support, children can sort animals into groups.
- Exp. Children classify animals according to key characteristics.
- Exc. Children classify animals and suggest ways of classifying the invertebrate group.

4 VERTEBRATES AND INVERTEBRATES

L.O. Recognise that living things can be grouped in a variety of ways.

- Explain that animals with backbones and skeletons inside the body, are called vertebrates.
- Show children Slide 12 and ask them to discuss the similarities and differences between the different animals skeletons. The other animals do not have a backbone (or a skeleton), and are called invertebrates. The CPD video 'Living things' gives useful ideas for this activity.
- Show children Slide 13 and ask them to talk with their partners and decide which animal is an invertebrate and which is a vertebrate. Ask children to explain why they think that.
- Show children Slides 14–17 to explain how invertebrates are split into insects and not insects.
- Return to using the animal cards from Activity Resource 2.1. Challenge children to create a key so that they can classify and identify all the animals. Remind them that they need to ask yes / no questions to classify the animals into mammals, birds, reptiles, fish, amphibians and invertebrates. Ask them to add themselves – humans to their key, which group do humans come under.

YOU WILL NEED

- PowerPoint Slides 12–17
- Activity Resource 2.1
- CPD video 'Living things'

ASSESSMENT

Working Scientifically

- Em. Children sort according to visible similarities, e.g. feathers, fur, scale and require support to sort according to backbone and no backbone.
- Exp. Children can classify the animals into their appropriate groups.
- Exc. Children can group additional animals that do not follow all characteristics, e.g. slow worm, platypus.

5 CLASSIFYING LEAVES

L.O. Explore and use classification keys to help group, identify and name a variety of living things in their local and wider environment.

- Working in pairs, give each pair a container, some chalk and send them on a leaf hunt, collecting different leaves, they are allowed to carefully take leaves from a plant or tree, but only if there are enough leaves on a tree or plant not to damage it.
- Before children go outdoors give them a copy of Activity Resource 2.4 which they should use to classify the leaves, use PowerPoint Slides 18–24 to develop their knowledge of different features for classification.
- Working in their pairs, children sort their leaf collection in different ways, e.g. shape, colour, size, veins, leaf edges, simple leaf (only one leaf), compound leaf (made up of smaller leaves), prickles. Visit each pair or stop the class to ask them about their observations and introduce new terms such as simple and compound.
- When children are familiar with their leaves and have observed different features they then use this experience to devise their own classification to identify their leaves. They use the leaves and chalk to create a large classification key on the school playground, small stones placed on top of leaves should stop them from blowing away.
- Once completed, children visit other keys and try them to see if they work, they could also leave comments.

YOU WILL NEED

- Activity Resources 2.4–2.5
- PowerPoint slides 18–24
- Containers for each pair

ASSESSMENT

Working Scientifically

- Em. Children sort their leaves according to obvious features, e.g. shape and colour.
- Exp. Children create a classification key according to obvious features, e.g. shape, colour, one or more leaf on stalk.
- Exc. Children classify according to fine detail, e.g. serrated edges, one main vein.

2.2 What's living in our school grounds?

GET STARTED

Show children a large scrapbook or big book that you have made. Explain to them that each month of the year they are going to go outside and collect evidence of the changes in the habitats in the school grounds. Ask them to think about an interesting title for their class book and get the children to vote for the title.

You could also show the Pupil video: 'Living things', which looks at identifying and classifying living things on the seashore.

LET'S THINK LIKE SCIENTISTS

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

- How many different ways can you record what you find out about the school grounds? Which do you think is the most scientific and which is the most interesting?
- Why are classification keys useful?
- Which do you think will be the most common plant or animal in the school grounds?
- What is the thing that you like most about your school grounds? Why?

ACTIVITIES

1 IDENTIFYING AND RECORDING LIVING THINGS

L.O. Explore and use classification keys to help group, identify and name a variety of living things in their local and wider environment.

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

- The aim of this activity is twofold. Firstly for children to use identification and classification keys to identify living things in the school environment. Secondly for children to start off the big book by listing, taking photographs, sketching and counting what is present in the school grounds, or if your grounds are limited, a local park, etc.
- The Pupil video: 'Living Things' shows how different living things can be identified and classified on the seashore.
- Working in small groups of three or four, the children use keys to classify and identify living things in the school grounds. The children might be given responsibility for different things, e.g.:
  - Different habitats, e.g. under stones, hedgerow, grass, tree.
  - Wild flowers.
  - Invertebrates.
  - Trees.
- When they have finished, children will have recorded, perhaps on individual whiteboards, the things that they have classified and identified. There are lots of classification keys, for example, Woodland Trust, Gatekeeper (www.gatekeeperel.co.uk), flower and tree Apps for mobile phones and tablets. It is essential that children use these to identify and name living things.

YOU WILL NEED

- Classification keys for plants and animals (available online)
- Camera or tablet to record findings
- Pupil video: 'Living things'
- Mini whiteboards or pens and paper

ASSESSMENT

Subject Knowledge

- Em. With support, children use a simple key to identify plants or animals.
- Exp. Children use a classification key to identify plants or animals.
- Exc. Children use keys to identify living things and remember their names by linking with specific characteristics.

- Back in the classroom, children could choose an animal or plant to draw (or use the photographs they have taken) and research information for the section in the big book entitled 'What's living in our school grounds?'
- Use the big book to record changes in the habitats across the year, including recording life cycles of plants and animals identified, food chains, also revising work from earlier years on plant parts and pollination and seed dispersal. Observing change across the year will also lead to children classifying and identifying different plants and animals, e.g. snowdrops in January, butterflies in June.

Working Scientifically

- Em. Children record by taking photographs.
- Exp. Children choose from suggestions how to record and research basic information.
- Exc. Children choose their own way to record and research information using range of sources.

2 GOING ON A BUG HUNT

L.O. Explore and use classification keys to help group, identify and name a variety of living things in their local and wider environment.

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

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

- Show children David Attenborough talking about invertebrates in the 'Amazing miniature world' video clip (see Useful Websites list on *My Rising Stars*) which shows how interesting and important invertebrates are.
- Explain that the children are going on a bug hunt, or to be scientific, an invertebrate hunt. You might need to explain the difference between vertebrates and invertebrates at this point.
- Working in groups, children should create a set of 'rules' for how they should behave when hunting for invertebrates. The key things that children need to think about are:
  - Respecting invertebrates as living things – taking care when collecting one.
  - Not destroying a habitat.
  - Returning invertebrates to where they were found.
- Provide each pair with a selection of plastic pots and boxes, paint brushes, classification keys and magnifiers and, if necessary, teach children how to gently sweep an invertebrate such as woodlice into a magnifier or pot for observation.
- Children have two main tasks:
  1. To produce a tally chart of the invertebrates identified in different habitats so that they can use the data to decide which invertebrate is the most / least common and where they are found (habitat). Which is the most common in the areas around the school?
  2. To find out about each invertebrate they identify, e.g. shape, size, body parts, movement, habitat.

YOU WILL NEED

- 'Amazing miniature world' video clip (see Useful Websites list)
- Containers
- Paint brushes
- Classification keys
- Magnifiers
- Pens and paper

ASSESSMENT

Subject Knowledge

- Em. Children require support to focus on key features to use identification keys.
- Exp. Children successfully use keys to identify and name living things.
- Exc. Children make links between habitats and reasons why the living things they identify live there.

Working Scientifically

- Em. Children record by taking photographs.
- Exp. Children choose from suggestions how to record and research basic information.

- To do this, children will need to draw on their maths skills to create a tally chart. It is worth children making their tally chart prior to going out. Remind them of the convention of marking four lines and striking through the fifth so that numbers can be counted in fives. Children should extend their tally chart to include other observations for example:

Name / sketch	Number (tally)	Habitat	Size less or greater than 1 cm	Colour	Body parts	Movement

- Back in the classroom the children should use their data to:
  - Use the numerical data to produce a bar graph to answer the question: 'Which invertebrate is the most common in the school grounds?
  - Complete a fact file on one or more of the invertebrates they found, researching additional information including habitat, body parts, food, life cycle.
  - Create a map of the school grounds to show the location of different invertebrates.

- Exc. Children choose their own way to record and research information using range of sources.
- Em. Children use a tally chart to draw simple conclusions.
- Exp. Children record using tally charts and use this data to create a bar graph.
- Exc. Children create tally charts and use their bar graphs to draw conclusions about the local environment

3 GOING ON A PLANT HUNT

L.O. Explore and use classification keys to help group, identify and name a variety of living things in their local and wider environment.

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

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

- Ask children what they learned from going on a bug hunt that would help them on a plant hunt. Make a list of their ideas.
- In this activity, children go on a plant hunt. Begin by taking children outside to find different plants, and, using a mobile phone or tablet plant Apps, or other identification keys, they should classify and identify the plants.
- It may be easier for children to be given a small area to survey, e.g. hedge, wild area. This is a similar activity to the big hunt to provide repetition and mastery of approach and confidence in classification and recording skills. Children should record their data using a chart similar to the one below.

Name of plant	Number (tally)	Sun or shade	Height	Width	Colour /s	Flowers

YOU WILL NEED

- Containers
- Classification keys for plants (available online)
- Magnifiers
- Pens and paper

ASSESSMENT

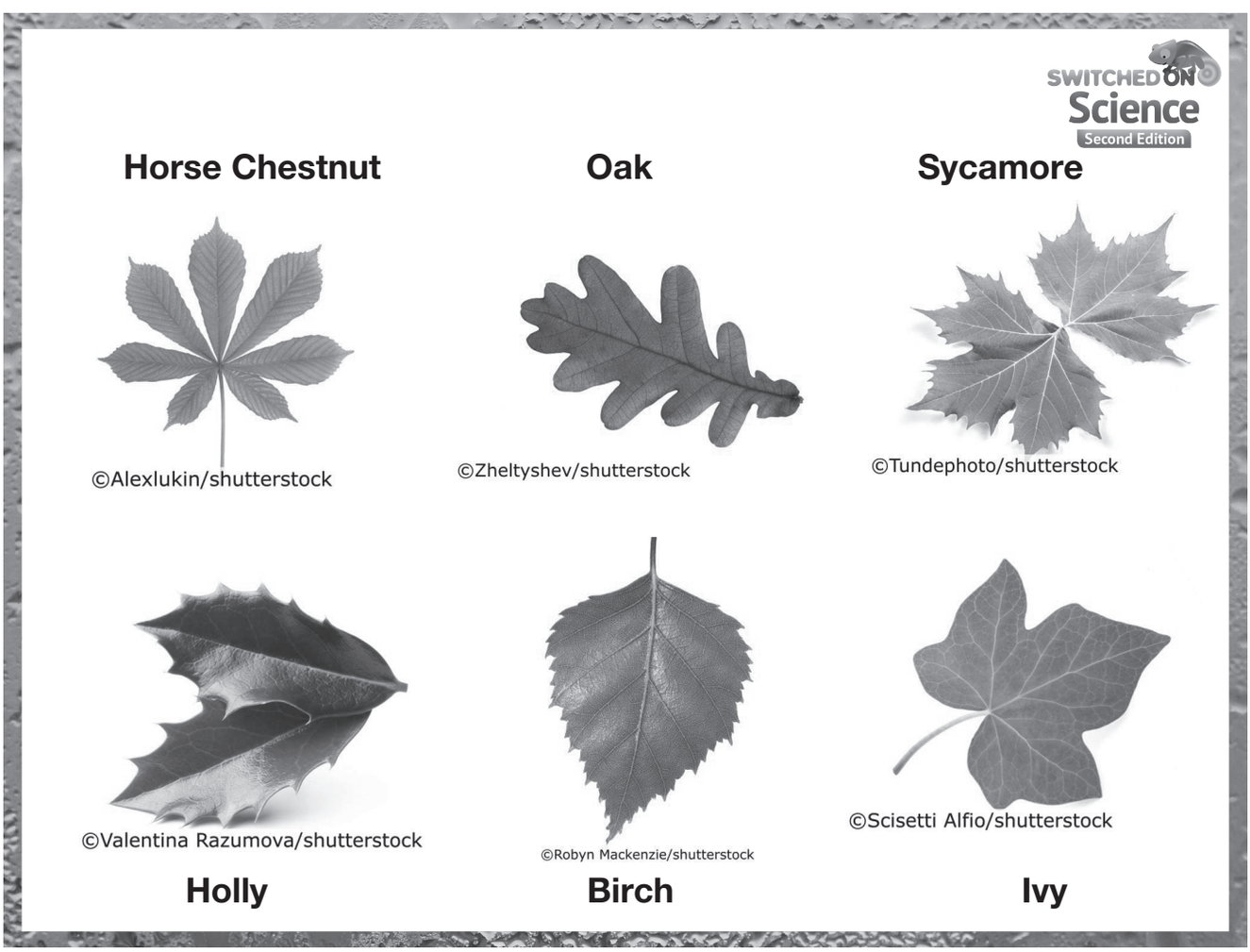
Subject Knowledge

- Em. Children use a tally chart and draw simple conclusions.
- Exp. Children successfully use keys to identify and name plants.
- Exc. Children make links between habitats and reasons why the plant they identify live there.

- Back in the classroom, the children should use their data to:
  - Produce a bar graph to answer the question:
  - 'Which is the most common plant in the school grounds?
  - Complete a fact file on one or more of the plants they found, researching additional information including where it prefers to live, e.g. sun, shade, flowers and seeds.
  - Create a map of the school grounds to show the location of different plants.
- Place some examples of children's work in the class big book. Children could repeat this activity in a different month to compare similarities and differences in living things in the school grounds.

Working Scientifically

- Em. Children use a tally chart to draw simple conclusions.
- Exp. Children record using tally charts and use this data to create a bar graph.
- Exc. Children create their own tally charts according to plants they find and use their bar graphs to draw conclusions about the local environment.



2.3 Saving bees

GET STARTED

Ask children to discuss in groups what they think about bees. Tell them that the saying 'busy as bees' has been used for over 800 years; what does this saying mean? Then show children the 'Bee detectives' video clip (see Useful Websites list on *My Rising Stars*) where a scientist describes her job as detecting pests that kill bees and why bees are so important. Ask children to think about whether they have changed their mind about bees.

LET'S THINK LIKE SCIENTISTS

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

- How would you classify bees?
- Do you see more or less bees these days?
- Why do you think that is?

ACTIVITIES

1 BEES – FRIENDS OR FOES?

L.O. Recognise that environments can change and that this can sometimes pose dangers to living things.

- The activities in this unit are based around bees and lead children through a series of activities from understanding why bees are important to changes in the environment that pose dangers to bees and then how children can work to have positive effect on bee populations. It is an activity therefore that needs to be carried out in spring and summer when children can observe bees in the local environment. Do contact a local bee keeping association to ask if a local beekeeper would talk to children.
- For this first activity children research information about bees to find out whether they are friends or foe and why they are good for the environment. There are many different ways that children can access a wide range of information on bees, for example:
  - Use QR codes for children to watch video clips, text and photographs.
  - Download appropriate text, enlarge and place around the room as posters for children to retrieve and record information, e.g. making notes.
  - Create web links for children to access information.
  - Print leaflets from websites for children.
  - Photocopy magazine and newspaper articles.
- Ask children to create a list of the reasons why bees are good for the environment, and how they help humans. Show them Slide 27 which provides some clues.
- Tell children that they should use their list to create a poster to illustrate their points to make it more interesting. Make sure that children do not copy verbatim and that they draft their own sentences and check spelling, grammar and meaning.

YOU WILL NEED

- 'Bee detectives' video clip (see Useful Websites list)
- PowerPoint Slide 27
- Research materials about bees or access to reference sources
- Paper, pens or computer to create posters

ASSESSMENT

Subject Knowledge

- Em. Children require support to access information and can describe why bees are good for the environment.
- Exp. Children research and present relevant information about why bees are good for the environment.
- Exc. Children use additional research to answer their own questions about bees.

2 THE LIFE OF A BEE

L.O. Recognise that environments can change and that this can sometimes pose dangers to living things.

- Working in groups, ask children to create a concept map on a large piece of paper showing what they know about bees, including if they know anything about their life cycle.
- Show children Slide 25, ask them to list the similarities and differences between the different bees.
- Children research the life of a bee, including its life cycle and the different kinds of bees and their roles. Show children Slide 26 to check their research and understanding of the life cycle of a bee.
- They should also find out what things are a danger to bees, e.g. other animals, gardeners and farmers using pesticides, habitats and their plants disappearing.
- Create a web file of video clips that children could use or a set of QR codes linking to sites such as the one on the Useful Websites list, which shows the inside of a hive.
- Children could take notes, place their research on a large sheet of paper, and the use their information to communicate and share with each other, for example:
  - Role-play.
  - ICT to create an animation using dough.
  - Two-minute video.
- Towards the end of this activity, tell the children to go back to their concept map and add new information. Ask them to think about how their learning has changed and what they think is the most important or maybe the most fascinating thing they have learned.

YOU WILL NEED

- Pens and paper 'Bees for kids' video clip (see Useful Websites list)
- PowerPoint Slides 25–26
- Equipment to present results of research, e.g. ICT, video

ASSESSMENT

Subject Knowledge

- Em. Children watch and talk about information from, for example, a video.
- Exp. Children research, record and communicate key aspects of the life of a bee.
- Exc. Children use additional research to answer their own questions about bees and communicate using scientific vocabulary.

3 BEE SURVEY – COLLECTING DATA

L.O. Recognise that environments can change and that this can sometimes pose dangers to living things.

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

- Ask children to think about how they could find out how many bees visit the school grounds in a week. They could guess and suggest a number by writing it on their mini whiteboard, holding it up and sharing it with the rest of the class.
- In this activity children begin by surveying the number of bees found in different areas of the school grounds over a week. For example, the playground, flower bed, wildflower garden, vegetable patch or hedgerow.

ASSESSMENT

Subject Knowledge

- Em. Children know that there are fewer bees in their local environment.
- Exp. Children can suggest ways in which they can change their school environment to help bees.
- Exc. Children research how human activity is affecting bee populations and use their research to suggest how the school could change the environment to help bees.

- Each day a group of children spend a given amount of time counting the number of bees in each area and recording using a tally chart. The group then transfers the data that they have collected onto a class bar graph (this could be a computer generated graph), for each day the graph would have three or four bars (different habitats) so that by the end of the week children have data to interrogate, asking questions such as:
  - Which habitat had the most bees?
  - Which habitat had the least bees?
  - Did the weather affect how many bees visited the school grounds?
  - How could we encourage more bees into the habitat with the lowest number?
  - Were the number of bees roughly the same each day?

Working Scientifically

- Em. Children use a tally chart to count bees and require support to transfer the data onto a graph.
- Exp. Children use their graph to draw conclusions about bee populations and the different habitats. They can suggest where they need to grow bee friendly plants.
- Exc. Children draw conclusions from their data and ask and research further questions about bees.

4 'BEE' FANTASTIC – SAVE OUR BEES

L.O. Recognise that environments can change and that this can sometimes pose dangers to living things.

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

- Show children Slide 28, ask them to discuss their ideas for saving bees, list their ideas, you could get children to prioritise them, e.g. easy to do, need help to do.
- Engaging children in making the school grounds a bee-friendly environment is an excellent way of helping children to realise that they can help to make positive changes to their environment.
- Children research how they can encourage more bees to visit their school grounds, using leaflets and the Internet. Even better would be if they could discuss ideas and approaches with people from the local community such as:
  - Bee keepers – advice on encouraging bees into the school environment.
  - Gardeners – for advice on planting 'bee-friendly' plants.
  - Carpenters / joiners to work with children to make 'bee hotels'.
- Typical ways in which schools can support bee populations include:
  - Planting wild flower seed mixes which include red campion, poppy, cornflower, thistle.
  - Planting heather, wallflowers and herbs in pots.
  - Designing and making bee hotels and placing them around the school grounds.
  - Designing areas that link together so bees travel from one bee-friendly area to the next easily.
  - The Useful Websites list (on *My Rising Stars*) has a link to a pack for schools to use.
- Obviously, it takes time for plants to grow, so children will not see the effects of their actions immediately. Talk to children about how they could gather evidence to prove they have had a positive effect on an environment by encouraging more bees.

YOU WILL NEED

- PowerPoint Slide 28
- 'The bee cause' pack (see Useful Websites list)

ASSESSMENT

Subject Knowledge

- Em. Children describe what they have done to attract bees into the school grounds.
- Exp. Children describe why they are making changes to their school grounds.
- Exc. Children can explain why they should collect scientific evidence to find out if the bee population in the school grounds changes.

Working Scientifically

- Em. With help, children research information about bees.
- Exp. Children use information from research to suggest ways of helping to improve bee populations.
- Exc. Children use their research to explain why some approaches would be more effective than others.

5 SPREADING THE WORD

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

- Explain to children that they have worked hard learning about bees and how to help bee populations, that it would be good to share this with other people in the school and the local community. Working in groups, ask children to think about different ways that they could communicate their work to other people and to make a list on a large sheet of paper. Each group should pick a presentation project to carry out. Ideas could include:
  - Setting up a BEE BLOG – sharing what they have learned, their data, explaining why bees are important, problems and what they are doing to help increase bee populations.
  - Writing an article for the school newsletter.
  - Working with, for example, a crafter who uses bees' honey to make candles, creams and honey to make and sell products at a school fair.
  - Having an assembly where children role-play the life cycle of a bee, for and against debate about bees, do a 'waggle dance'.
  - Creating a 'Save our bees' video campaign to go on the school website or show parents.
  - Producing a leaflet to go home about their work.
- Ask children to think about what they have learned about bees and what they think would be important for other people to know, they should use the information and data they have collected during these activities on bees.

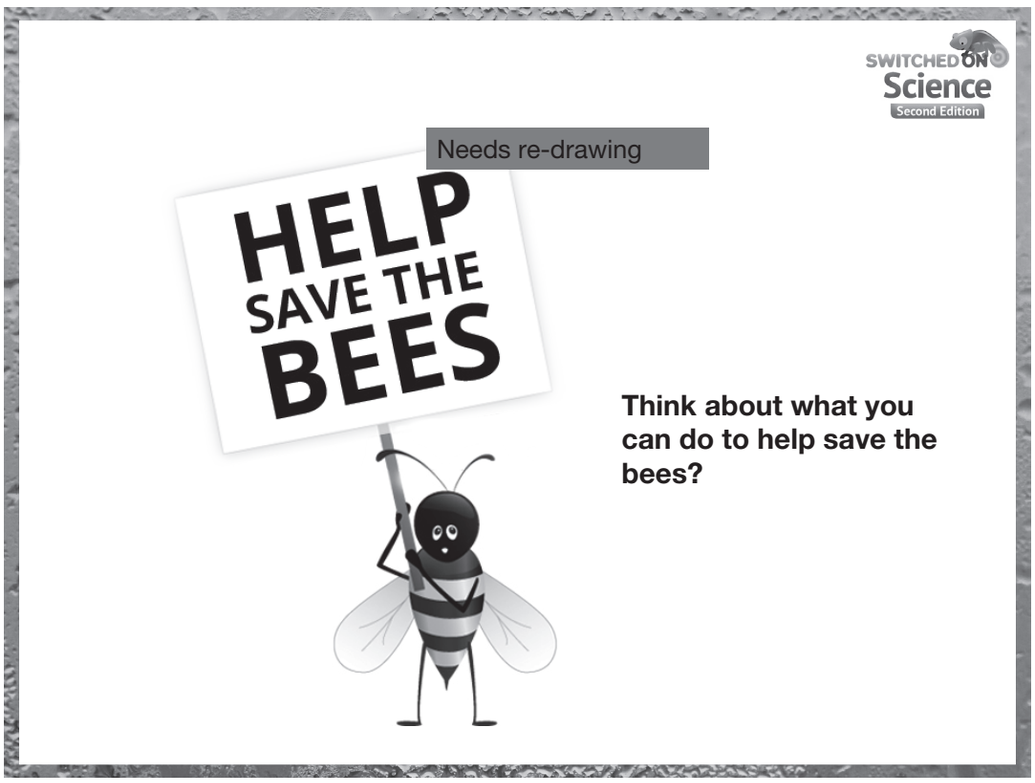
YOU WILL NEED

- Pens and large sheets of paper
- Materials for each group to create their chosen presentation

ASSESSMENT

Working Scientifically

- Em. Children take part in a presentation with other children.
- Exp. Children present key information about bees and explain why bees are important and describe what they have done to encourage bees into the school grounds.
- Exc. Children combine different ways of presenting their learning that shows good understanding of how humans can have a positive impact on living things.



TOPIC 3 Looking at states

About this topic

Curriculum link: Year 4, States of matter

SUMMARY:

Children will learn about states of matter. They will compare and group materials together, according to whether they are solids, liquids or gases. They will observe that some materials change state when heated or cooled, and they will identify the part played by evaporation and condensation in the water cycle.

UNITS:

3.1: What's the matter?
3.2: Food changing state
3.3: The water cycle

ACTIVITY RESOURCES

- 3.1 What a state!
- 3.2 A watery end
- 3.3 Making ice-cream
- 3.4 Freezing substances
- 3.5 Cloud in a glass
- 3.6 The water cycle

ONLINE RESOURCES:

PowerPoint presentation: Looking at states
Interactive activity: Looking at states
CPD video: Looking at states
Pupil video: Looking at states
Word mat: Looking at states
Editable Planning: Looking at states
Topic Test: Looking at states

Learning objectives

This topic covers the following learning objectives:

- Compare and group materials together, according to whether they are solids, liquids or gases.
- Observe that some materials change state when they are heated or cooled, and measure or research the temperature at which this happens in degrees Celsius (°C).
- Identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature.

Working scientifically skills

This topic develops the following working scientifically skills:

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

CROSS-CURRICULAR LINKS

This topic offers the following cross-curricular opportunities:

English

- Making lists, e.g. solids, liquids and gases.
- Drafting and re-drafting definitions, e.g. solids, liquids, gases.
- Creative writing based on ice hands.
- Use headings and sub-headings when writing up tests.
- Writing instructions, e.g. making ice hands.
- Annotating diagrams.
- Create an advert for saving water.
- Research different melting points.

Numeracy and mathematics

- Measurement, volume and time.
- Bar graphs, e.g. of melting and boiling points of different substances.
- Reading line graphs.
- Temperature, reading scales.
- Negative numbers.
- Sorting and Venn diagrams.

Computing / ICT

- Using digital thermometers.
- Making and reading computer-generated bar and line graphs.
- Using PicCollage to create water and ice montages.
- Photography and video activities.

Drama

- Role-play the water cycle.
- Riole-play solids, liquids and gases.

Design technology

- Make a water cycle model.

Art

- Painting using water colours.
- Watercolour wash paintings.
- Photography – raindrops, puddles, ripple and splashes.

STEAM (SCIENCE TECHNOLOGY ENGINEERING ART AND MATHS) OPPORTUNITIES

Invite into class

- Someone from local water company to explain how water gets to the home.
- University outreach – scientist to show and explain activities related to water.
- Request a STEM ambassador with knowledge and skills about water treatment, saving water, sewage treatment and careers.
- Artist to develop new approaches, e.g. watercolour wash paintings
- Photographer to teach children techniques.
- IT professional to work with children to make a video on the water cycle.
- Writer to develop creative writing linked to solids, liquids and gases.

Visit

- Site visit to a local water treatment works.
- Local canal – Canal and River Trust
- Local manufacturer that uses water in different states, solid, liquid and gas.

TEACHER SUBJECT KNOWLEDGE

A material may exist in three states: solid, liquid, and gas. The state that a material is in depends on the temperature. Water, for example, is in its solid state (ice) at 0°C or below, liquid state (water) between 0 and 100°C and, at temperatures of 100 °C and above, water exists in the gas state, as steam. It is unique in having different names for each state of matter.

When a sample of a material is in the solid state, you can hold it in your hands. You can form it into a pile. It is not easy to change the shape of a material in the solid state. You may question this: a sponge is a solid. You can squash a sponge, but it is the air you are 'squeezing', not the sponge itself.

When a material is in the liquid state, you cannot hold it in your hands. It forms a pool, not a pile. Liquids take the shape of the bottom of the container they are in. Another misconception would be about sand being a solid but it runs through your fingers. You need to consider each grain as a tiny solid.

In the gas state, a material escapes from an unsealed container. It spreads out to fill all the space available, and takes the shape of the entire container.

When a sample of a material melts, it turns into a liquid, because heat has been applied. Pure water melts at 0ºC and gold melts at 1064ºC. You can tell a material is melting if, when taking in heat, it is

present in both its solid and liquid states, such as an ice cube with a pool of water present.

Pure water and gold melt very suddenly because they are pure substances. The melting point of a substance is the same, however big the sample. Margarine and chocolate are mixtures of substances. For this reason, they do not have sharp melting points, but melt over a range of temperatures.

The reverse of this change of state, i.e. from liquid to solid, is called freezing. When cooled, a pure substance in its liquid state freezes when it reaches a certain temperature, which is also its melting temperature. It will remain at this temperature until all the liquid has frozen. The temperature at which a particular material freezes does not change no matter how much material is present. As with melting, it is only the time taken for the change to occur that increases with an increase in the amount of material.

A mixture of salt and water freezes at a lower temperature than pure water. This means that lower temperatures can be achieved by mixtures of ice and salt than by ice alone. This principle is the reason for salting roads in winter.

Evaporation can happen at any temperature. The higher the temperature, the faster a material evaporates.

Evaporation is speeded up if moving air carries the particles away from the surface of the liquid. It is evaporation that dries wet clothes, and that dries the wet kitchen paper in the investigation in this unit.

Boiling occurs throughout a material in the liquid state. Bubbles rise to the surface, where they escape to the air.

A material can change from the gas state to the liquid state by condensing. Condensing happens at any temperature below the boiling point, but happens most readily at cold temperatures.

These processes are linked in the water cycle.

The Sun heats up a water source so that particles of water escape (evaporation takes place). The vapour rises and cools, or the vapour condenses into droplets. These gather together to form clouds, which it drops as rain once there is too much water for them to hold. Rain fills streams and rivers and other water sources so that the process continues in a cycle.

Sometimes, water droplets in the atmosphere freeze to form tiny ice crystals. These tiny ice crystals may collide and stick together in clouds to form snowflakes. If the snowflakes get heavy enough, they fall to the ground as snow. Snow eventually melts, and moves into streams and rivers, so the water cycle continues. Hail, is a water droplet that has frozen after it has left the cloud.

Top tip: The Met Office website (www.metoffice.gov.uk/learning) has some weather-related explanations, video clips and ideas for further activities.

CHILDREN'S MISCONCEPTIONS

Children might think…

- That materials always exist in just one state.
- That ice is a different material from steam or liquid water, not water in different states.
- Soft things are not solids.
- Powders are not solids because they can be poured and take the shape of their container, e.g. sand and flour.
- That only water boils.
- That there aren't temperatures below zero or above 100°C.
- That everything freezes at 0ºC.

Children already know…

- How to describe simple physical properties of everyday materials.
- How to compare and group together a variety of everyday materials.
- How to compare using observations.
- That materials are either solid, liquid or gas.
- That ice melts at 0°C.
- That ice and water can be present at the same time.

SCIENTIFIC VOCABULARY

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

boiling point: the temperature at which a liquid turns into a gas

boiling: when a material reaches a temperature when it bubbles and turns into a gas rapidly

condensing: the process when a gas turns into a liquid

evaporation: when a liquid turns into a gas, below its boiling point

freezing: when a liquid turns into a solid

freezing point: the same temperature as a material's melting point. This is the temperature at which a liquid turns into a solid

gas: a state of a material when it fills the entire space available

liquid: a state of a material when it can flow from one place to another, and can be poured

matter: another name for 'material'

material: what an object is made of (not just fabric)

melting: when a sold turns into a liquid

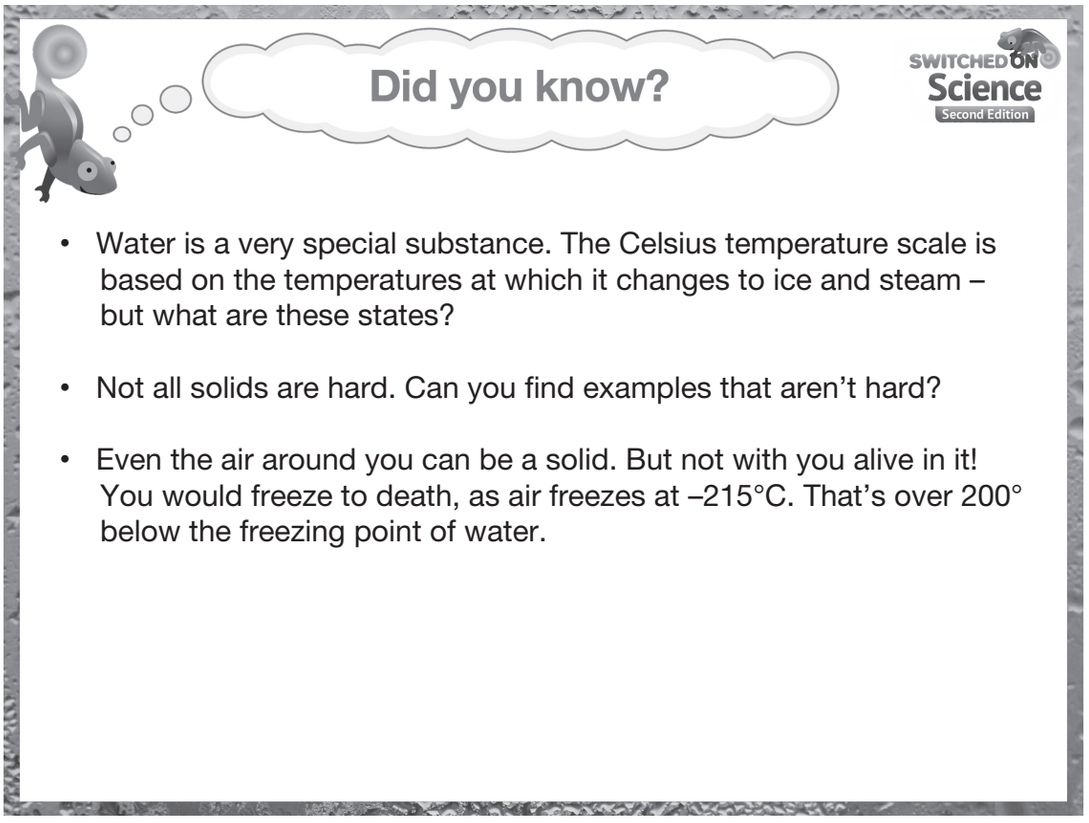
melting point: the temperature at which a solid melts

solid: a state of a material when it cannot change shape, but holds the shape of whatever container it was frozen in

temperature: a measurement of how hot or cold something is

thermometer: a device or instrument used to measure temperature

water cycle: how water moves around to create clouds, rain and the weather



- Water is a very special substance. The Celsius temperature scale is based on the temperatures at which it changes to ice and steam – but what are these states?
- Not all solids are hard. Can you find examples that aren't hard?
- Even the air around you can be a solid. But not with you alive in it! You would freeze to death, as air freezes at –215°C. That's over 200° below the freezing point of water.

3.1 What's the matter?

GET STARTED

On a large sheet of paper, ask children to write down *solid*, *liquid* and *gas* and, as a group, write down what they already know about each one, including some examples. Use PowerPoint Slides 1-4 as an additional introduction.

LET'S THINK LIKE SCIENTISTS

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

- Air is a gas. It is made of lots of different materials. Can you find out what they are? Try presenting it as a graph.
- Are all liquids the same? Do they have the same appearance? Carry out a survey around your home and compare them all. How can you share what you have found out?
- Glass is a liquid! Look at old church windows and see if you can spot the evidence.

ACTIVITIES

1 IN A STATE

L.O. Compare and group materials together, according to whether they are solids, liquids or gases

- Tell the children that they are going to learn about 'states of matter' in other words about solids, liquids and gases. They have already written things down about these (see Get started) and the next set of activities should help them learn more about them.
- Tell children that they are going to return to their piece of paper lots of times and add to it, or change what they have written.
- Give each group a glass with beads in it, a glass with water in it and a glass with air in it. Take a vote on which is the solid, liquid or gas. The children discuss why they have labelled them this way. Build up some definitions of what a solid, a liquid and a gas are on the board.
- Give children a range of materials, and ask them to decide as a group which they think are solids and to say why.
- Collect children's ideas. Do they agree with what other groups say? Show children Slide 5 and recap on the idea of what is a solid. Ask children to think about whether they need to rethink any object they have on their list as a solid and why.
- Ask children to explore the sponge on their table, is this a solid? Why? The class could vote. Use Slide 7 as a discussion point – you could add the reasons why they think it is a solid. Show children Slide 6, this might challenge some children who think that solids have to be hard.

YOU WILL NEED

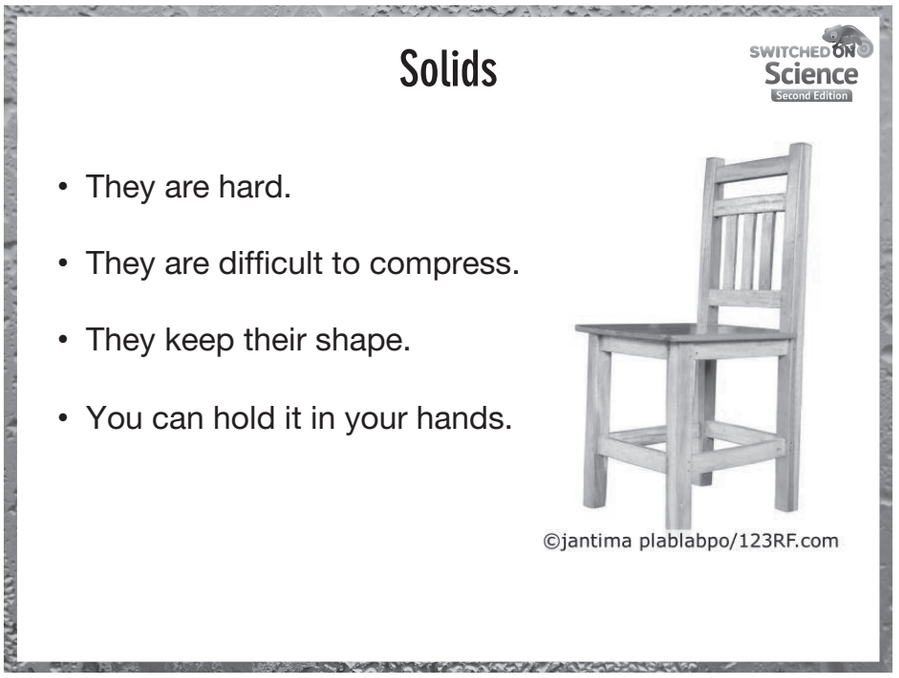
- PowerPoint Slides 5–10
- Sponges
- Range of solid objects, e.g. beads, Lego or building blocks, metal objects, wooden, glass, etc.
- Range of liquids, e.g. milk, water, juice, squash, etc.
- Range of objects with gas in them: balloon, ball, sealed glass or bottle
- Sorting hoops
- Cameras
- Variety of containers and measuring jugs to pour liquids in and out of
- Activity Resource 3.1

- Next ask children to group the liquids on their tables and to decide why they are liquids; show them Slide 8. Are they correct or do they want to change any of their choices?
- Provide liquids and d shaped containers for the children to explore how a liquid behaves compared to a solid. Pouring them and measuring the volume of liquid helps establish that nothing is lost when they change shape. Discuss what happens if they tilt the container. Can they refine their definition of a liquid?
- Show children Slide 9. If children are unconvinced, give them samples of sand to feel and view under a microscope or hand lens to show that they are small pieces of rock.
- Provide a range of more challenging solids, such as rice, sugar or flour, in jars, beakers or plastic cups. Ask the children to pour them from one container to another. Are they liquids? Why not? (This revisits the definition of a liquid.) Children then explore what makes them solid but also how they are like liquids. Using close observation under microscopes and / or hand lenses, can they explore whether they are solids or liquids? Can they refine their definition of a solid?
- Finally, ask children to sort gases and discuss their answers using Slide 10.
- Using a different set of materials, children could complete the table in Activity Resource 3.1 and explain their reasoning.
- Tell children to go back to the large piece of paper and change or write new ideas using a different pen. What is the most surprising thing that they have learned? Which do they think is the most important?
- Finally, set a challenge to children. Ask them to look at the objects on their table and decide which ones could be more than one thing, e.g. solid and liquid, or solid, liquid and gas.

ASSESSMENT

Working Scientifically

- Em. Children require support to sort objects into groups and may confuse some solids as liquids.
- Exp. Children can sort objects into solids, liquids and gases.
- Exc. Children suggest or collect from the classroom additional objects to sort.



2 ICE HANDS

L.O. Observe that some materials change state when they are heated or cooled, and measure or research the temperature at which this happens in degrees Celsius (°C).

- Show children Slide 11 and ask children whether the objects are solid, liquid or gas or could they be more than one thing? Some children might suggest that the bat, for example, is all three, bones solid, blood liquid and air (gas) in lungs.
- Working in pairs or groups, give children previously prepared ice hands, in a tray. These can be made by filling a latex glove with water, tying a knot in the end and freezing. Once they are frozen, cut off the glove.
- Give children time to explore the ice hands. They could record their observations on a sheet of paper, encourage them to use adjectives, e.g. *cold, slippery, wet, spiky*. Praise the use of scientific language, e.g. *transparent, translucent, frozen, melting, liquid, solid*.
- Through discussion, establish what state of matter the ice is and what the ice is made from. Children find it hard to recognise that ice is frozen water and not a different substance, it is water that is in a solid state.
- Ask children to discuss what will happen to the ice hand? Children will already observe that the ice is melting, and many will use this word, do check that they know that this is a change from solid (ice) to liquid (water) and use the phrase 'change of state'. The change is from water in a solid state, to water in a liquid state we call this change melting. Freezing is when water in its liquid state is cooled and changes into a solid state.
- Ask children why the ice is melting? Why is it changing from a solid state, melting, changing into the liquid state?
- Tell them to put the ice hand into a container and describe what will happen. Ask them what they think will happen to the temperature of the solid and liquid in the container. Give them either digital thermometers or spirit thermometers (remind them how to hold a thermometer correctly). They should log the change in temperature until the solid (ice) has completely changed state to a liquid.
- If you have digital thermometers linked to a computer you could set this to log the temperature and produce a line graph for children to 'tell the story' of what happens.
- As children take each reading point, they could stick an image of what the ice hand looked like. What do they notice about the temperature and the images on the thermometer? (It should stay about zero until the ice has all melted then start to rise.) Reinforce the idea that for the ice to melt the temperature has to rise above 0°C.
- Children could use Activity Resource 3.2 to record this activity.
- Use Slide 12 to find out how secure children are in their understanding of changes of state from solid to liquid.

YOU WILL NEED

- Ice hands (made using latex gloves or moulds)
- Trays
- Containers
- Thermometers
- Activity Resource 3.2
- PowerPoint Slides 11 and 12

ASSESSMENT

Subject Knowledge

- Em. Children can say that the ice hand melts because, for example, the room is warm.
- Exp. Children know that ice melts at 0°C and above.
- Exc. Children are able to explain the pattern in their data, either using a line graph from a digital thermometer or spirit thermometer.

3.2 Food changing state

GET STARTED

Give each pupil a small piece of chocolate, e.g. a chocolate button. Ask them to put it in their hand and hold it tightly. As they are doing this you could read Michael Rosen's poem *'Chocolate'* (see Useful Websites list). What happens to it? Elicit that the chocolate melts.

LET'S THINK LIKE SCIENTISTS

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

- Why do we add salt to paths in the winter? What does it do to the ice?
- How many places can you see changes of state taking place?
- Why do changes of state happen?

ACTIVITIES

1 IT'S MELTING

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

Set up simple practical enquiries, comparative and fair tests.

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

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

Identify differences, similarities or changes related to simple scientific ideas and processes.

- There are lots of foodstuffs that we use in cooking such as chocolate, cheese, butter, margarine which can help children to understand changes in state from solid to liquid and back to solid. The most fun of course is using chocolate. Children might have asked questions such as:
  - Why does chocolate melt?
  - How can we change melted chocolate back (into a solid)?
  - Which kind of chocolate melts the fastest?
  - What temperature does chocolate melt? Is it the same as butter?
  - Can we make our own chocolate shapes?
  - Where will chocolate melt fastest in the classroom or in the school grounds?

YOU WILL NEED

- *'Chocolate'* by Michael Rosen (see Useful Websites list)
- Plastic containers
- Chocolate – milk, dark and white
- Small foil pie dishes
- Thermometers and / or digital thermometers
- Flask of safe hot water
- PowerPoint Slides 13–15

- Will chocolate melt faster it we heat it over a candle?
- What happens to chocolate when it melts.

- All children could begin by melting chocolate, taking photographs or notes of observations and then choose one of their questions to answer by carrying out a fair test or comparative test depending on children's ability. At Year 4 most children should be applying their maths skills by using standard measures in their activity, for example, stopwatch, thermometer, measuring jug for capacity, scales for weighing chocolate.
- Melting chocolate is easy. Show children Slide 13 and then Slide 14 which shows how to set up a melting chocolate test.
- Where children collect data, this should be recorded using a table and then represented as a graph. Use Slide 15 to support children in constructing a bar graph. Help children by showing them that the headings from the table go on the graph, and that the scale on the vertical axis goes from 0 to the highest number in their table. Remind children that there should be gaps between the columns.
- When children have completed their activity they should draw conclusions. Scaffold these by telling children to use words from their science word mat, e.g. *melt, change, state, heat* and, if they have numerical data, they should use the numbers in their conclusion. Do use literacy strategies, for example, children drafting and redrafting using an individual whiteboard.

ASSESSMENT

Working Scientifically

- Em. Children ask a question and carry out a comparative test and can describe what happened.
- Exp. Children ask questions, carry out a fair test using standard measures. They use their graph data to draw conclusions about chocolate melting.
- Exc. Children explain their results, e.g. differences, similarities and changes related to changes in state, solid to liquid.

2 FREEZING

L.O. Observe that some materials change state when they are heated or cooled, and measure or research the temperature at which this happens in degrees Celsius (°C)

Set up simple practical enquiries, comparative and fair tests

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

Identify differences, similarities or changes related to simple scientific ideas and processes

- Give each child a previously frozen grape, and a normal grape. Ask pupil pairs to discuss similarities and differences, and to work out reasons for these differences. Take feedback from the discussion, and establish that, in the frozen grape, it is the water that has frozen. The water has changed from the liquid to the solid state. Tell the children that water freezes at 0 °C.
- Ask children what happens when a liquid freezes? Encourage them to use scientific language, you could tell them to use the words on their science word mats, e.g. *liquid, solid, colder, freezing point, 0°C, opposite, melting, change.*

YOU WILL NEED

- 'How to make ice cream – turning a liquid into a solid' video clip (see Useful Websites list)
- Ice-cube trays
- Frozen grapes, defrosted and fresh grapes
- Range of solids and liquids, e.g. ketchup, baked beans, sawdust, dried rice, cooked spaghetti, jelly cubes, fizzy drinks, cheese, margarine, water, milk, raisins, grapes, orange segments, vinegar
- Winter gloves
- Several bags of ice
- Activity Resources 3.3 and 3.4
- Ingredients and equipment for making ice-cream (see Activity Resource 3.3)
- PowerPoint Slide 16

- Remind children about their experience with the ice hands (page 44), what state was the water: a solid, liquid or gas? How was the liquid water changed to become a solid? What was the process called? What was the process called when the solid (ice) changed state to a liquid?
- Divide the class in half, one half discusses in their groups, 'Does everything freeze?' the other half discusses 'Do all liquids freeze?' and ask children to plan how they will answer this question. Tell them that every group will be given an ice-cube tray and they must make a list of the substances they want to test from the resources provided. Give children Activity Resource 3.4 to record the substances they are going to test, their prediction, their reason, and in the next lesson they complete the results.
- Show children the video clip about making ice-cream (see Useful Websites list on *My Rising Stars*) so that children have some prior knowledge of the recipe they are going to follow. Each group will need a copy of Activity Resource 3.3, which includes instructions for making the ice-cream.
- Make sure you use freezer bags which are very strong and that when children hold the bag of ice and salt they are wearing thick gloves since the temperature of the mixture will decrease to –10°C. The process of making ice-cream changes the liquid into a solid by the process of freezing, adding salt takes the liquid down to 0°C and lower to –10°C. In maths children learn about negative numbers, so this is an ideal opportunity to discuss this in reality.
- Making ice-cream is of course exciting but make sure that you draw the science out of this activity, use Slide 16. Ask children what processes take place in making and eating ice-cream (freezing and melting), ask what the salt does to the ice and where in the activity substances were solids and liquids. Talk about how the ice-cream as a solid can be reversed to become a liquid and then the process reversed again to become a solid.

ASSESSMENT

Subject Knowledge

- Em. Children are able to talk about freezing and cold.
- Exp. Children know that changes of state from liquid to solid happen because substances freeze.
- Exc. Children talk about the processes of freezing and melting linked to changes in state from liquid to solid and back to liquid, they know these are reversible changes.

Working Scientifically

- Em. Children can compare two things and describe what happens.
- Exp. Children carry out comparative tests and are able to record what happened relating this to processes e.g. freezing and melting.
- Exc. Children explain their results in relation to scientific processes e.g. freezing, melting and ask new questions to test.

3.3 The water cycle

GET STARTED

Get children thinking about some familiar examples of evaporation and condensation, here are some suggestions:

- Leave a bowl of water overnight, tell the children that is what you are doing.
- Next day make a fuss of finding an empty container, ask the children 'What happened to the water? Where has it gone?'. Collect children's ideas.
- Give each child a piece of dried apple and a piece of normal apple. Let them eat both pieces. What is the difference? Where has the water gone?
- Take a can of cola or a glass out of a fridge or cool box full of ice. What happens, what do the children see? Where has the water come from?

You could also show the Pupil video: 'Looking at states' to introduce evaporation and condensation.

The CPD video 'Looking at states' also gives ideas for activities to develop understanding of the water cycle.

LET'S THINK LIKE SCIENTISTS

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

- Do all materials boil? What material has the highest boiling point? What has the lowest? What about melting and freezing points? Produce a table to show a few examples.
- There are people who can predict the weather. They use temperatures and winds to work out where it is going to rain. Why not find out more about the part that water and temperature play in this?
- Tumble driers at home dry the washing. How do they work? They have a part called a condenser – what do you think this is for?

ACTIVITIES

1 EVAPORATION

L.O. Identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature.

Set up simple practical enquiries, comparative and fair tests.

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

Identify differences, similarities or changes related to simple scientific ideas and processes.

- Remind children that they have learned about changes in state where liquids can be frozen to become solids and then can melt to become liquids again. These are reversible changes. Explain that there are two other changes, one is evaporation and the other is condensation.
- Show children the Pupil video: 'Looking at states' (on *My Rising Stars*) explaining evaporation and condensation. Get children to discuss what the two words mean and which word they should use

YOU WILL NEED

- Pupil video: 'Looking at states'
- Activity Resource 3.5 (includes list of equipment for activity)
- PowerPoint Slide 17
- Mini whiteboards
- Sticky notes and pens
- CPD video 'Looking at states'

for what happened in the Get started activities. Ask them to explain why they linked condensation or evaporation to each of the activities. What was happening to the water?

- Demonstrate to children a cloud forming in a glass (see Activity Resource 3.5). Discuss with them what is happening, challenge them to use the words *condensation* and *evaporation, vapour, changes in state* and *gas*.
- Show them Slide 17, and working in pairs children set up the same activity and observe what happens using Activity Resource 3.5. Then each pair uses their mini whiteboards to draw an annotated diagram with captions to explain what is happening. Children peer assess each other's work and say what is good and if there is anything that could be improved. Check children's work so that they can record it in their science books.
- Go back to the bowl you left overnight (see Get started activities). Ask children to think again about what happened to the water in the bowl. Ask children to think about puddles and the dried apple, what process was happening was it condensation or evaporation?
- Now ask children to think about some ideas that they could test about evaporation, get them to write their ideas on sticky notes and share them on a working wall, or an area such as a door. For example, children could suggest:
  - I think that all liquids will evaporate at the same time.
  - I think that thicker liquids will evaporate more slowly than others.
  - I think small puddles will evaporate more quickly than big puddles.
  - I think you can stop evaporation.
  - I think that you can make evaporation happen more quickly.
- Working in pairs, ask children to decide what they want to test, they could choose their own idea to test or they might like someone else's idea better and want to test that.

Explain that they have to:

- Decide how to test their idea, e.g. a comparative test or a fair test.
- Make sure that they take measurements using millimeters and measuring equipment.
- Record their results and use them to say if their idea was correct and why.
- Use what they know about evaporation and condensation to explain what happened.
- Make a poster showing their idea, what they did, what happened and their conclusions using key words from their science word mat.

ASSESSMENT

Subject Knowledge

- Em. Children require support to recognise the processes of evaporation and condensation.
- Exp. Children know about condensation and evaporation
- Exc. Children apply their knowledge of evaporation and condensation to a range of new contexts.

Working Scientifically

- Em. Children are able to copy an activity, observe and describe what happens.
- Exp. Children can test their own ideas, record results and draw conclusions using their data.
- Exc. Children carry out new test to check their predictions for new values.

2 THE WATER CYCLE

L.O. Identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature.

- Show children Slide 18, explain to them that another Year 4 class is learning about changes in state. The photograph shows how they made a plastic bag water cycle. Ask children to discus in their groups what it shows.
- Get the children to explain how changes of state happen in the plastic bag. Challenge them to orally draft and redraft their explanation and use as many of the words on their scientific word mat. What will keep happening in the plastic bag? Why?
- Now ask them to think about why it is called the water cycle? Get them to share their ideas and create a class definition.
- Give children time to set up their own plastic bag water cycle, they must use their own knowledge to work out what the diagram looks like. They could draft their diagram of the water cycle on their mini whiteboards first, then when they are ready they pour some water in their bag, seal it and attach it to a window.
- At this point children could test their knowledge of the water cycle by playing the interactive activity.
- Revise children's understanding of changes of state by showing them the CPD video: 'Looking at States'.
- Take them out onto the school playground and ask them in groups to use chalk to draw an annotated diagram of the water cycle – showing how it works in their own school grounds. Some children could list ideas about what would make the evaporation process in the water cycle speed up and slow down.

YOU WILL NEED

- Sealable clear plastic bags
- Activity Resource 3.6
- Interactive activity:
- PowerPoint Slide 18
- Plastic zip-lock bags
- Water
- Permanent markers
- CPD video: 'Looking at states'
- Chalk

ASSESSMENT

Subject Knowledge

- Em. Children only understand part of the cycle, but do not link to the process of evaporation.
- Exp. Children know why it is called a water cycle and can describe the part of evaporation and condensation in this process.
- Exc. Children are able to suggest how, for example, evaporation in the water cycle can be speeded up or slowed down, e.g. temperature, wind, size of a puddle.

TOPIC 4 Teeth and eating

About this topic

Curriculum link: Year 4, Humans and other animals

SUMMARY:

Children learn about digestion and different types of teeth, before moving on to explore deadly predators and their prey, in their exploration of food chains. They work scientifically throughout the topic, using enquiry, practical experiments and hands-on research to answer questions and investigate how we eat, why we eat and what we eat.

UNITS:

4.1: Tremendous teeth
4.2: The digestive system
4.3: Producers, predators and prey

ACTIVITY RESOURCES

- 4.1: Tooth map
- 4.2: First impressions
- 4.3: Food's incredible journey
- 4.4: Food chain cards

ONLINE RESOURCES:

PowerPoint presentation: Teeth and eating
Interactive activity: Teeth and eating
CPD video: Teeth and eating
Pupil video: Teeth and eating
Word mat: Teeth and eating
Editable Planning: Teeth and eating
Topic Test: Teeth and eating

Learning objectives

This topic covers the following learning objectives:

- Describe the simple functions of the basic parts of the digestive system in humans.
- Identify the different types of teeth in humans and their simple functions.
- Construct and interpret a variety of food chains, identifying producers, predators and prey.

Working scientifically skills

This topic develops the following working scientifically skills:

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

CROSS-CURRICULAR LINKS

This topic offers the following cross-curricular opportunities:

English

- Practise handwriting when writing instructions on how to clean your teeth properly.
- Use persuasive writing to sell the toothbrush that you have designed.
- Storyboard and write a story or extended piece of writing about the journey of food.
- Create a glossary for this topic.
- Make notes when researching teeth and the digestive system.
- Script and produce a short documentary on predator / prey relationships or how to look after your teeth.
- Children can interview each other and explain the process of digestion using scientific language.

- Read Pam Ayres 'I wish I'd looked after my teeth'. Write a poem about taking care of teeth.
- Produce a leaflet on teeth as a result of interviewing a dentist or dental technician.
- Write a script for a TV advert, to advertise the toothbrush you have designed.

Numeracy and mathematics

- Keep a record of the time it takes to brush teeth, use data in a bar graph.
- Collect data using a tally chart to find out which is the most popular toothpaste – covert to a bar graph.

Computing / ICT

- Create graphs of how old children were when they lost their first tooth.
- Search safely information on teeth and the digestive system.
- Use software or video camera to produce a short documentary.

Design technology

- Design a toothbrush.

Art

- Sketches of animal skulls.

Drama

- Role-play the food going through the digestive system.
- Role-play predator / prey relationships and food chains.

History

- People and teeth across history.
- Dentists through history
- Find out why in the 1900s some people used to have all their teeth taken out when they were 21 years old.

STEAM (SCIENCE TECHNOLOGY ENGINEERING ART AND MATHS) OPPORTUNITIES

Invite into class

- Dentist or dental technician from local practice or dental hospital.
- Dental student.
- University outreach – scientist to show skulls of carnivores, omnivores and herbivores.
- University outreach – historian to talk about 'Teeth carnivores, omnivores, herbivores through history'.
- Request a STEM ambassador with knowledge and skills relating to medicine and nutrition to support teaching of digestive system.
- Local secondary teacher with skulls or model of digestive system and to carry out an interesting activity.
- Artist to teach sketching, e.g. skulls of carnivores, omnivores and herbivores.
- IT professional to work with children to make a video on the digestive system.
- Writer to support writing poetry about teeth, digestive system and eating.
- Actor to help create sketches or role-play predator / prey relationships, digestive system.

Visit

- Local dentist.
- Local dental hospital.
- Local museum – for exhibits on the human body, in particular the digestive system, plus skulls and models of different animals.

TEACHER SUBJECT KNOWLEDGE

Humans are omnivores, meaning we eat both plants and animals, and our teeth have evolved to suit our diet. Our canines are smaller than a carnivore's and we have flat molars to help us chew our food before swallowing, as plant material needs grinding before we can digest it.

Our first set of teeth is known as our milk teeth. There are 20 teeth in total at this point: eight incisors, four canines, four premolars and four molars. Foods that are high in calcium, such as milk and other dairy products, are important in the formation of teeth and bones, and keep them strong and healthy, which is why children, who are growing bigger bones and new teeth, need full-fat (whole) milk and other dairy products as part of their diets. Between six and 12 years old, our milk teeth are gradually replaced with permanent teeth. There is a third set of molars called 'wisdom teeth' which appear in our late teens – although they may not come through at all. This means adults have 32 teeth. The jaw gets bigger as we grow older, so there is space for those teeth to appear. The human mouth contains 12 molars, eight premolars, four canines and eight incisors.

The outer layer of tooth is called enamel. It is one of the hardest substances in the body. Below enamel is a layer of softer dentine and inside the tooth is the pulp, which contains blood vessels and nerve endings. Bacteria in the mouth eat away at enamel and cause plaque. If plaque is not removed regularly, it can build up and harden to form tartar, which builds up on our teeth and is difficult to remove. Some foods can stain our teeth, such as tea and coffee.

The digestive system

Our digestive system is made up of organs that take in food, including our mouths and teeth which start off digestion as a mechanical process, to then digest it chemically to extract energy and nutrients, and expel the remaining waste.

Food contains large, complex chemicals such as carbohydrates, proteins and fats. To be of use to the body, they must be broken down into smaller chemicals:

- Carbohydrates are broken down into sugar.
- Proteins are broken into amino acids.
- Fats are broken into fatty acids and glycerol.

Digestion starts in the mouth. Teeth provide mechanical breakdown of the food, then saliva moistens food so that it slides down the oesophagus into the stomach. The stomach is a bag of muscle that breaks up food by churning it around. It also contains hydrochloric acid, which kills off bacteria in the food, and enzymes, which further break down carbohydrates and proteins, starting the chemical breakdown of the food.

After a few hours in the stomach, food travels down the duodenum (small intestine), where it is broken down further and sends the nutrients around the body in the blood. The solid waste such as fibre that can't be digested continues along into the large intestine, where water is removed. Then this passes out of the body via the colon and the anus.

Carnivores and herbivores

All living things need energy to survive. Plants are able to use the energy from the Sun to produce their own food. Animals are unable to make their own food so have to eat other living things to get their energy.

Some animals have adapted to eating only other animals and get their energy from meat. These animals are known as carnivores. Animals that eat other animals are known as predators, with the animals that they eat known as prey, whether they are herbivores or carnivores.

Some animals, including humans, have a diet comprising both animals and plants. These animals are known as omnivores. Well-known omnivores that the children might be familiar with include pigs, hedgehogs and rats.

The teeth of carnivores are long and pointed. They have particularly long canine teeth to grip and kill their prey quickly. The incisors at the front of the mouth are used to strip flesh from the bones. Meat is easier to digest than plants, so does not need to be chewed so much.

Plant material, however, is tougher to break down. Therefore herbivores' teeth are different from carnivores'. They have large, flat molars (back teeth) with ridges to help grind plants. Many do not have upper incisors, but instead a bony pad on their upper jaw. Herbivores can spend a long time chewing before the food is finally swallowed. They also have special bacteria in their guts to help break down plants.

CHILDREN'S MISCONCEPTIONS

Children might think…

- That teeth grow continually.
- There are two tubes, one for food and another for drink.
- That the tube from the mouth stops at the stomach.
- That the digestive system covers every part of our bodies, with bits of food going directly to the legs to make you run, for example.
- That a predator can't be prey.
- That only herbivores are prey.
- That humans aren't predators or are not part of food chains.

Children already know…

- The names of external parts of the body.
- About the importance of food for human survival.
- That children grow into adults and the changes that happen as a result.
- How important it is to eat the right amounts of different foods.
- That animals, including humans, need the right types and amount of nutrition.
- We cannot make our own food: we get nutrition from what we eat.
- How nutrients and food are transported within animals and humans.
- How to identify and name a variety of common animals that are carnivores, herbivores and omnivores.
- How to explore and compare the difference between things that are living, are dead and have never been alive.
- How to find out and describe the basic needs of animals and humans for survival.

SCIENTIFIC VOCABULARY

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

anus: the end of the digestive system where unwanted food leaves the body

canine: a tooth for gripping food, a pointy tooth

canines: the pointed, conical teeth next to the incisors

carnivores: animals such as lions whose main way of getting food is to kill and eat other animals, or to scavenge their dead flesh

decay: what happens when teeth aren't cared for

digestion: breaking down food

enamel: the hard covering of the tooth

energy: used to help us move, grow and repair our body

herbivore: animals such as cows that mainly eat plants

incisor: a tooth for biting food, at the front of the mouth

incisors: the flat, sharp-edged teeth in the front of the mouth, used for cutting and tearing food

large intestine: absorbs water and stores undigested food

molar: a tooth for grinding food at the back of the mouth

molars: large back teeth in humans and other mammals, used for chewing and grinding. Humans have 12 molars

mouth: where digestion starts and food gets into the body

nutrients: chemicals needed for growth, movement, repair and health in general

oesophagus: the scientific name for the food pipe

omnivores: animals, like you and me, that eat both plants and meat

small intestine: the thin tube where broken down food is absorbed

stomach: a bag of muscle used in the first part of digestion

4.1 Tremendous teeth

GET STARTED

Give groups a large piece of paper and lots of sticky notes. On each note they should write something they know about human and animal teeth and include their name on their sticky notes. Children go around each group, what do they think is true and what do they think might not be quite right?

The CPD video: 'Teeth and Healthy Eating' (on My *Rising Stars*) introduces the different types of teeth in humans and animals, as well as the causes of tooth decay. You can also use PowerPoint Slides 1 to 5, and 8 to introduce the topic.

LET'S THINK LIKE SCIENTISTS

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

- Why are teeth so hard and what would happen if they were made of something softer?
- How are our teeth different from other animals' teeth?
- What types of food and drink are worst for our teeth?
- What's the best way to brush your teeth?
- How do you become a dentist?

ACTIVITIES

1 FIRST IMPRESSIONS

L.O. Identify the different types of teeth in humans and their simple functions.

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

Set up simple practical enquiries, comparative and fair tests.

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

- Tell children they are going to clean their teeth. Ask them how clean they think their teeth are, then (with parental permission) give them half a disclosing table to chew thoroughly and spread saliva to all tooth and gum surfaces with their tongue. They then spit out saliva and rinse their mouths out with water. Back in class get them to look at their teeth. What do they notice? What does this mean?
  - Old plaque will stain blue.
  - New plaque will stain pink.
- Once they discussed their observations and draw conclusions about their teeth, e.g. that they should clean them thoroughly. Use Slide 6 to support your discussions.
- Engage children in discussion using PMIs, Positives, Minuses and Interesting about the question, What if we did not have any teeth?
- Give children or put on the board question stems, e.g. which, what, where, how does, who, when, what if, could, and ask them to work in pairs or groups to ask a question for each stem, e.g. How does toothpaste work? You could also use Slide 7.

YOU WILL NEED

- Disclosing tablets
- Boiled eggs
- Lolly sticks
- Range of different liquids, e.g. fizzy drinks, fruit cordial, vinegar, fruit juice
- Containers
- Card and pens
- PowerPoint Slides 6 and 7

ASSESSMENT

Working Scientifically

- Em. Children can help to set up a simple test and observe what happens. With support, they ask questions linked to their experience.
- Exp. Children ask a range of questions and suggest what will happen to the egg. They record observations and link conclusions to what they know.
- Exc. Children apply what they know to each of the activities, asking questions that take their learning forward and using knowledge of liquids e.g. acid, sugary to draw conclusion.

- Once all the groups have about ten different questions, ask them to sort them to work out how they will answer their questions, e.g.:
  - Carry out a fair or comparative test.
  - Carry out a survey (pattern seeking).
  - Identify and classify.
  - Research.
- Tell the children that in the next lesson they are going to begin answering their own questions working as pairs or in a small group. Tell them that they should organise the group so that everyone takes a research question home to answer.
- Ask children to think about what they have been told is not good for their teeth, some children will say fizzy or other kind of drinks. Use this as an opener to explain to the class that they are going to set up an experiment over time to find out how drinks affect our teeth (this might be a question that someone has asked).
- Give each group a boiled egg (explain that egg shells are made of calcium the same material as teeth) and, using lolly sticks as choice sticks, someone from each group picks a lolly stick, on which is written a type of liquid, e.g. fresh orange juice, high-sugar orange cordial, low-sugar cordial, fizzy drinks, vinegar, etc.
- Tell children that they are going to leave their egg to soak in their chosen liquid. Ask children to write down the liquid and what they will predict will happen on the card next to their egg. Leave one egg in just plain tap water.
- Children might need to renew some of their liquids after a day or two, e.g. vinegar. Do not use milk as this will turn sour and smell.
- Get the children to keep a daily diary, it could be in the form of a table to record the changes. At the end of say a week to ten days, children should compare their egg with the egg left in water. Get children to discuss their results and draw conclusions about the effect of different liquids on their teeth and what they could do to stop this happening to their teeth.

2 MY TEETH

L.O. Identify the different types of teeth in humans and their simple functions.

- Give children small mirrors and the tooth map worksheet (Activity Resource 4.1). In pairs, the children look at the teeth of their partner and complete the worksheet for them, labelling the different teeth in a human mouth. They should mark which teeth are missing / filled / adult / milk. When they have both finished ask them to compare their charts, and talk about similarities and differences between their teeth.
- Next give children Activity Resource 4.2 and check that they know what they are doing and then carry out the activity. When they have finished, they should compare the impressions with their partner

YOU WILL NEED

- Small mirrors
- Activity Resource 4.1 and 4.2
- Polystyrene plates
- Scissors
- Marker pens
- Pictures of, or actual, animal jaws
- PowerPoint Slides 9–12

and the chart they completed on Activity Resource 4.1. Can they still see where the different teeth are? What is similar or different about their bites?

- As a class tell the children to look at their 'bites' and their teeth charts. Discuss what they think the different teeth are used for.
- At this stage you might like to give children a small piece of fruit, e.g. apple to eat and feel which teeth they are using to bite and chew, are they at the front, middle or back.
- Show children Slide 9 and discuss the names and what the different teeth are used for, and tell the children to add the scientific names to their tooth charts from the mirror activity (molars for chomping and grinding food, incisors for piercing and biting off pieces of food, canines for tearing and gripping the food).
- Show children PowerPoint Slides 10 and 11 and ask them to discuss in pairs and then, as a class, name the types of teeth labelled and say whether each animal is a carnivore or a herbivore or an omnivore and say what evidence they have used for their answer. At this point you could show children a range of pictures of animal mouths or jaw skeletons and ask them to discuss what they see and classify them into carnivore, omnivore or herbivore using teeth as their evidence.
- If you have been able to borrow skulls, children could observe, discuss and produce an annotated drawing naming the teeth, etc.

ASSESSMENT

Subject Knowledge

- Em. Children can say that they have different types of teeth.
- Exp. Children can name the different human teeth and describe their functions.
- Exc. Children apply what they know about teeth to compare the similarities and differences between human teeth and other animals.

3 LOOKING AFTER OUR TEETH

L.O. Identify the different types of teeth in humans and their simple functions.

Set up simple practical enquiries, comparative and fair tests.

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

- Look at the egg shell from the first activity along with your predictions. What has happened? Ask the children to describe the changes and decide whether their predictions correct? Children could draw an annotated diagram in their books and include sentences using correct scientific terminology and in the correct tense about their results and conclusions.
- Ask children to discuss the different ways to look after their teeth and share ideas as a class. Include ideas like avoiding acidic or sugary foods and drinks, and regular brushing of teeth and flossing.
- Show children the Pupil video: 'Teeth and Healthy Eating' and also Slide 12 to help children learn about different teeth, dental hygiene and parts of a tooth.

YOU WILL NEED

- Egg shell from Activity 1
- Hard-boiled eggs
- Containers
- Different liquids
- Toothbrushes
- Toothpaste
- Dental care products
- Media for creating advert or animation
- PowerPoint Slides 12
- Pupil video: 'Teeth and Healthy Eating'
- TV advert for dental product
- Resources about dental care, e.g. leaflets from dentist, access to the Internet, books

- Give each group a collection of dental care products such as toothpaste, dental floss and mouthwash. Get them to discuss what each does. Ask them to think about how each helps to keep their teeth strong. Explain that a chemical called fluoride is useful for keeping teeth strong. Can they find fluoride in any of their items?
- Ask children to think back to the results from the egg in liquid activity. Could they use this approach to find out whether or not toothpaste protects teeth from the effects of different liquids. It will not take long to set this up, since children already have experience, this time children coat one egg in toothpaste and place it in the same type of liquid they used in the previous activity. Ask the children to predict what will happen based on their knowledge and experience.
- Then show the children a TV advert for dental care. Discuss. Have they seen anything like this before? How do the teeth look compared to the other teeth? How does the advert make you want to look after your teeth?
- Provide the children with lots of resources about teeth, e.g. leaflets from a dental practice, web addresses, books, video clips and posters. In this activity they will be applying literacy skills related to research such as:
  - Retrieving and recording information from non-fiction sources.
  - Deciding what information they need to look for before they begin.
  - Use contents pages and indexes to locate information.
- They will use the information they collect to create an advert or information for a new dental product or guidance on how to look after your teeth. Give the children time to decide how they will present their advert or information, for example:
  - T.V. or radio advert
  - Animation
  - Poster
  - Newspaper or magazine advert
  - Leaflet

ASSESSMENT

Subject Knowledge

- Em. Children know that there are different types of teeth in their mouth.
- Exp. Children know from their research the names and functions of teeth.
- Exc. Children can apply knowledge of type and functions of teeth to other animals.

Working Scientifically

- Em. Children are supported to research information and communicate key facts.
- Exp. Children communicate their research on teeth in their advert.
- Exc. Children make links between their test results and research on teeth in their advert

4.2 The digestive system

GET STARTED

Give children a piece of fruit. Tell them that when they eat it they need to focus on their body and think about what they do to the food, e.g. when it is in the mouth and what happens to it as it goes through the body.

LET'S THINK LIKE SCIENTISTS

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

- What would happen if we didn't have saliva?
- Why do you think some foods take longer to pass through the digestive system than others?
- Do we need fat? Why?

ACTIVITIES

1 FOOD'S INCREDIBLE JOURNEY

L.O. Describe the simple functions of the basic parts of the digestive system in humans

- Prior to this activity you could watch the, CPD video which shows how this activity can be organised as well as useful questions. Ask children to discuss in their groups what happens to food when they eat it and if they know any words or names of parts of the body associated with the digestive system.
- Divide the class into groups and give each group a large piece of paper and some pens. First, they must draw around one member of their group, then ask them to draw what they think the digestive system is like and where the food they eat goes. This is the equivalent of a mind map and shows what they know at the beginning of their work. This work could be displayed and photographed, towards the end children will return to this.
- Discuss food's journey through the body and note down key words, such as *mouth, oesophagus, stomach* and *intestine*. You could use Slides 13 and 14 to reinforce the different parts of the digestive system and the functions of each part.
- Give each group a part of the digestive system. As with previous activities you could use the wooden lollipop stick approach, each stick has a word on it, a member from each group picks one and the group are in charge of researching that part of the digestive system. They then decide how to communicate their information to the rest of the class, helping to build up children's knowledge. Include on the sticks:
  - Teeth
  - Saliva
  - Oesophagus
  - Stomach
  - Small intestine
  - Large intestine
  - Rectum

YOU WILL NEED

- CPD video: 'Teeth and eating'
- Pieces of fruit
- Large pieces of paper and pens
- Wooden lolly sticks
- Reference material, e.g. web addresses, posters, books, video clips
- PowerPoint Slides 13 and 14

ASSESSMENT

Subject Knowledge

- Em. Children are able to use a diagram to show where the food goes.
- Exp. Children describe the function of different parts of the digestive system
- Exc. Children recognise that the different parts of the digestive system are connected and do different jobs.

2 LET'S MAKE A DIGESTIVE SYSTEM!

L.O. Describe the simple functions of the basic parts of the digestive system in humans.

- In planning, watch the CPD video 'Teeth and eating' which shows a class taking part in the activity.
- Show children the resources for modelling the digestive system. Ask children to think about what they know about the system and which items they think would be used for which part.
- You could either demonstrate this activity or show the children Slide 15. The aim is that once the children have been shown they can carry out this activity for themselves.
- Talk through their ideas about the resources so the children begin to understand what each might represent. Ask them to describe what happens from the moment we put something in our mouth all the way through to the rectum, using the information that they researched in the last activity.
- If you are demonstrating, break up the crackers and cut the banana using scissors to represent the action of teeth in the mouth into a container and add some water to represent, saliva. Break this up into smaller pieces using a potato masher to represent molars crushing food.
- Using a spoon send the mixture down a tube representing the oesophagus into a zip-lock bag which represents the stomach.
- Now mimic the action of the stomach by adding an acid – the orange juice. Keep mashing or kneading the food until you have a paste-like substance.
- Talk about the mixture moving to the small intestine. This is where all the nutrients or 'goodness' is taken out of the food. Demonstrate squeezing the food through a small hole (cut the corner off the bag) into the small intestine, which is half a leg of a pair of tights. At this point it is useful to show that the small intestine is actually longer than the piece of tight, demonstrate this by having some rope or plastic tubing which is at least seven-metres long.
- Squeeze the bag / stomach food down to the bottom of the tight. As you do so liquid will come out of the sides of the tight, this represents nutrients being passed into the body. Continue to squeeze the food down to the bottom of the tight (keep your hand on the end so it does not come out yet. This imitates the small intestine becoming the large intestine, or colon, where water is absorbed from the remaining foodstuff. Demonstrate this by squeezing the mixture and extracting as much of the water as possible into a bowl. Now squeeze what is left into a paper cup with a hole in it and use another cup placed inside to push the remaining drier mixture out – the 'poo'!
- During the demonstration, ask children what they think is happening making sure that they are using correct language, and check that they understand the process.

YOU WILL NEED

- CPD video: 'Teeth and eating'
- PowerPoint Slides 15–17

Per group and for demonstration:

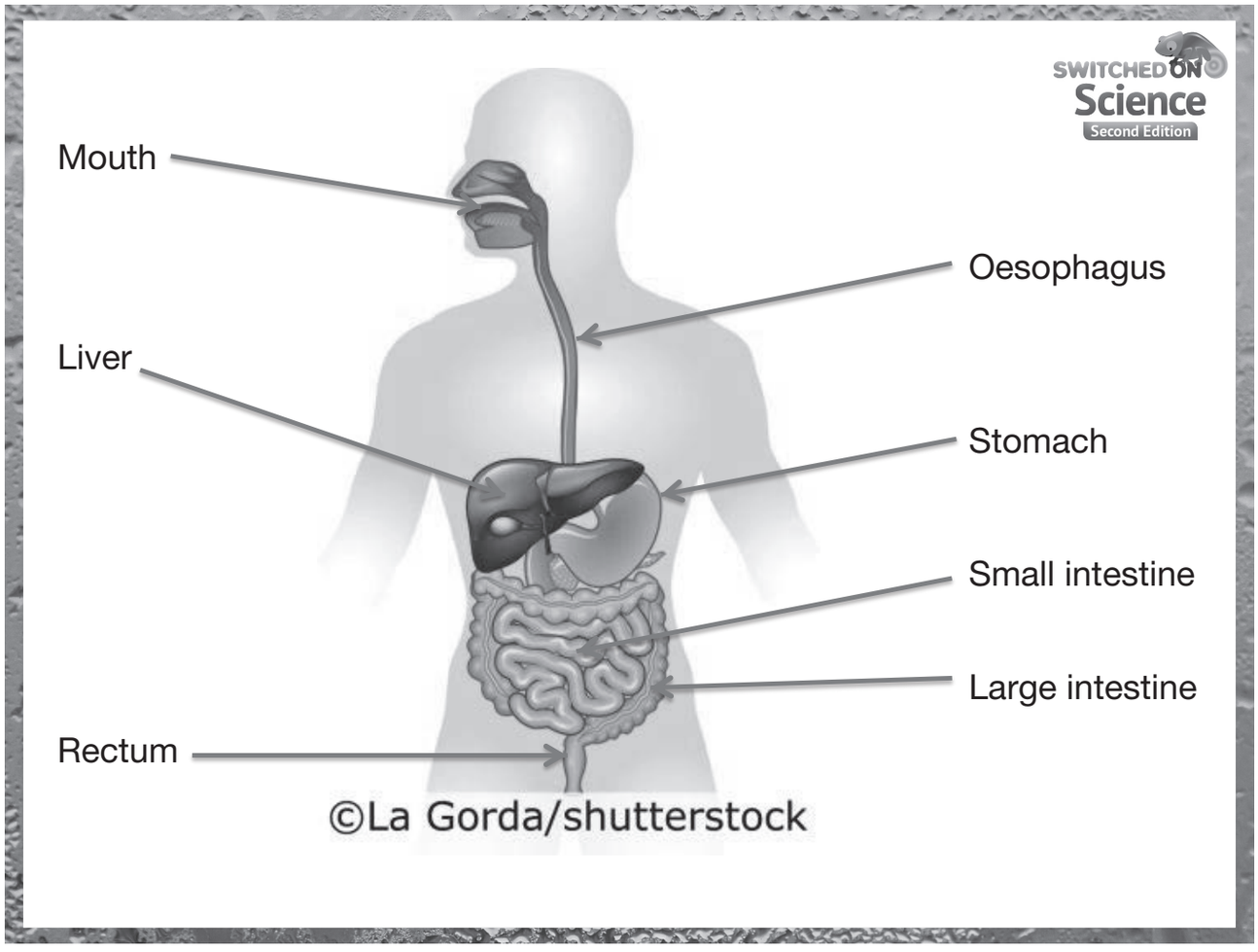
- Large bowl
- Smaller container
- Kitchen roll tube
- 1 zip-lock plastic bag
- 2 cream crackers
- 2 ripe bananas (cut into pieces)
- Any other pieces of food so the children can try different ideas of meals.
- 50 ml orange juice
- 1 tablespoon water
- 1 leg of a pair of tights
- 1 plastic cup
- 1 paper cup with a hole cut into the bottom
- Scissors
- 7 m of tubing or string for demonstration
- Activity Resource 4.3

ASSESSMENT

Subject Knowledge

- Em. Children participate in modelling the digestive system and can link some parts of the model to what happens inside their body.
- Exp. Children can use the model to explain what happens to food in the digestive system.
- Exc. Children know the limitations of the model and make suggestions or include additional information from their own research.

- Children could revisit the steps to embed learning using Activity Resource 4.3. You could also show them Slides 16 and 17.
- Now let the children have a go themselves and think about how the children could record this, for example, a video or photographs at different stages to be used later.
- At the end of this topic get the children to repeat the first activity, where they drew around one of their group, once again they draw the digestive system and annotate to include what they have learned. Give children time to self assess, comparing what they knew at the beginning to what they know now. How has their learning changed and what was it that helped them the most to learn about the digestive system?



4.3 Producers, predators and prey

GET STARTED

Set a timer for three minutes and ask the children to create two lists, one for carnivores and one for herbivores. Children name and write down as many as they can before the timer stops. You could get a group to read out their carnivores and another their herbivores. Use PowerPoint Slide 18 as a support.

LET'S THINK LIKE SCIENTISTS

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

- Why do cows have two stomachs? The food goes there once and is then brought back up to the mouth again to be chewed a second time, but why do cows need to do this?
- Rabbits eat their own droppings to absorb the nutrients on their second pass through the gut! Does any other animal do this? How can you find out? Watch rabbits carefully – what do you notice about where they leave their droppings?

ACTIVITIES

1 A CHAIN REACTION

L.O. Construct and interpret a variety of food chains, identifying producers, predators and prey.

- Children first learned about food chains in Year 2 so the first part of this activity revises prior understanding.
- Can the children create a correct food chain with you, thinking about which animals eat what? Make the point that it is a chain. One eats the other, which eats the other, and so on. How are they using their knowledge of herbivores and carnivores to help their thinking? You could use PowerPoint Slides 22 and 23 to remind them about different animals.
- Use the picture cards from Activity Resource 4.4 and make sure there is a jumbled up set of cards, each with an animal or plant on it, on every table. Working in groups, the children have five minutes to create as many food chains as they can. Differentiate the number of food chains and how challenging they are according to ability. After five minutes, the groups share their food chains with the rest of the class and discuss whether they are correct.
- Sharing the food chains provides a formative assessment point for how much children remember about basic food chains and whether some children need more practise.
- Take the children outdoors and give each child a picture card (from one food chain). As a class, can they create food chains by finding the rest of their food chain (classmates) in the correct order. Make this even more fun by timing them or giving them a time limit in which

YOU WILL NEED

- Activity Resource 4.4
- PowerPoint Slides 22 and 23
- Access to ICT for creating an animation

ASSESSMENT

Working Scientifically

- Em. Children can place three cards in order to make a food chain.
- Exp. Children can use the cards to make a number of different food chains.
- Exc. Children can talk about herbivores, omnivores and carnivores in their food chains.

to do it. You can do this with a variety of food chains and use lots of children to assess progress and understanding.

- The children could create an animation using ICT to teach their classmates the story of a food chain. They must use scientific language in their animation.

2 PREDATOR AND PREY

L.O. Construct and interpret a variety of food chains, identifying producers, predators and prey.

- Ask children to define the words *predator*, *prey*, *producer* and *consumer*. Give them access to the Internet and dictionaries and tell them that they must make sure their definition fits the animal and plant world.
- Get them to write their definitions on a large piece of paper and display each one like a poster around the classroom. Ask children to go around and read each one and decide which one they think might be the most scientifically accurate (not the best because children often look at things like handwriting rather than the science). Children could vote for the most accurate (not their own) and explain why they chose it.
- Use Slides 19–21 to reinforce what they have learned about predators, prey, producers and consumers.
- Set as a home / school activity a challenge for children to find out the ten deadliest predators in the world? What do they eat and where do they live? Ask children to draw them and present them to the class.
- Tell children to make a set of three or more cards which show a food chain. On the back of each card children should write the word *predator*, *prey*, *consumer*, *producer*. They then swap with another group that has to make the food chain and see if they have named each part correctly.
- Take the class outside to apply their learning about food chains. Their task is to find evidence of consumers, producers and prey. They should build up some food chains based on what they find and then draw these, using chalk on the school playground. Children go round and check that they agree with each other's food chains, and label the predator, prey, consumer and producer in one of the food chains.
- To summarise the whole topic, split the children into groups to produce a drama of how food moves through a carnivore and a herbivore. Each group enacts a different process, including, the food chain, the teeth eating, the stomach, the intestines, etc. and then perform it in assembly.

YOU WILL NEED

- Images of predators and prey
- Paper and pens
- Activity Resource 4.4
- PowerPoint Slides 19–21
- Chalk

ASSESSMENT

Subject Knowledge

- Em. Children can talk about predator and prey but they need support with producer and consumer and applying learning to finding food chains outdoors.
- Exp. Children apply their knowledge and recognise food chains in the school grounds.
- Exc. Children create complex food chains and begin to link food chains to create food webs.

TOPIC 5 Power it up

About this topic

Curriculum link: Year 4, Electricity

SUMMARY:

Children revisit some uses of electricity and the importance of safety before constructing simple circuits. Understanding how to change a circuit by changing its components makes up the third part of this topic, leading in a final application of knowledge and skills when the children design and make an alarm using their knowledge of circuits.

UNITS:

- 5.1: Living with electricity
- 5.2: Let's make circuits
- 5.3: Conducting investigations

ACTIVITY RESOURCES:

- 5.1: Which source?
- 5.2: Changing circuits
- 5.3: Lemon battery

ONLINE RESOURCES:

PowerPoint presentation: Power it up
Interactive activity: Power it up
CPD video: Power it up
Pupil video: Power it up
Word mat: Power it up
Editable Planning: Power it up
Topic Test: Power it up

Learning objectives

This topic covers the following learning objectives:

- Identify common appliances that run on electricity.
- Construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers.
- Identify whether or not a lamp will light in a simple series circuit, based on whether or not the lamp is part of a complete loop with a battery.
- Recognise that a switch opens and closes a circuit and associate this with whether or not a lamp lights in a simple series circuit.
- Recognise some common conductors and insulators and associate metals with being good conductors.

Working scientifically skills

This topic develops the following working scientifically skills:

- Ask relevant questions and using different types of scientific enquiries to answer them – setting up simple practical enquiries, comparative and fair tests.
- Gather, record, classify and present data in a variety of ways to help in answering questions.
- Record findings using simple scientific language, drawings, labelled diagrams, keys, bar charts and tables.

CROSS-CURRICULAR LINKS

This topic offers the following cross-curricular opportunities:

English

- Produce instructions for their models and games.
- Instructions on how to wire a plug.
- Extended writing – create a biography of Edison, Joseph Swan.
- Creative writing – 'The day the electricity…'
- Produce a poster persuading children to stay safe around electricity.
- Keep a diary of using electrical appliances.
- Produce a 'Save energy' leaflet.
- Produce a poster for 'Switch it off week'.
- Create an electricity vocabulary crossword.

Numeracy and mathematics

- Venn diagrams appliances that use mains and batteries.
- Calculate energy bills.
- Read information from SMART meter.
- Bar graph of electrical appliances use.
- Survey solar panels around the locality.

Computing / ICT

- Create posters and leaflets.
- Create a video on how to wire a plug.
- Research historical figures and timelines.

Design and technology

- Use programme for creating a poster or leaflet.
- Design, make, test and evaluate:
  - A flashing headdress or a cyclists headlamp.
  - Question and answer boards.
  - Pictures and models incorporating an electrical circuit.
  - A burglar alarm.
  - A digestive system game.

Art

- Electrical storm picture.
- Lighting designs, e.g. lampshades, lamps.
- Lumieres and light festivals, research art work and create own, e.g. glass jar lamps.
- Stained glass patterns.

History

- Create a timeline of electrical inventions.
- When was the first electric street light – compare with today.
- Research Alesandro Volta and batteries.
- Research Joseph Swan and Thomas Edison.
- Locate power stations, wind farms, solar panel farms locally and nationally.

PSHE

- Health and safety at home and outdoors.

Drama

- Role-play electricity in a circuit – show it to children in assembly.

Teacher subject knowledge

Electricity is the most useful form of energy. It can be transformed into other forms of energy relatively easily. It makes things turn using motors, heats and lights up places like our homes, and produces sound in loudspeakers.

Most mains electricity is produced in power stations and carried to users by overhead power lines. Power stations use coal, oil, gas or nuclear fuel to heat water, produce steam, drive a turbine and turn a generator to produce electricity.

Batteries contain chemicals which react in a special way to produce an electric current. The current from a lemon battery is very small and will not light a bulb. But several fruit batteries will light a small LED. A potato can power a special clock, which can be purchased quite easily online.

Voltage indicates the amount of energy delivered by a source of electricity. The voltage of the most common household batteries varies from around 1.5V to 12V, but some specialist batteries can be much higher. Mains electricity in this country is 230V. Overhead power cables carrying sufficient supply for thousands of users can carry voltages as high as 400,000V. The children may be aware of the term ‘voltage’, but they do not need to know about this in depth.

Completely pure water does not conduct electricity, but when impurities that are present in our normal water supply get into it or when mixed with the salt on our skin, it does conduct. This is why you must never turn on the lights with wet hands. The spark produced by the flicking of the light switch will travel through the body, giving us a shock as it goes to earth.

There are two types of circuit. A series circuit has all its components wired into one simple circuit: all the components are one after another, as in a series on television.

A parallel circuit is one with different branches which behave like mini-circuits and can work independently of each other. Only simple series circuits are investigated in Key Stage 2.

Conventional bulbs contain a filament made from wire. As electrons flow through the wire,

they encounter resistance. It's like lots of people trying to squeeze through a small doorway. The more people or the smaller the gap, the more resistance felt. When a wire is very thin, it has a large resistance. The electrons get hot as they try to move through it (just as people do going through a small doorway!) and we can feel this. If it gets very hot, it glows – as in the filament of a light bulb.

When investigating the changing of components in a circuit, the brightness of a bulb depends on the current or number of electrons passing through it. The more bulbs you have, the slower the electricity flows because the battery 'runs out of push', so the electrons flow more slowly, due to the resistance through the wires, and the bulbs, so the dimmer the light. The opposite is true of adding more batteries (the electricity flows faster).

The batteries must be connected in series with positive terminals connected to negative ones. If a battery is reversed, its value is regarded as negative. So, if three batteries are connected in series and one is reversed, this will be equivalent to one battery.

Metals are good conductors of electricity. Most non-metals do not conduct electricity. They are insulators. The rest of the information here is for your understanding but not the children at this stage.

All materials are made of atoms, but metals are special. Instead of each atom being a separate entity (for the sake of neatness this is how we can picture them), metal atoms have electrons which are not tied to one particular atom. They are free to move within the metal in a 'sea' and this movement of electrons is what produces an electric current.

Non-metals do not have these free electrons, so a current cannot pass through a non-metal.

The exception is graphite, which conducts electricity but is a form of carbon. Carbon is a non-metal that can exist in different forms. One form is diamond, which is an insulator as it doesn't have free electrons.

CHILDREN'S MISCONCEPTIONS

Children might think…

- That electricity from batteries is not dangerous.
- That wires are made of plastic (as they are coated in it).
- That all metals conduct electricity.
- That a bulb uses the electricity.
- That both ends of the battery produce electricity.
- That the first bulb in a circuit will be brighter than the second in a circuit.

Children already know…

- That electricity makes things work.
- That you need wires for electricity to work.
- That batteries produce electricity.
- That electricity can be dangerous.
- That batteries are safe to use in the classroom.

SCIENTIFIC VOCABULARY

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

battery: a portable electricity supply

bulb: part of a circuit that gives out light

cell: the scientific name for a battery

circuit: the path followed by an electric current. Electricity must flow in a circuit to do useful work

components: the items that make up a circuit

conductor: a material that transmits electricity in the wall and through wires

insulator: a material through which electricity cannot flow

mains: the electricity that comes from a socket

rechargeable: a battery that we can put 'electricity' back into

switch: a component that turns a circuit on and off

terminals: the ends of the battery. One is negative and one is positive

wires: used to connect components together

Make a lemon battery

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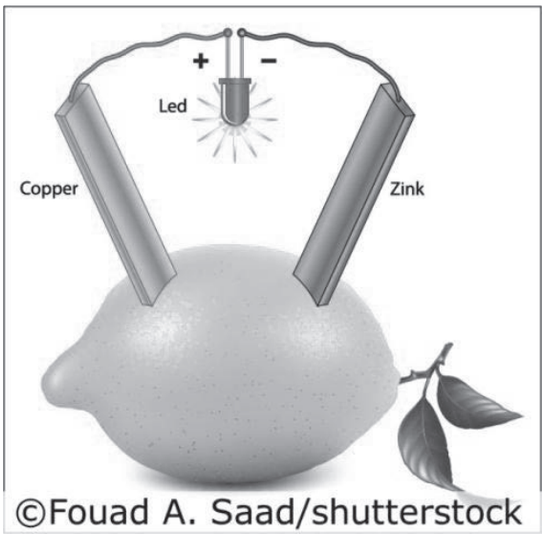
Look at the picture.

What materials do you need to make a lemon battery?

How would you prove it makes electricity?

What else would you need to show it really makes electricity?



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5.1 Living with electricity

GET STARTED

Run through PowerPoint Slides 1–4, then ask the children to imagine a life without electricity. What would they miss? How would they create light, heat and entertainment? What would they do and how might they feel? Talk together as a class. Then, either alone or in small groups, write diary entries about three days without electricity, or a piece of extended writing entitled 'When the lights went out ... .'

LET'S THINK LIKE SCIENTISTS

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

- Who was Michael Faraday and why is he so important?
- Thomas Edison was the first person to invent a light bulb – or was he? Who was Joseph Swan? Can you produce a news report on this?
- Can you find out how the first battery was made? You might be able to make some batteries like this. Share your ideas with others use a demonstration.

ACTIVITIES

1 WHICH SOURCE?

L.O. Identify common appliances that run on electricity.

- Together, brainstorm a list of electrical appliances. Then ask the children to use Activity Resource 5.1 to independently make a list of electrical equipment in their homes. They should include whether the equipment is mains-operated, battery-operated or can operate on either. Mains-operated equipment will have a plug, whereas purely battery-operated appliances won't. Batteries can be used in smaller, portable appliances.
- Explain that mains electricity is generated in power stations and brought to homes, schools and other places by power lines. Point out that the word 'voltage' is used as an indication of the energy available from a supply of electricity,
- Do not go into any more detail than this now. Mains-operated equipment includes most domestic appliances. Battery-operated will include portable equipment such as mobile phones, torches and watches. Laptops, radios and burglar alarms will run on either.
- To reinforce these ideas children could carry out any of the following activities:
  - Collect pictures from catalogues of electrical appliances or actual examples and use a Venn diagram or hoops to classify into mains, battery, both.

YOU WILL NEED

- Pictures or examples of a range of electrical appliances
- Activity Resource 5.1 and 5.3 (see 5.3 for list of equipment)
- PowerPoint Slide 5

ASSESSMENT

Subject Knowledge

- Em. Children recognise electrical appliances, but they need help to differentiate between mains and battery operated.
- Exp. Children can sort objects correctly into an intersecting Venn diagram
- Exc. Children can sort objects and apply their understanding to include some items not included by other children, e.g. electric toothbrush, security light.

- Think about a typical day, begin with getting up and go right through to going to sleep, children create a diary of which electrical appliances they used.
- Create a survey for the following question: Which electrical appliance is used most by children in Class 4? Share this data and create a tally chart on the whiteboard then children use the data to create a bar graph.
- As a home / school activity children choose a scientist linked to electricity and research their life and invention or discovery. Children produce a fact card, which is then shared with other children, so they learn new information from each other, e.g. Benjamin Franklin, Volta, Michael Faraday, Samuel Morse, Edison, Alexander Graham Bell, Joseph Swan.
- Having learned that batteries are important for portable electrical items, and children knowing that many of the things they use require batteries, children can make their own battery. Show children slide 5 then hand out the instructions for a lemon battery which are on Activity Resource 5.3, children will be amazed that this works; some will want to extend the activity by suggesting other things to use, e.g. more lemons, try other citrus fruits. Children might go home and research alternative 'food' batteries.

2 USING ELECTRICITY SAFELY

L.O. Pupils should be taught about precautions for working safely with electricity. (NSG)

- You could prepare for this activity by watching the CPD video: 'Power it up'.
- Ask the children what they know about any dangers associated with electricity. What have they been warned of before? Who has warned them?
- Show children the video clip about safety in the home, 'P.I. Plug's home safety video' (see Useful Websites list on *My Rising Stars*). As they watch, or afterwards, ask the children to list all the dangers they saw and all the things you could do to make it safer.
- Working in pairs give children access to an interactive activity where they circle the dangers (see 'Electrical safety' on the Useful Websites list).
- Using what they have learned so far and any other research that the children carry out, split the class in half. One half works in groups to produce their own safety poster and the other group creates a 'spot the danger' picture for younger children to use (use Slide 6 as an example).

YOU WILL NEED

- CPD video: 'Power it up'
- 'P.I. Plug's home safety video' video clip (see Useful Websites list)
- PowerPoint Slide 6
- Paper and pens

ASSESSMENT

Subject Knowledge

- Em. Children can recognise some safety hazards they may need help to explain why they are dangerous.
- Exp. Children recognise safety hazards inside and outside the home.
- Exc. Children can explain what they can do to prevent accidents with electricity around the home, school and outside.

5.2 Let's make circuits

GET STARTED

Give each child a bulb, battery, wires and bulb holder and challenge them to make a circuit light before the timer goes off. Tell them that it is ok to watch other children and learn from them or you could also use PowerPoint Slide 8.

This is a good time to show the CPD video: 'Power it up', which introduces the different components of a circuit.

LET'S THINK LIKE SCIENTISTS

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

- What does the word 'series' mean? Where else have you seen it? Explain this to your friends and how it relates to a circuit.
- How do light-up toys that float in the bath work? How can you find out?
- How many different types of light bulb are there? Why are there so many? What has happened to the design of light bulbs in the past few years? Why?

ACTIVITIES

1 SIMPLE CIRCUITS

L.O. Construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers.

Identify whether or not a lamp will light in a simple series circuit, based on whether or not the lamp is part of a complete loop with a battery.

Children quickly learn to make circuits and then to explore how to use them and change components.

- All children should, if possible have their own battery, wires, bulbs (lamps) and bulb holders and access to a range of components.
- After the starter activity ask children to name each component that they used to make their circuit. Use PowerPoint Slide 7 and get children to play a quick memory game, then ask children to swap and check their answers.
- Now let the children explore and find out what all the different components can do. Show children Slide 9, it has a range of questions and quick challenges. Tell the children to work their way through them either on their own or with their partner. It does not matter what order they do them in, but each time they complete one they must stop and think about what they have just learned. Where children experience problems with their circuit encourage them to problem solve and take a logical approach, e.g. check each component is connected, replace a bulb (lamp) or battery (cell) with one they know works to check if what they are using does not work.

YOU WILL NEED

- Batteries
- Circuit components
- Pens and paper
- Tray
- Cloth
- PowerPoint Slides 7 and 9

ASSESSMENT

Subject Knowledge

- Em. Children can make a circuit and name some of the components.
- Exp. Children can name the components they use in a circuit and say why a circuit does not work.
- Exc. Children identify and name components which are not working and can problem solve and adapt their circuits so they work.

- When children have completed the challenges, ask them to make their favourite circuit and draw a diagram of it, labelling the components. They should write a sentence describing what happens in their circuit.
- These activities allow children to work at their own pace, some children will work more quickly than others so have some challenges ready where they apply their knowledge of circuits, such as:
  - Make a picture that uses a bulb to light part of it up.
  - Make a name card and light part of your name up.
  - Make a face or an animal where a circuit is used to light up part of it, e.g. a cat, with bulbs lit up for eyes.
- At the end of the session ask children to share the most interesting things that they have learned with their partner, then play 'Kim's Game' with the class.
  - Place components on tray or a table and cover them with a large sheet of paper or a cloth.
  - Divide the class into groups, each group has a large sheet of paper and pens.
  - Each person in a group is given a number 1, 2, 3, 4.
  - When a number is called out the child with that number dashes to the table, looks at the components, goes back and tells the group what they remember seeing and they start to draw and name the components.
  - When that person gets back to their group, another number is called, and the next child goes and says which objects they saw and the group draw and name them.
  - Give children a tip – tell them to think about which components have already been drawn and which ones they need to find on the table.
  - At the end children mark their own sheet and score 1 for drawing and 1 for naming.

2 SWITCHES

L.O. Construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers.

Recognise that a switch opens and closes a circuit and associate this with whether or not a lamp lights in a simple series circuit.

- Ask children to find a switch amongst their components and put it in their circuit and switch their bulb on and off. Then they explain to their partner what a switch does and why we need switches on appliances at school and home.
- Share reasons why appliances have switches, why there are switches for lights and why bathroom switches are usually cord pull switches. Talk about the language that is used (off and on), and tell children that when a switch is closed the electricity can flow through, and when it is open the electricity cannot flow and the light or appliance will not work.

YOU WILL NEED

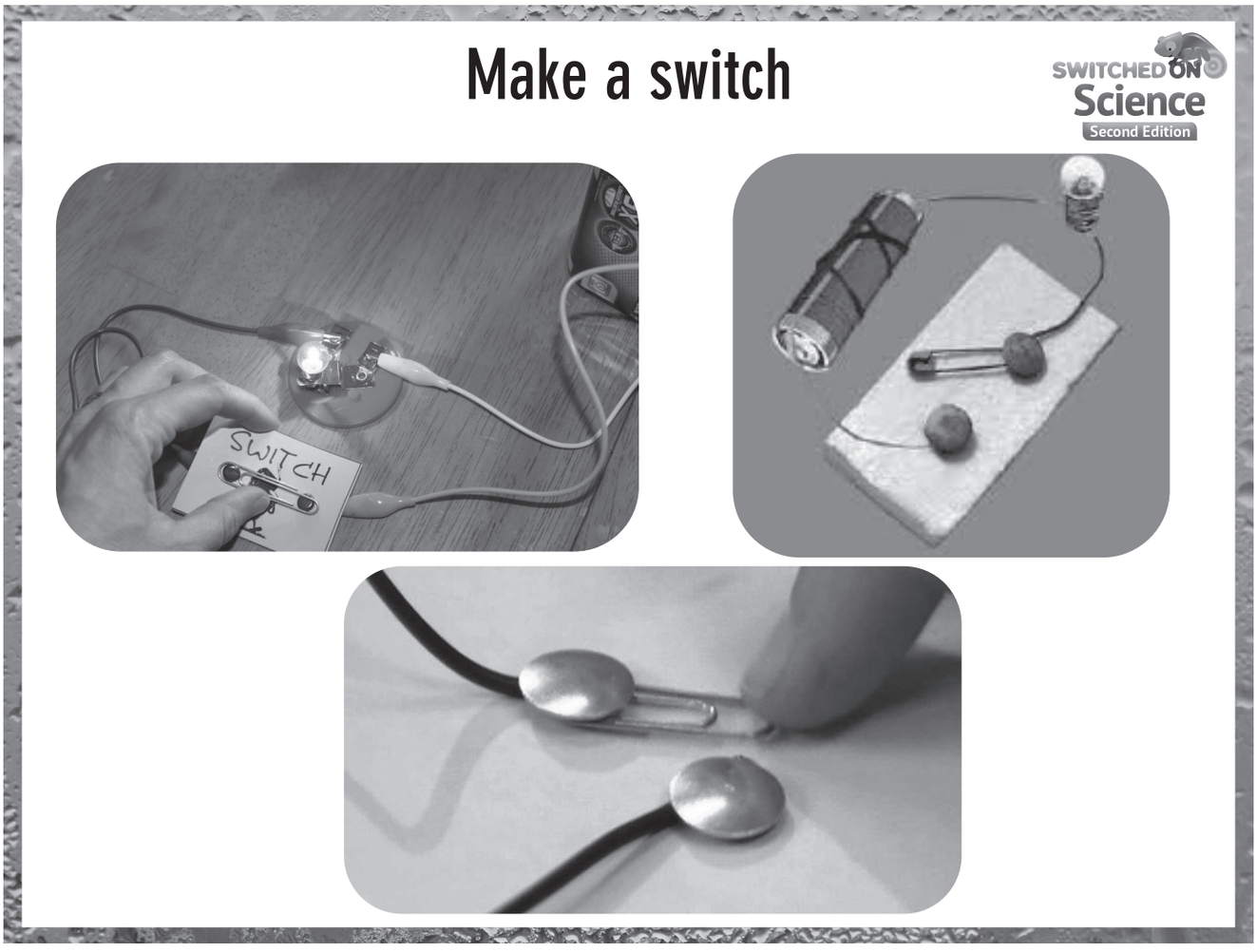
- Brass fasteners
- Thick card
- Paper clips
- Polystyrene blocks
- PowerPoint Slide 10

ASSESSMENT

Subject Knowledge

- Em. Children are able to make the switch and use it to turn a light on and off.
- Exp. Children know that a switch opens and closes a circuit and can use the switch to turn components on and off.
- Exc. Children incorporate a switch into their circuit and test different places where a switch can go, they talk about using open and closed circuits.

- Making their own switches helps children to understand how this works and why we use the terms open and closed.
- Show children Slide 10, which has examples of switches made by children. In pairs, children discuss how each one is made and which one they think they could copy.
- Make sure that there are enough resources so that everyone can make their own and incorporate it into a circuit that they have made. You might want to stop children at a point where they can open and close their circuit and talk about what happens when the circuit it open and when it is closed.
- Children could take a photograph, make a quick video clip with their tablets or draw a diagram showing their circuit open or closed and write a sentence underneath to explain.



5.3 Conducting investigations

GET STARTED

Make a human circuit, with children being different components. What will happen when the switch is closed? Or if the wires are broken?

LET'S THINK LIKE SCIENTISTS

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

- Scientists are always working to make electricity 'cleaner'. What does this mean?
- How do we get electricity into our homes?
- How can we save electricity, and why should we do so? Produce a list of things we could do.

ACTIVITIES

1 CONDUCTORS

L.O. Recognise some common conductors and insulators, and associate metals with being good conductors.

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

- Introduce the word 'conductor' – what do the children think it means? (The point here is to clarify the dual use of the word. They could look it up in the dictionary online or practice the skill from literacy.) Conductors are materials like metal which conduct electricity. Now introduce 'insulator' for materials like plastic, which don't conduct electricity.
- Ask children to make a collection of small objects that they could put in their circuit made from different materials around the room. Show children PowerPoint Slide 11 so that they can work out how they can test materials to find out if they are conductors or insulators.
- Explain to children that they should decide how they are going to record their results, e.g. using a table. Talk about the headings to check that children understand that they are testing the material and not the object. You could use Activity Resource 5.2 to help children plan their fair test.
- Tell them that at the end of this activity they will use their results and evidence to make a rule about which materials are conductors and which are insulators
- Children should test each of the materials and record their results. Do not limit children to how many things they test, encourage them to try objects such as scissors which are plastic and metal.

YOU WILL NEED

- Activity Resource 5.2
- PowerPoint Slide 11
- Circuit components
- Plugs
- Electrical wire
- Range of everyday materials including a mix of conductors and insulators
- Interactive activity

ASSESSMENT

Subject Knowledge

- Em. Children talk about the object causing a bulb to stay on or off.
- Exp. Children know that metals conduct electricity and other materials are insulators.
- Exc. Children talk about electricity being able to flow easily through conductors and are not able to flow easily through insulators.

- Set the challenge who can make the craziest circuit using only a battery, bulb and bulb holder and conductors from around the classroom. Children could use metal objects, e.g. paper clips, aluminium foil, metal scissors, metal spoons.
- Bring the class together to discuss their results. Ask them if there is anything in common about the materials that do conduct electricity. Lead them to the conclusion that metals are conductors and non-metals are insulators. They may have discovered that pencil lead is a conductor. If so, explain that it is not the same as the metal lead and that it is the only non-metal that is a conductor.
- Challenge children to apply their knowledge; ask them to look at the components they have been using for their circuits and identify materials that are conductors and insulators, where and why they have been used.
- Give pairs a plug to undo and look for the conductors and insulators and why they are used. Give children some electrical wire and ask them to explain which materials are conductors and which are insulators and why the materials are used.
- Give children access to the interactive activity on *My Rising Stars* on conductors and insulators.
- If children have access to tablets or other recording equipment, get them to create a 60-second demonstration and explanation about conductors and insulators – they should draft and redraft their commentary prior to recording.

Working Scientifically

- Em. Children describe their observations.
- Exp. Children use their observations to draw conclusions and answer the question.
- Exc. Children use their results to ask and answer new questions.

2 WHAT CAN YOU MAKE USING CIRCUITS?

L.O. Construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers.

Identify whether or not a lamp will light in a simple series circuit, based on whether or not the lamp is part of a complete loop with a battery.

Recognise that a switch opens and closes a circuit and associate this with whether or not a lamp lights in a simple series circuit.

- The aim of this final section is for children to apply what they have learned about electricity and circuits to make a model that requires a circuit. Children might find it better to work in pairs although some might prefer to work alone.
- In groups ask children to think about what kind of things they could make and share their ideas – of course you could offer your own. They should use a range of recyclable materials such as boxes and cardboard to make their models. For example:

YOU WILL NEED

- Recyclable materials
- Electrical components

ASSESSMENT

Subject Knowledge

- Em. Children require support to make a model where something lights up or makes a sound.
- Exp. Children make a model with a working circuit.
- Exc. Children challenge themselves to include several components and change their circuits to use the least number of batteries and wires so that the circuits cannot be seen.

- A burglar alarm to protect your favourite toy or sweets from your older or younger sibling/s.
- A room for Lego people which has a doorbell and one or more lights.
- A question and answer board – a football quiz, or match the animal to its baby, countries and their capitals.
- A model streetlight.
- A lighthouse.
- A robot with flashing lights.

- Whatever they choose they should go through the design, test and evaluate process used in Design and Technology, including drawing plans, listing materials they need. They should also draw and label the circuit that they are going to use and if they need a switch they must make their own.
- Encourage children to help each other problem solve and then when their models are complete and of course working, display them for other people to see, e.g. parents and children from other classes.

Testing conductors and insulators

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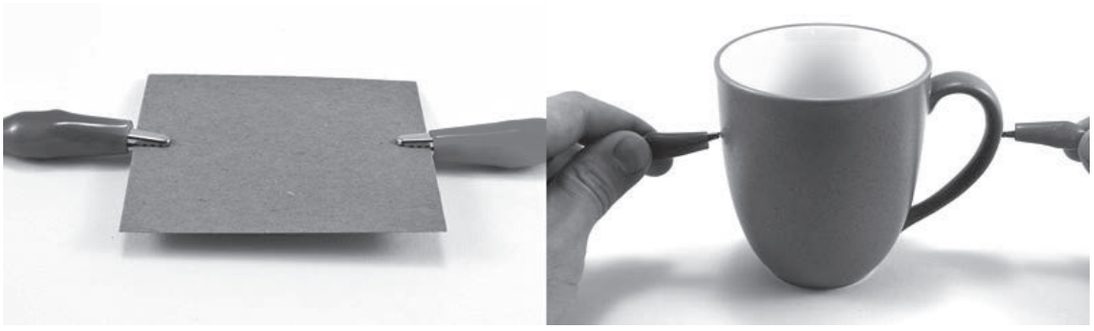


TOPIC 6

The big build

About this topic

Curriculum link: Year 4, Cross curricular

SUMMARY:

In this topic, children learn about building towers and bridges, starting with constructing tall towers, then exploring bridges, next they look at animals as builders and finally engage in researching famous engineers and architects and the structures they built. Children will already know many things about the materials they will encounter, how different materials stretch and their uses. They will use and develop working scientifically skills and understanding though comparative and fair tests, measuring, repeat readings and drawing and reading bar and line graphs.

UNITS:

6.1: Bridges
6.2: Building towers
6.3: Animal big builds
6.4: Big builds project

ACTIVITY RESOURCES:

6.1 Animal Homes investigation

ONLINE RESOURCES:

PowerPoint presentation: The big build
Interactive activity: The big build
Pupil video: The big build
Word mat: The big build
Editable Planning: The big build
Topic Test: The big build

Learning objectives

This topic covers the following learning objectives:

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

CROSS-CURRICULAR LINKS

This topic offers the following cross-curricular opportunities:

English

- Writing instructions for building bridges and towers.
- Following instructions.
- Using non-fiction to research information on bridges, buildings and record breakers.
- Using non-fiction to research bridge disasters, e.g. Tay Bridge 1879, Tacoma Bridge disaster 1940.
- Proofread for spelling and punctuation errors.
- Compose and rehearse sentences orally before writing.
- Organise paragraphs around a theme, e.g. materials for building.
- Use organisation devices, e.g. headings and subheadings.
- Non-chronological writing – science activities.
- Newspaper articles.
- Research careers, e.g. structural engineer.
- Persuasive arguments, write and deliver a speech for a for and against building a new bridge.
- Create fact cards on bridges and buildings.

Numeracy and mathematics

- Measuring length.
- Repeat readings – calculating averages.
- Using tables.
- Drawing bar graphs.
- Decimals, e.g. length and weight.
- Calculating difference.
- Making 3D shape nets.

Computing / ICT

- Image collage – bridges, construction, buildings.
- Creating an infographic on famous buildings and bridges – using statistics.
- Producing videos of testing, using slow motion.
- Photographs of testing, local structures.
- Safely using the Internet for research.

Design and technology

- Classify bridge types.
- Make and test different shapes and structure.
- Design, make, test and evaluate a bridge for a specific purpose, e.g. river, gorge or railway crossing.

Geography

- Classify types of bridges from around the world and reasons for construction.
- Locate using maps, Google maps or globe, famous buildings and bridges around the world.
- Using ordnance survey maps to find local bridges. What do they span, Why were they built?

History

- History of bridges, first to latest.
- Timeline of bridges and tallest buildings with key information.
- Research famous engineers, e.g. Brunel, Gustav Eiffel.
- Research famous architects / builders, e.g. Antonio Gaudi, Sir Christopher Wren, Michelangelo (the dome of St. Peter's Basilica), Renzo Piano (the Shard, London).

Art

- Photograph local buildings and bridges – experiment with effects such as sepia.
- Patterns – brick rubbings, tessellations.
- Design and paint a stamp to celebrate a local or famous bridge or building.
- Bridge or building silhouettes on watercolour washes.
- Fabric / material collages of buildings or bridges.

PE

- Creating strong structures working in pairs and small groups.
- Use PE equipment to create a bridge.

Drama

- Tay Bridge disaster.
- Role-play local discussion for and against a building project.

PSHE

- Building bridges, e.g. friendships.

STEAM (SCIENCE TECHNOLOGY ENGINEERING ART AND MATHS) OPPORTUNITIES

Invite into class

- Civil engineer, structural engineer, builder or architect.
- STEM ambassadors from the construction industry.
- Representative from the Local Authority Highways
- Primary Engineers https://www.primaryengineer.com/

Visit

- A local construction site.
- Local bridges to take photographs and study structures.
- A local quarry that takes visits from primary pupils.

TEACHER SUBJECT KNOWLEDGE

Bridges and towers can be made from many different materials such as wood, stone, bricks, iron and steel even plastic and glass fibre can be used. The material a bridge is made from is important but so is the shape, a material can be made stronger by changing its shape. Good shapes for bridges are arches and triangles. The reason triangles are so strong is that their shape is fixed, the angles cannot be changed once they have been made. However in squares and rectangles the angles can be changed – using pieces of card fixed with paper fasteners helps to show this.

Bridges are essential for transport networks to be developed and not only to cross obstacles such as rivers, bays, gorges and canyons, but to join communities. The earliest bridges were beam bridges probably inspired by trees that had fallen over streams or gullys. This type of bridge requires the material laid across the gap to be strong and not bend or sag when a load (person, vehicle) is placed on it. When making bridges using paper or card a single sheet will not be a strong bridge, add a curved piece of card or paper underneath the bridge (an arch) then the structure resists the forces making the card beam bend. If a load, for example a weight, is placed on top of an arched bridge, the force of the load pushing down is transferred to the sides of the arch which push outwards. The pillars or, for example, river bank, push back and so the bridge does not collapse.

Triangles are very strong structures, so if a beam across a bridge is made using triangles then it will be strong. Children changing card or paper so that it is pleated like a fan can use this to make a structure that holds a greater load.

Common types of bridges include beam bridges, arch bridges, suspension bridges, cantilever bridges, truss bridges and cable-stayed bridges. The type of bridge depends on what they are to be used for, cost and the ground where they are built.

Historical bridge designers such as Isambard Kingdom Brunel and Thomas Telford created bridges, canals and tunnels without the technology we have today. However, even bridges built with modern technology can have problems as in the case of the Millennium Bridge which wobbled when lots of people were using the bridge at the same time.

Bridge disasters

There have been many famous bridge disasters such as the Tay Bridge in Scotland. On 28th December 1879, the central spans of the Tay bridge collapsed into the Firth of Tay, 75 people died because the bridge structure could not withstand gale force winds. The Tacoma Bridge disaster in 1940 was also caused by wind, causing the whole bridge to vibrate and twist, there are many video clips online showing this happening.

Why are towers built?

Towers are built because on the ground they take up very little space, but they can have a lot of floor space because the floors are built one on top of the other. So a tower will cover a small area on the ground but have over 100 floors which is a lot of space. More people can live or work in a tower compared to buildings that are only a couple of storeys high.

Engineers

Structural engineers design structures such as bridges, tunnels and buildings. The work with architects who design these structures, it is the structural engineer's job to make sure that the materials used, and the design can withstand forces such as the load (e.g. cars, people, trains) as well as wind, rain and even earthquakes. The structural engineer's role is to make sure that the building or bridge is safe.

CHILDREN'S MISCONCEPTIONS

Children might think…

- That a green building is the colour green where in fact it refers to the building being environmentally friendly

Children already know…

- The names of some materials used in buildings.

SCIENTIFIC VOCABULARY

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

structure: something built from different parts

tower: a structure that is much taller than it is wide

6.1 Bridges

GET STARTED

Show children PowerPoint Slides 1–6. Slide 6 shows a simple beam bridge. Now ask children to create a sugar paper stream with books or blocks at either side (both equal height) and challenge them to make a beam bridge using sugar paper or card to go across and find out how much weight (load) it can hold before it collapses.

LET'S THINK LIKE SCIENTISTS

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

- Why do people build bridges?
- Who built the first bridges?
- What kind of bridges are there where you live?
- Where would you build a bridge? Why?
- Who do you think works on building a bridge? What jobs do they do?

ACTIVITIES

1 BRIDGING A STREAM

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

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

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

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

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

- Having made their first beam bridge and found out how much load it takes (which might be very limited), the children's challenge is to use the information on Slide 7 to strengthen their bridge. They test the different ways to improve the bridge and record their results.
- Ask children to discuss what they would want to improve next time they made this kind of bridge. How could they make it take more weight? How could they make the bridge longer?

YOU WILL NEED

- A4 scrap paper or card
- Masses
- Scissors
- PowerPoint Slide 7

ASSESSMENT

Working Scientifically

- Em. Children carry out a simple comparative test between the bridges and say which collapsed and which did not.
- Exp. Children use results from their fair test to draw conclusions using their data.
- Exc. Children apply what they have learned to extend their test and refine their bridges.

2 WHICH SHAPE IS THE STRONGEST FOR BRIDGE PILLARS?

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

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

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

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

- Show children Slide 8 which shows 3D shapes, e.g. triangular prism, cylinder, cube and a cuboid. Ask children to predict which would be the strongest and hold the greatest load (weight). Then get the children to vote for one of the 3D shapes, and ask one group to keep a tally chart on the board to record the votes. Then, working in pairs, children use this to create a simple bar graph on their individual whiteboards.
- At this stage, children are not expected to be able to make their own 3D shapes, however some children may be able to construct their own, otherwise provide each group with a set of ready-made card shapes to test.
- Tell each group that they are going to work together to plan how to carry out a fair test to find out which shape is the strongest pillar for a bridge. Emphasise that they will only get one chance because each group has only one set of shapes. Get children to share their plans, so that each plan is checked, this could be through peer assessment. Then explain that each person in the group is going to have a job when they carry out their test:
  - Measurer – person who places weights on the pillars.
  - Recorder – person who records the results using a table.
  - Fair tester – person who makes sure that the test is carried out in a fair way.
  - Resources manager – person who gets and makes sure the resources are used properly.
- Once children have negotiated roles, they carry out their fair test. Once completed, they should transfer the data from their table to a bar graph and use their data (evidence) to answer the original question. Was their prediction at the beginning of the lesson correct?

YOU WILL NEED

- 3D shape set for each group
- Masses
- PowerPoint Slide 8
- Mini whiteboards and markers

ASSESSMENT

Working Scientifically

- Em. Children carry out a comparative not a fair test.
- Exp. Children carry out a fair test and use their graph results to answer the question.
- Exc. Children use their results to ask new questions, e.g. does the height of the pillar affect the strength?

3 TERRIFIC TRIANGLES

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

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

- Show children Slide 9 of a Truss bridge. Give them about two minutes and ask them to count how many triangles they can see. Ask them to discuss why they think this bridge was built using so many triangles.
- Show children Slide 10 and ask them to use their spaghetti and mini marshmallows to make the different shapes to carry out comparative tests to find out which one keeps its shape best. They should use the marshmallows to attach the pieces of spaghetti. Children should observe that the triangle is the best shape.
- Now show children Slide 11 and ask them to make the cube using their spaghetti and marshmallows. They should test it to see how strong it is and then make another using triangles to find out whether they can be used to make the shape stronger.
- Show children Slide 9 again and ask them to discuss what they think would happen if the engineer who built the bridge did not use triangles. Now ask them why they think so many triangles are used in the construction of the bridge. Challenge them to use their observations from their comparative tests in their answer.
- Now challenge children to use their knowledge of triangles as a strong structure to make a beam bridge which is stronger than the beam bridge they made in the Get started activity at the start of unit 4.1.

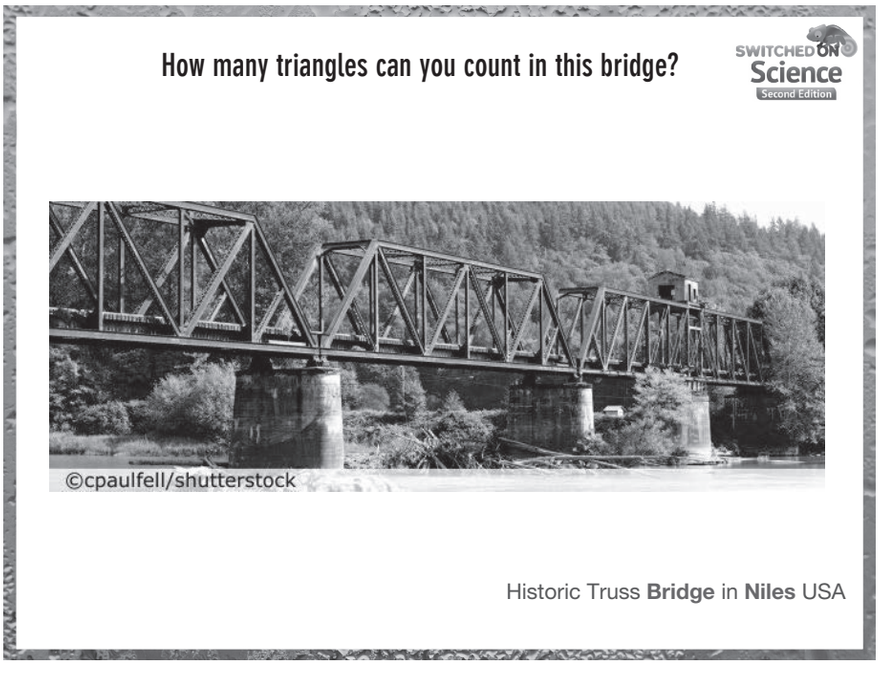
YOU WILL NEED

- Spaghetti
- Mini marshmallows
- PowerPoint Slides 9-11

ASSESSMENT

Working Scientifically

- Em. Children make and compare the different shapes with and without triangles, they can say what happened.
- Exp. Children use their observations from comparative tests to say why triangles are used in the bridge.
- Exc. Children use their results to ask and answer new questions.



6.2 Building towers

GET STARTED

Show children PowerPoint Slide 12 which shows the Burj Khalifa currently the tallest tower in the world. Take children outside to measure 100 metres and then ask them to estimate where 800 metres would end, perhaps it would be outside the school? This will help them to develop some idea of how tall the tower is.

LET'S THINK LIKE SCIENTISTS

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

- What problems do you think structural engineers would have building towers?
- When you have built towers when playing what problems did you have?
- Do you think that people who build towers need to know about science? Why?

ACTIVITIES

1 TALLEST TOWERS

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

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

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

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

- Health and safety – if using metal masses, make sure that this activity is carried out on the floor and children keep fingers and feet out of the way if the mass falls.
- In this activity children are going to create the strongest tallest tower using only 1 sheet of A4 paper, by folding it or making shapes. Have children to reflect on their experience so far. What do they know about structures that they could use here? Make sure that children they have lots of scrap A4 paper to try out different designs and test them. Do stress that they are not allowed any scissors, sticky tape or glue and that they should make their towers by folding the paper.
- They should carry out a fair test to find the strongest and tallest tower. Focus their attention on:
  - Making systematic and careful measurements using standard units.
  - Recording their data using a table and converting the data into a bar graph.
  - Using their results to draw simple conclusions using their scientific evidence (data).
  - Suggest improvements to their test and raise further questions.
- When children have completed this activity, they could share and compare what they have found out about the kind of structures that made the tallest, strongest tower.

YOU WILL NEED

- A4 scrap paper
- Masses

ASSESSMENT

Working Scientifically

- Em. Children carry out a simple comparative test between two towers.
- Exp. Children use results from their fair test to draw conclusions using their data.
- Exc. Children apply what they have learned to extend their test to create and test new towers.

2 SPAGHETTI TOWERS

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

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

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

- Show children the dried spaghetti, mini marshmallows and a creme egg or a toy figure and a tower of building blocks about 60 cm high. Snap some spaghetti, ask if it is a strong material. Challenge children to build a tower from a weak material to hold the egg as high as or higher than the building blocks.
- Show children Slide 13. Then, working in pairs or groups of three or four, get them to make the structure using spaghetti and marshmallows. Each group should have the same materials and time to construct their tower. Make sure that they understand that there are no additional resources and that they should use their knowledge and experience of strong shapes to build their. You could remind them of what they learned in the previous 'Terrific triangles' activity.
- Explain that you have set up QR codes around the classroom with pictures of the Eiffel and Blackpool towers. Explain that there are clues in the way these have been constructed that could help them build their own towers. For example, they are made using a wide base at the bottom and triangles to make the tower stronger.
- Prior to children beginning this task, explain that they must work carefully and learn as they go along so they will:
  - Explore what does and does not work.
  - Observe – cause and effect, what happens and why?
  - Test their final structure to make sure it holds an egg and work out how to accurately measure the height.
  - Work as a team listening to each other's ideas.
  - Reflect and evaluate what they are doing, learn from it so that they can change and improve their tower.
- As children work, they should take photographs of what they are doing so they can create a six-slide PowerPoint of their experiment explaining how they built it, what did and did not succeed and why, suggest improvements and provide new questions to answer.
- The winning tower will be the tallest and able to hold a creme egg or toy figure of a set size and weight and will be tested alongside all the other towers.

YOU WILL NEED

- 50g of dried spaghetti (approx. 50–60 strands) per group
- Mini marshmallows
- Creme egg or toy figure
- Tower made from building blocks 60 cm high
- Measuring equipment
- PowerPoint Slide 13
- QR codes with pictures of the Eiffel and Blackpool towers
- Camera

ASSESSMENT

Working Scientifically

- Em. Children build a tower without applying prior experiences.
- Exp. Children apply their understanding of structures and learn as they build.
- Exc. Children organise their project using prior experience to create basic shapes which are strong to build their tower.

6.3 Animal big builds

GET STARTED

Share with children a video clip which show how beavers build their homes (see 'How Beavers Build a Lodge' on the Useful Websites list). Before it begins, ask children to think about:

Why does a beaver need to build a home?

What materials does it use and how does it use them?

How is it similar and different to your home?

You could show other clips. The Useful Websites list includes a clip which shows how the caddis fly builds its home out of local materials.

LET'S THINK LIKE SCIENTISTS

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

- Think about where you live and the school grounds, which animals have built their home there?
- Why do animals build homes?
- Which animals build their home and carry it around with them?

ACTIVITIES

1 ANIMAL HOMES

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

Gather, recording, classifying and presenting data in a variety of ways to help in answering questions

Recognise that living things can be grouped in a variety of ways.

Explore and use classification keys to help group, identify and name a variety of living things in their local and wider environment

- Challenge children to find out how common animals in the local environment build homes, such as birds and bees. Extend the environment to include creatures such as badgers, a caddis fly larvae, beavers and termites. Show children Slide 14 which shows example of animal builders.
- Divide the class into groups and give each group a different animal to research. Get them to ask questions first so that they have thought about and planned what information they need. Children could use question stem cards and ask, for example:
  - What kind of animal is it, e.g. mammal, bird, insect?
  - Where is its habitat?
  - What does the home look like?
  - Why do they build it?
  - What sorts of materials are used to build the home?
  - How is it constructed?
  - What size and shape structures do they build?

YOU WILL NEED

- 'How beavers build a lodge' video clip (see Useful Websites list)
- Animal home information
- Poster-size paper
- PowerPoint Slide 14
- Materials and equipment for making posters
- Sticky notes and pens

ASSESSMENT

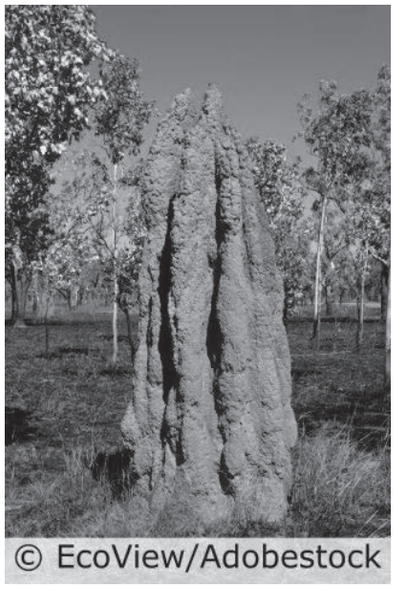
Working Scientifically

- Em. Children ask questions and use their answers to make a poster.
- Exp. Children ask and answer their own questions and present key information as a poster to show understanding of why their animal is a builder.

- Provide children with a wide range of information sources such as video clips, leaflets, books and QR code links to websites, pictures, etc. When they have collected their information, their task is to create a poster about their animal and its 'Big build'. Before starting they should plan their poster:
  - What do they think children in the class need to know and will find interesting?
  - What pictures / illustrations will they use?
  - What key information to include?
  - Why is the animal impressive as a builder?
- Explain to children that they need to use their literacy skills, e.g.:
  - Proofread for spelling and punctuation errors.
  - Compose and rehearse sentences orally before writing.
  - Reread to check the meaning is clear.
  - Organise paragraphs around a theme, e.g. materials for building.
  - Use organisation devices, e.g. headings and subheadings.
- When children have completed their posters, give them time to engage in peer assessment for both science and literacy. Each group visits the other posters and leaves a sticky note with comments, e.g. *Positives*, *Could Change*, *Interesting*. Then display the posters in a public area in the school where other children, parents and visitors can learn about animal 'Big builds'.

- Exc. Children ask questions linked to the needs of an audience and present information using different formats, e.g. sentences, QR codes, annotated diagrams, photographs, collage. They can compare the building techniques with humans or other animals.

Animal builders



Catherdral termite mound

Weaver bird nest

Caddis fly larvae case

6.4 Big build project

GET STARTED

Begin by showing one of the many time-lapse video clips which show some of the tallest buildings in the world being built (see Useful Websites list for several examples).

Ask children to discuss how the buildings were being constructed, challenge them to think about how they would get builders to the top of the constructions, carry materials and huge glass windows. Find out what children know about architects and engineers and their role in construction, list their ideas and then give them time to search information on these jobs either in a dictionary or on the Internet.

LET'S THINK LIKE SCIENTISTS

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

- What would you have to do to become a structural engineer?
- Why does a structural engineer need to have scientific understanding about rocks, soils, forces, earthquakes, the weather?
- If you were a structural engineer, what would you like to build?

ACTIVITIES

1 RESEARCHING BIG BUILDS

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

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

- Show children Slides 15–17 which have photographs of famous buildings and bridges, and different styles of bridges. Working in pairs, ask children to choose which one they would like to research.
- Research is one of the key scientific enquiry activities children need to do so give them access to question stems they can use e.g.:
  - Who built it?
  - When was it built?
  - Why did they build it?
  - Where was it built?
  - What was it made from?
  - How did they build it?
- Discuss with children how they will collect their information. They should identify the main point from paragraphs and take notes to be used later when creating a fact file or annotated picture / photograph with key facts around it to go in a class big book or working wall on big builds.

YOU WILL NEED

- 'Amazing four-year time lapse of Shanghai Tower construction' video (see Useful Websites list)
- Activity Resource 6.2
- PowerPoint Slides 15–17

ASSESSMENT

Working Scientifically

- Em. With support, children ask questions about a bridge or tower building and use limited resources to answer questions.
- Exp. Children ask and answer a range of questions and write up their answers.
- Exc. Children ask and answer additional questions that arise as they research.

2 BIG BUILD – NEWSPAPER BRIDGE OR TOWER

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

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

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

- Explain to children that this is a 'Big build' challenge. They are going to work in groups and use what they know about building bridges and towers and using different shapes to build a bridge to span 50 cm between two classroom chairs and hold the most weight or to build a tower that is as tall as they are and can hold 1 kg. Give them time in their groups to discuss which structure they are going to make. Then, when they have chosen, tell them that it has to be made from newspaper and that they can only have 50 cm of sticky tape.
- Divide this activity into five sections:
  - Research – Children use previous and additional research to help them decide what their structure will look like.
  - Design – Children draw their design and annotate it to show features, e.g. arches, use of triangles for strength.
  - Make – In this section, children can make, test sections and redesign.
  - Test – Carry out a fair test with the rest of the class to find out which structure is the tallest and can carry 1 kg, or the strongest bridge. Record the results as a whole class which children use to draw a graph and draw conclusions.
  - Evaluate – Children evaluate each other's bridges, strengths and weaknesses.
- As children work, they could take photographs of their big build to communicate their workby creating, e.g. a poster, big book, Microsoft Photostory, PowerPoint, text, WordArt, Video. In this work, children should show an awareness of an audience when reporting their tests and results.
- Ask the children to discuss the question: 'If you could start from the beginning again, what would you keep the same (what worked best for you) and what would you change and why?'
- When they have completed their work, their 'big build' structures could be displayed somewhere so that the rest of the school can look at and read their work.

YOU WILL NEED

- Newspaper
- Sticky tape
- Masses
- Scissors

ASSESSMENT

Working Scientifically

- Em. Children participate in a group to make and test a structure and require help to work with data from the whole class test.
- Exp. Children test their structure and use the graphed data to draw conclusions.
- Exc. Children test their structure and use the graphed data to draw conclusions and suggest improvements to the process.

1.1 What a racket!

Instrument / sound source	How is the sound made?	What is vibrating?

1.2 Can you hear it?

1. What sound source / instrument are you using for your investigation?

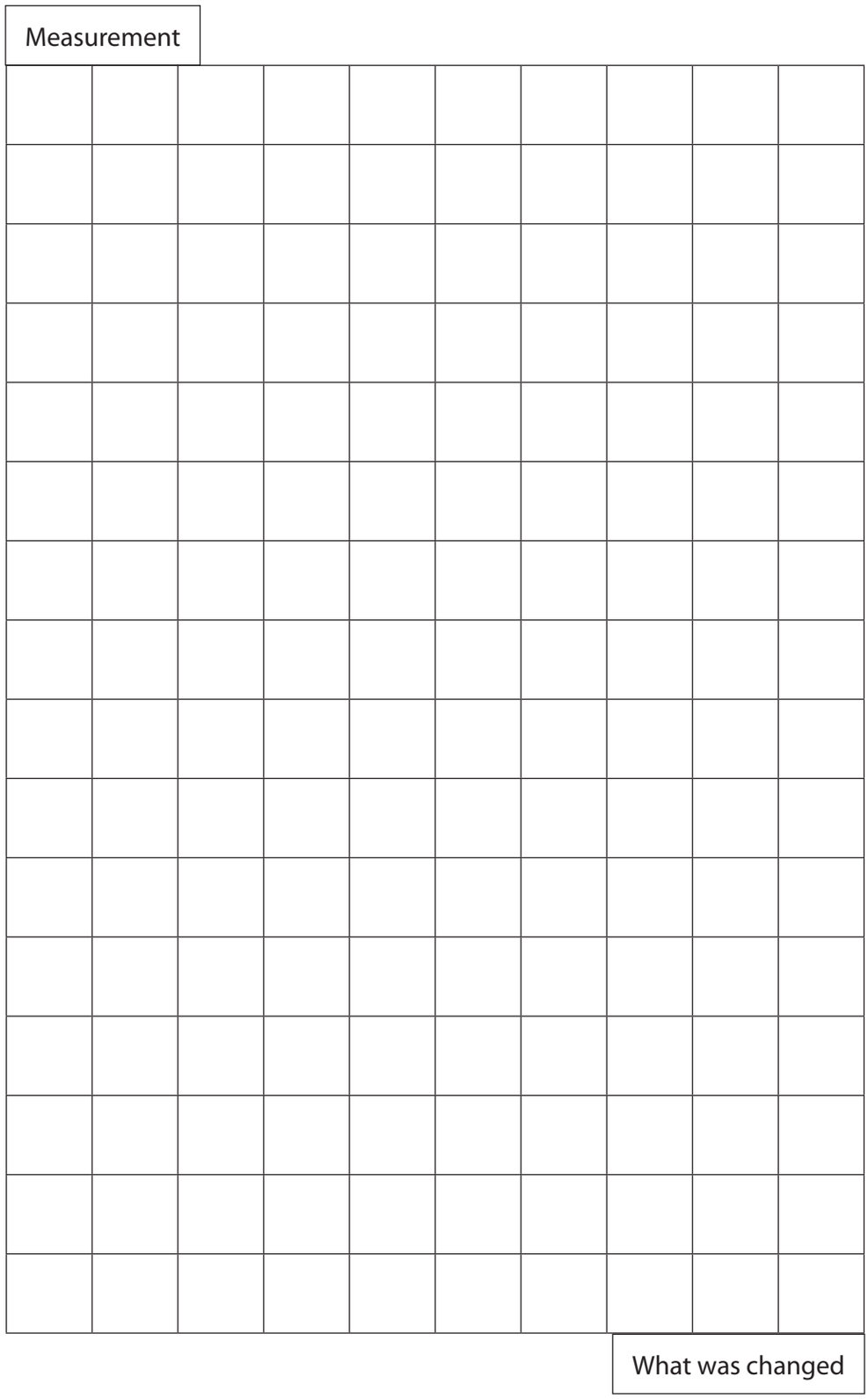
2. What are you using to measure distance?

3. Where are you doing the investigation?

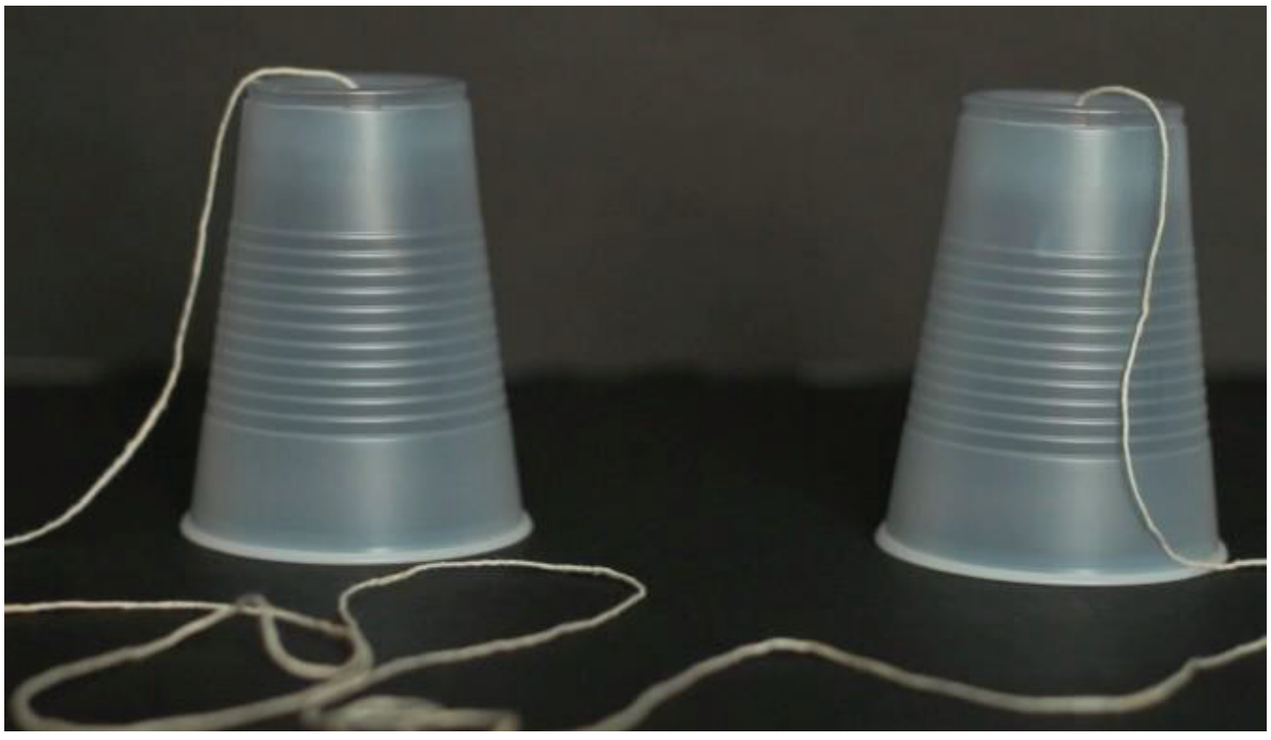
4. Why might this affect your results?

1.3 Moving data from a table to a bar graph

What you changed	What you measured



1.4 Make a string telephone



What you'll need:

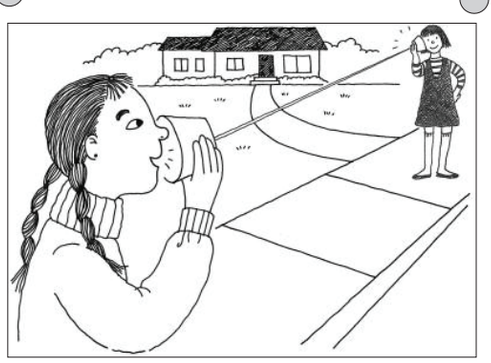
- 2 plastic cups
- Scissors
- String

1. Using the tip of the scissors, ask an adult to make a small hole in the bottom of each cup.
2. Measure 5 metres of string.
3. Thread one piece of string through each hole from the outside to the inside of each cup so that they are connected by the string.
4. Tie a big knot on the inside of each cup so that the string cannot slip through the hole.
5. Now go outside and try out your string telephone.

What can you do to improve your string telephone? Test your ideas, evaluate how well they worked.

1.5 My own questions

My answer is



My answer is

My answer is

My answer is

1.6 Let's make it louder! Investigation

1. What are you going to investigate? _____

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

3. What will you keep the same? _____

4. What will you change? _____

5. What will you measure? _____

6. How will you record your results? _____

7. How will you make sure that you are accurate? _____

8. What have you found out? _____

9. Is there a pattern? What is it? _____

10. Is there a rule? What is it? _____

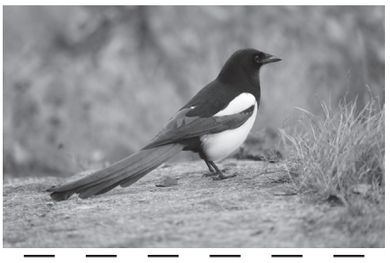
2.1 Animal cards

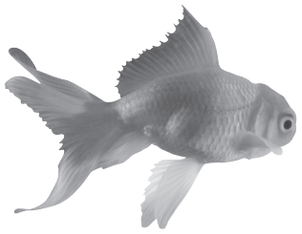










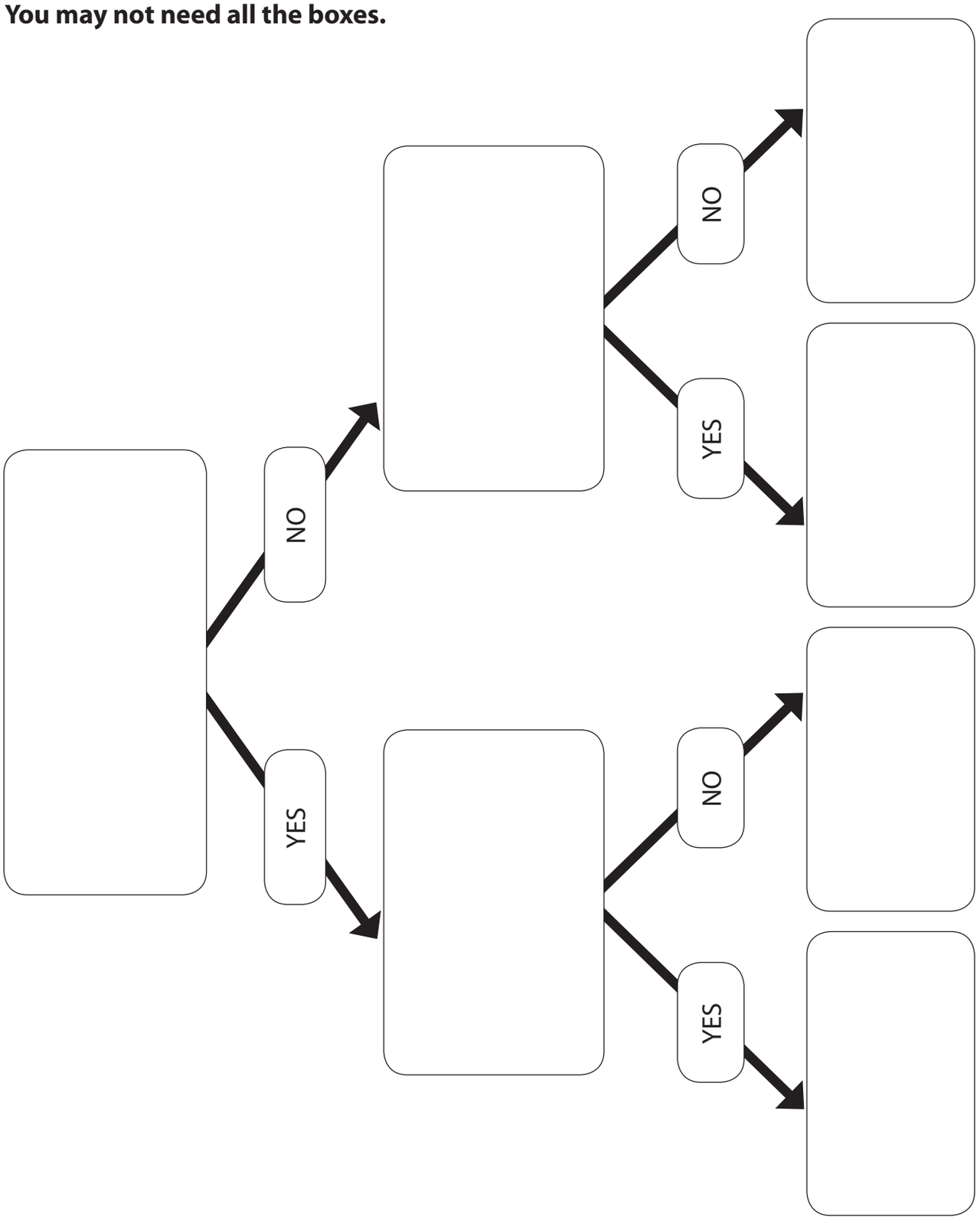







2.2 Skeleton key

Use this template to help lay out your key.
You may not need all the boxes.

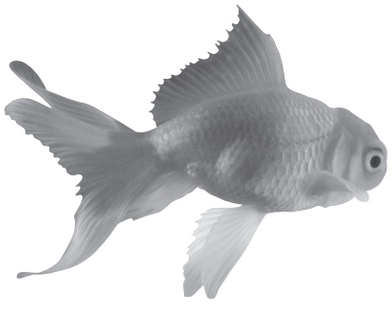


2.3 Vertebrate key

1. Can you make a key to help identify these five animal groups?







2. Here's a description of Ziggy.
Use this information, and your key, to find out what group he belongs to.

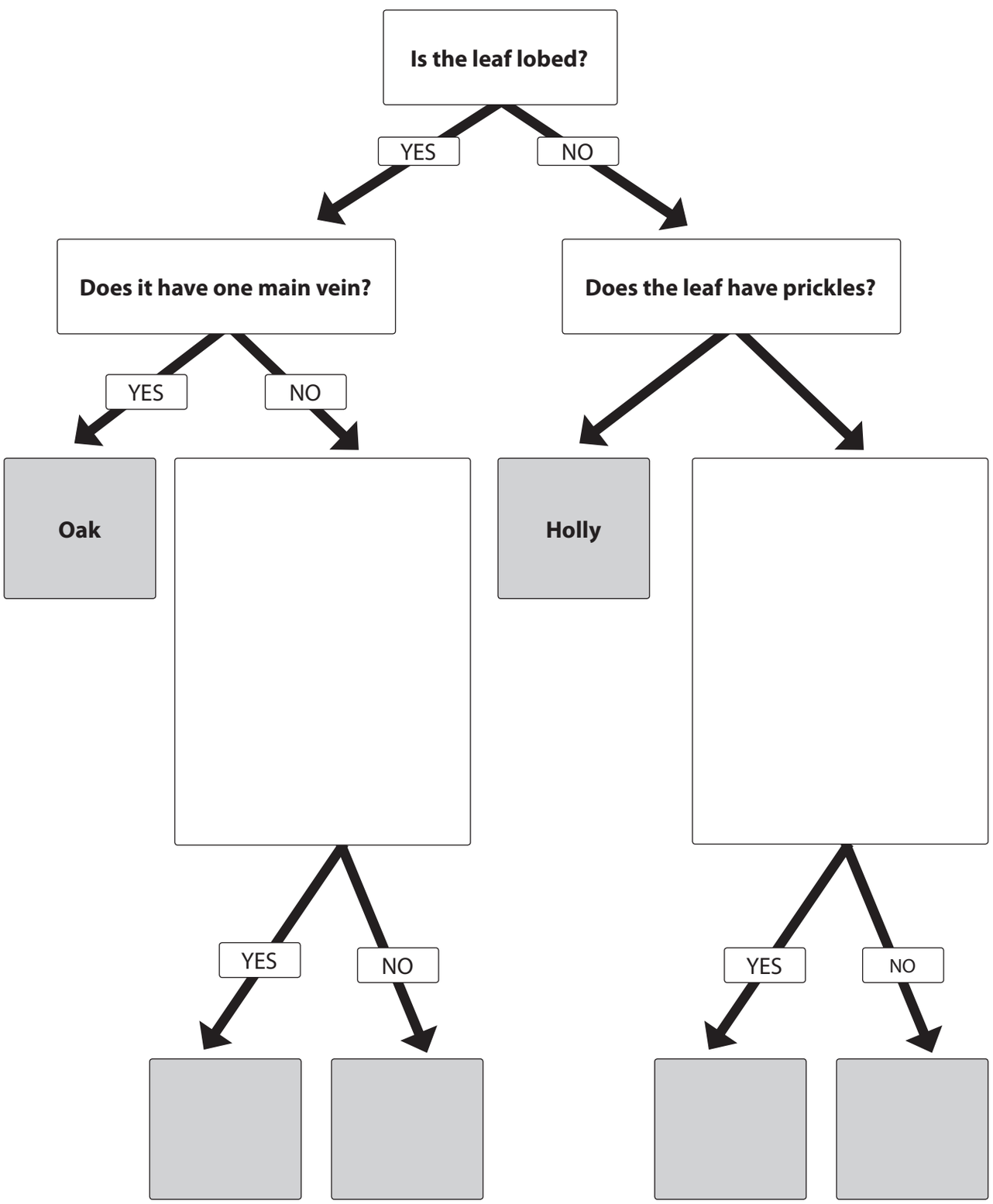
Ziggy loves to climb trees. He has special toes that let him grip branches and a long tail to help him balance.

Ziggy is cold-blooded, so he needs to sunbathe in the morning to warm his body up. He loves to eat insects, which he catches with his super-long tongue. Ziggy has dry, scaly skin which can change colour to help him blend in with his surroundings.

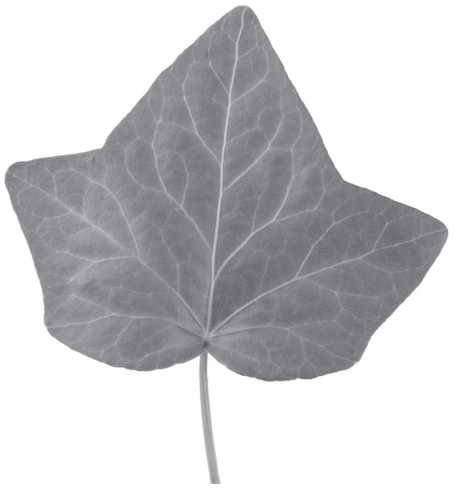
Like other chameleons, he hatched out of an egg which is soft and leathery, very different from a chicken's egg!

2.4 Leaf keys

Complete this key to identify the different leaves.



2.5 Leaf pictures



3.1 What a state!

Name of material	Is the material in its solid, liquid or gas state?

What do the solids have in common? _____

What do the liquids have in common? _____

What do the gases have in common? _____

3.2 A watery end

Melting different amounts of ice

1. Asking a question

Write down the question your class is investigating.

_____

2. Our apparatus

Draw and label your apparatus.

3. Things we can change

- Colour in blue the thing that will be different for each group.
- Colour in yellow the thing that will stay the same for each group.
- Colour in red the thing you will measure.

The type of material we will melt
Temperature
The amount of material we will melt

4. Our measurements

We used _____ g of ice.

Time (minutes)	Temperature (°C)	Can we see ice, liquid water, or both?
0		
1		
2		
3		
4		
5		
10		
20		
30		

Our table shows that the melting point of our ice was _____ °C.

5. What we found out: Circle the correct choice below (does/does not).

Our class found out that the amount of ice does / does not make a difference to the melting point of ice.

3.3 Making ice-cream

You will need:

- 80 ml milk
- ¼ teaspoon vanilla flavouring
- 10 tablespoons salt
- 1 big freezer bag, with fastening or zip
- To serve the ice-cream – small plate or bowl, and spoons
- 1 tablespoon caster sugar
- 1 litre crushed ice
- 2 small freezer bags, with fastening or zip
- Winter gloves

You must wear winter gloves when holding the bag of ice-salt mixture.

1. Measure out the milk, sugar and vanilla and place in one small bag. Remove the air from the bag. Fasten securely.

2. Place the bag in another small bag. Remove the air. Fasten securely.

3. Place the salt and crushed ice in the big bag.

Shake to mix the contents.

4. Place the small bag and its contents in the big bag of ice-salt mixture. Remove the air. Fasten securely.

5. Using gloves, hold the big bag and its contents. Shake for about 10 minutes.

6. Remove the ice-cream from the inner bag.

Make sure it **does not come into contact** with the ice-salt mixture.

AND EAT!

1. Which substances were solids?

2. Which substances were liquids?

3. What helped to change the mixture into ice-cream?

4. Did you have to use ice? Why?

5. Why do you think salt was added to the ice?

3.4 Freezing substances

Substance	Prediction	Reason	Result

Which substance surprised you the most? Why? _____

_____

3.5 Cloud in a glass

You are going to show how clouds form by making a cloud in a glass.

1. You will need

- Beakers
- Thermometer
- Ice
- Cold baking trays
- Mirrors
- Warm water
- Kettle
- Foil trays such as apple pies come in
- Access to a freezer

2. What to do

- Put the ice in the foil container. Wait for the foil to get very cold.
- Pour about 1 cm height of warm water into the glass beaker.
- Place the foil container and ice on top of the beaker.
- Look carefully at the inside of the beaker.

3. What we saw

- Draw a picture to show what you saw inside your glass.

4. Explaining what we saw

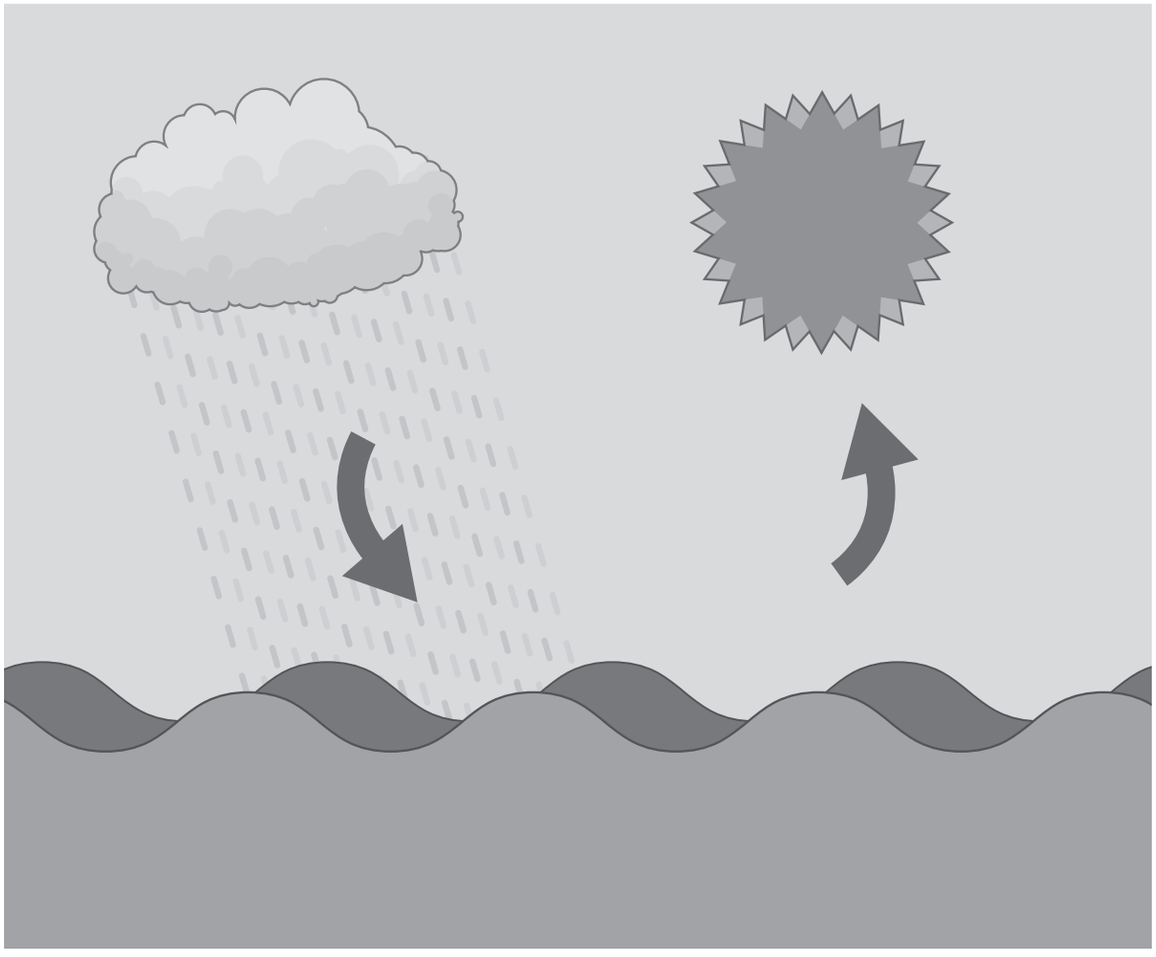
- Highlight the correct bold words to explain what happened.

Some of the warm water **condensed/evaporated** to form water in the **solid/gas** state. This is also called water vapour. The vapour moved up to the cold part of the glass. Here, it **condensed/evaporated** to form tiny droplets of water in the **liquid/gas** state. These droplets formed our cloud.

- Describe how your model is similar to the way that real clouds form, and how it is different.

3.6 The water cycle

The total amount of water on the Earth's surface and in the atmosphere does not change. Water simply moves from place to place, sometimes changing state as it does so. The water cycle shows these changes. Add the correct processes to the diagram.



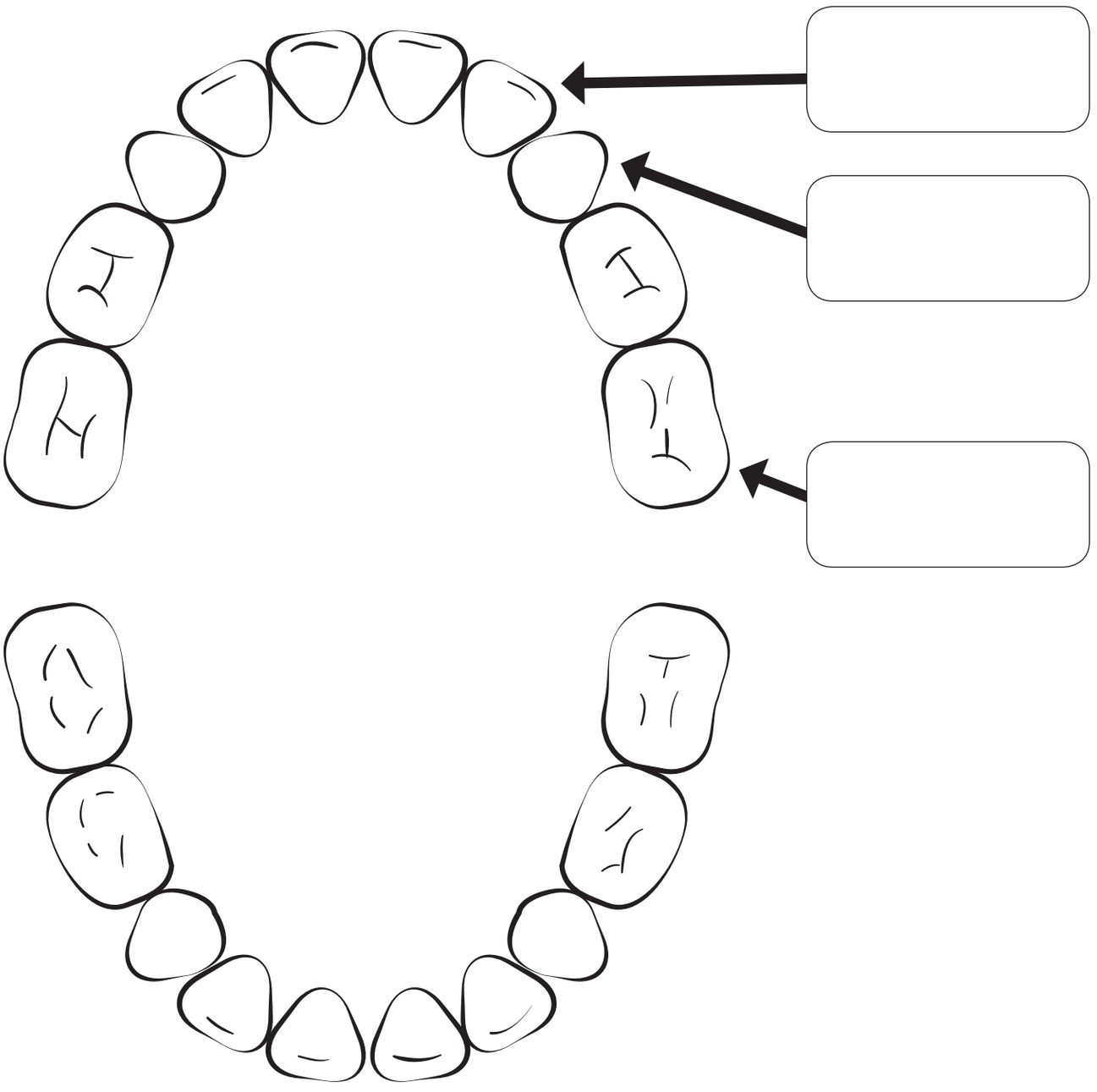
4.1 Tooth map

Name: _____

Ask a partner to use a mirror to take a look at your teeth. Imagine the map below is a map of your own mouth.

Put an X through any teeth that are missing.

Colour in any teeth that that have a filling.

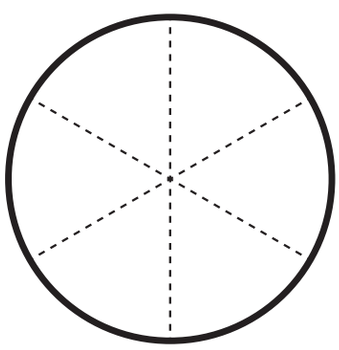
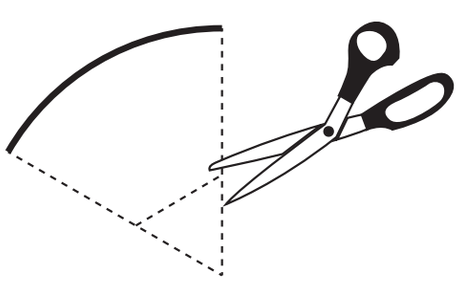
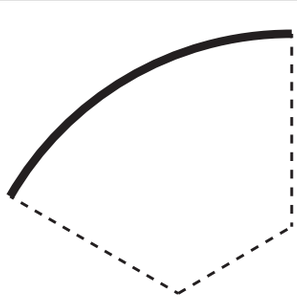


In the boxes, label the incisors, canines, molars.

4.2 First impressions

Each pair will need:

• A polystyrene plate **• A pair of scissors** **• A marker pen**

1. Divide the polystyrene plate into six equal wedges, like a pizza.	
2. Cut along the lines to make six wedges.	
3. Take two of the wedges and put one on top of the other together. Cut off 3 cm from the pointed end of the wedges.	
4. Place the two wedges into your mouth as far as possible. 5. Bite down on the wedges as firmly as you can. 6. Label the top and bottom wedges 'Top teeth' and 'Bottom teeth'.	

Questions :

a) Count the number of teeth marks in the top and bottom impressions.

b) Compare your top teeth to the bottom.

c) Are there teeth missing, spaces, chips?

d) Compare your teeth impression to your partner's.
Do they look the same?
How are they the same / different?

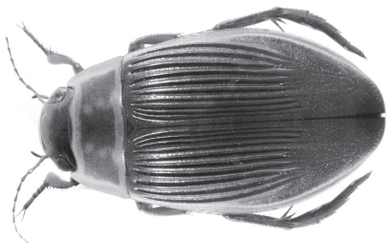
4.3 Food's incredible journey

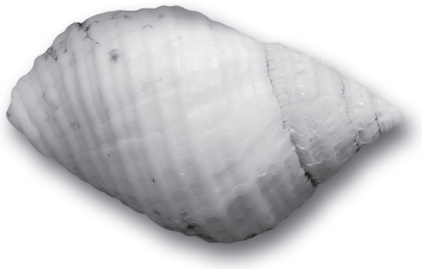
What do the different steps of the digestion practical show? Use these words in the boxes:

Chewing food	The large intestine	Saliva	The small intestine
Going to the toilet	The stomach	The stomach mixing up the food	

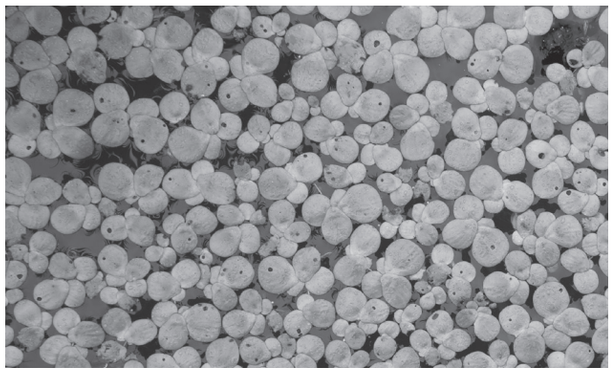
Part of the practical	What this is working like?
Breaking up the food with your hands	
The plastic bag	
Adding water to the food	
Smashing up the food inside the plastic bag	
Squeezing the food inside the tights leg	
Squeezing the food into the paper cup	
Pushing the food through the hole in the paper cup	

4.4 Food chain cards





4.4 Food chain cards



5.1 Which source?

Look around your home or school and make a list of electrical equipment. Find out and record if it is mains operated (has a plug), battery operated or both.

Mains operated	Battery operated	Mains and battery operated

5.2 Changing circuits

1. What are you going to investigate?

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

3. What will you keep the same?

4. What will you change?

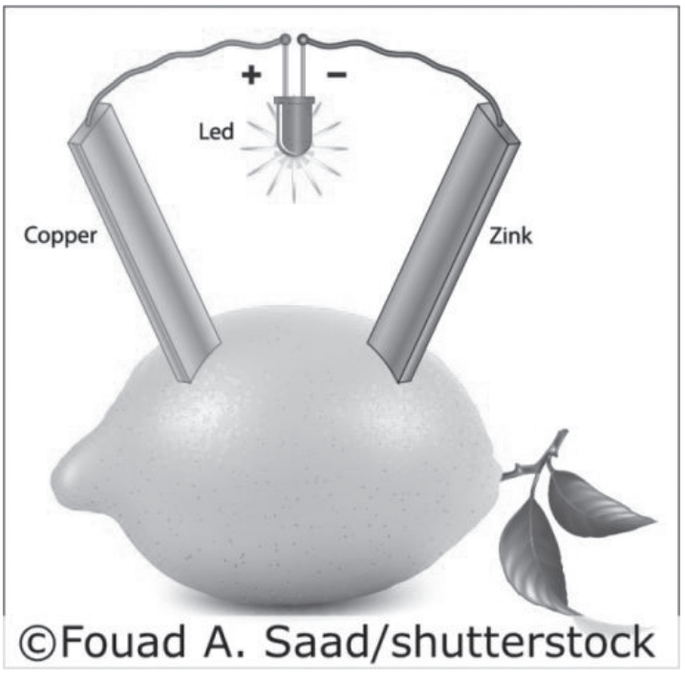
5. What will you measure?

6. How will you record your results?

7. How will you make sure that you are accurate?

8. What have you found out?

5.3 Make a lemon battery



What you need:

- 1 lemon
- 1 copper nail, screw, or wire, roughly 5 cm in length
- A zinc nail, screw, or galvanized nail, roughly 5 cm in length
- LED
- Short leads (about 5 cm)

What to do

1. Press down (gently) on your lemon and roll it around on your desk so that the juice begins to flow inside.

2. Push both nails into the lemon, about 5 cm apart, they must not touch.

3. Take off the insulation (plastic) from one end of each wire.

4. Wrap one wire around the copper nail and one round the zinc nail.

Your lemon battery should work and the LED light up.