NAC Second Level Science

Skills Progression Framework

RAiSE
Raising Aspirations in Science Education

North Ayrshire Council
Comhairle Siorrachd Àir a Tuath

NAC Second Level Science Skills Progression Framework

User Guide

The Second Level Science Skills Progression Framework is a collection of investigative and inquiry activities designed to support the delivery and tracking of science skills. One activity has been included for every Second Level experience and outcome.

Each activity consists of:

- a pupil activity card
- a comprehensive teacher guide
- a risk assessment where applicable

Electronic copies of all activities and support documents can be downloaded from the NAC STEM Hub Glow tile.

Pupil activity card

This can be reproduced to provide pupils with instructions and/or spaces to record measurements and observations during the investigation.

Teacher Guide

The teacher guide contains details of experiment procedures, variables, expected outcomes, correct presentation of results and describes common misconceptions.

Example experiment report (digital resource only)

Example reports for each activity can be downloaded from the NAC STEM Hub Glow tile. Each report has been prepopulated to provide teachers and pupils with a scaffold to write experiment reports. Teachers can download the editable word document and remove the science skill the pupils are focusing on developing. E.g. Primary 5 pupils may be given an example report that has all sections completed apart from the conclusion. As they progress through second level, more sections of the report are left blank for pupils to complete. It is intended that by the end of Primary 7, or sooner if able, pupils can write a complete experiment report with minimal assistance.

Risk Assessment

Each practical activity that uses equipment or procedures not usually used in the primary classroom has an accompanying risk assessment. These risk assessments are provided to highlight safe use of equipment. Staff completing activities from this resource must assess risks unique to their own setting such as pupil behaviour and additional support needs. **In order for the risk assessment to be valid a hard copy must be printed, and hand signed.**

This resource was produced by NAC teaching staff with funding from the RAiSE programme. Raising Aspirations in Science Education (RAiSE) is a programme of The Wood Foundation, Education Scotland, Scottish Government and participating local authorities which enhances the delivery of STEM education in primary schools. The resource is designed to support progression and is not in any way prescriptive. The degree to which a school engages with the resource is entirely dependent on the curriculum needs of individual schools.

Table of Contents

Let's Investigate

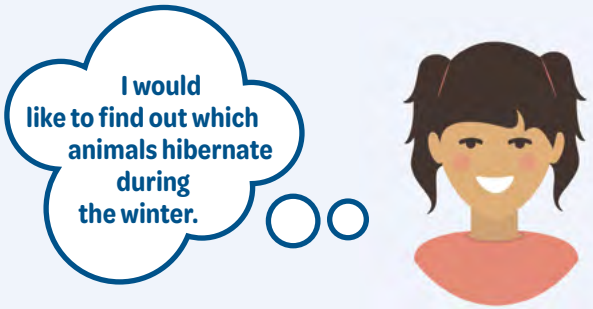
Animals Over Winter

How do animals survive through the winter?

Method

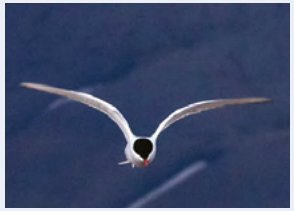
1. Collect Animals over Winter pupil sheet.
2. Working with a partner research each of the different species. Put a cross in the box to show whether they migrate, hibernate, change diet or grow a thick coat. (Some animals may do more than one!)

What do you think?

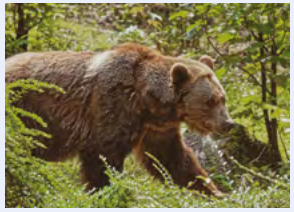


Animals Over Winter – Pupil Sheet

	Migrate	Hibernate	Change diet or store food	Grow a thick coat
 Bar headed goose				
 Grey squirrel				
 American bison				
 Stoat				

	Migrate	Hibernate	Change diet or store food	Grow a thick coat
 Arctic tern				
 Dormouse				
 Garter snake				
 Blue whale				

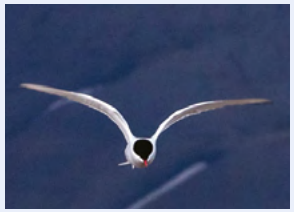
Planet Earth SCN2-01a

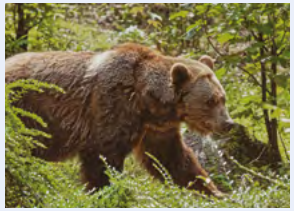
	Migrate	Hibernate	Change diet or store food	Grow a thick coat
 Arctic fox				
 Skunk				
 Brown bear				
 Swallow				

Animals Over Winter – Answers

	Migrate	Hibernate	Change diet or store food	Grow a thick coat
 Bar headed goose	✔			
 Grey squirrel			✔	
 American bison				✔
 Stoat				✔

Planet Earth SCN2-01a

	Migrate	Hibernate	Change diet or store food	Grow a thick coat
 Arctic tern	✔			
 Dormouse		✔		
 Garter snake		✔		
 Blue whale	✔			

	Migrate	Hibernate	Change diet or store food	Grow a thick coat
 Arctic fox				✔
 Skunk			✔	
 Brown bear		✔		
 Swallow	✔			

Teacher Guide: Animals over winter

SCN2-01a

- I can identify characteristics of living things and their environment which have contributed to the survival or extinction of a species.

- I can describe how some plants and animals have adapted to their environment.

This pack supports investigation into physical and behavioural characteristics of living things (both past and present) relating to survival and extinction.

Key Vocabulary:

Adaptation: the process whereby a species evolves characteristics that enable it to survive in a particular habitat.

Migrate: move from one region or area to another.

Hibernate: enter a dormant, or sleep-like, state.

Behavioural: any action an organism takes to survive in an environment.

Anatomical: are physical features of an organisms that help it survive.

Physiological: are changes to the way an organism functions in response to its environment.

temperate regions: is used to describe a climate or a place which is never extremely hot or extremely cold.

polar regions: the regions within the Arctic and Antarctic circles.

Aim:

To understand some of the adaptations that animals can adopt to survive in winter conditions.

The Big Question:

How do animals survive through the winter?

Materials (per group):

- Pupil card – Animals over Winter
- Laptops/i-Pads
- Paper
- Pens/ pencils
- PowerPoint 'Animals over winter'. Available in the digital resource or by visiting *www.stem.org.uk/rxzzs*

Lessons:

Summary

This activity is designed to introduce 7-11 year olds to some of the adaptations that animals can adopt to survive winter in temperate zones, reinforcing the concept that animals are adapted to the environment in which they live. Students will explore some of the different winter survival strategies employed by species living in temperate regions and will complete a worksheet which requires students to sort different animals according to whether they migrate, hibernate, store food or grow a thick coat in order to survive over winter. The worksheet activity is followed by a class discussion about which type of overwintering behaviour each group of species employs and why. Students are asked whether they are able to think of other species not listed which might use similar mechanisms to survive the winter.

Students will compare animals inhabiting temperate regions with two case studies of polar species which are well adapted to survive in cold environments year-round, and will identify the differences and similarities between their survival strategies. Students will be introduced to the concept that adaptations for survival may be behavioural, anatomical or physiological, and that many animals exhibit a combination of adaptations to their habitat which help them survive. To finish the session and consolidate their understanding, students will compile a case study of one of the species featured in the presentation (excluding the polar case studies), identifying and explaining the different adaptations of the species that help them survive in winter. Students will produce a poster or PowerPoint presentation to showcase the different adaptations of their case study species.

Introduction:

1. Begin by introducing the concept of how animals are adapted to survive over winter by working through the Animals over Winter PowerPoint presentation. See notes on the PowerPoint slides for further guidance and information. Please note: there are optional videos (from ARKive and external sites) in the presentation that require internet access.

2. Introduce some of the strategies that animals in temperate regions might adopt to cope with changing conditions in winter – migration, hibernation, changes in behaviour such as food caching, growing a thick coat, etc. Before moving on to the worksheet activity, elicit students' understanding of the terms 'hibernation' and 'migration'. If necessary, provide a brief explanation (e.g. migration = to move from one region to another; hibernation = to become inactive over winter). These will be covered in more detail later in the PowerPoint presentation.

Activity 1 – different types of adaptation:

1. Hand out the Animals over Winter worksheet and use it to assess students' prior understanding of the different kinds of adaptation by asking them to classify each species according to its winter survival strategy.

2. Once the students have completed the worksheet, initiate a class discussion and work together through the answers – ask why species exhibit these adaptations to winter, why different species have different adaptations and whether they can think of other species not listed that might exhibit similar adaptations.

Activity 2 – winter survival strategies:

1. Continue working through the PowerPoint presentation and build on students' understanding of winter survival strategies of temperate species (migration, hibernation, adaptations in resident species) by exploring the concepts in greater depth. Give students the opportunity to ask questions throughout and prompt them to suggest examples of other species that exhibit the adaptation being discussed.

2. Look at the two polar case studies that have examples of species that are well adapted to cold environments year-round. Encourage students to identify and list the similarities and differences between polar species and the temperate species they have discussed. Introduce the students to the idea that adaptations for survival may be behavioural, anatomical or physiological, and that many animals exhibit a combination of adaptations to their habitat which help them survive.

3. To finish the session and consolidate students' understanding, get them to compile a case study of one of the species featured in the presentation (excluding the polar case studies), identifying and explaining the different adaptations of the species that help it survive in winter. Students could produce a poster or PowerPoint presentation to showcase the different adaptations for their case study, or communicate their findings in any other suitable format for the activity (e.g. a verbal presentation, written report).

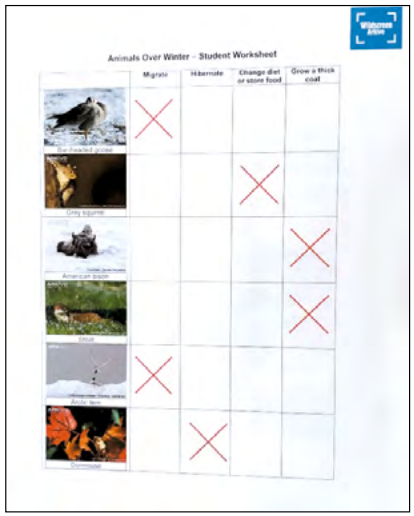
Presenting data:

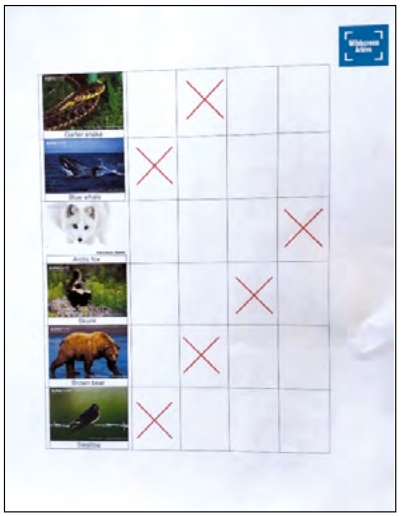
Activity 1: Complete the table from pupil worksheet

Activity 2: Results of experiments

Activity 3: Case study of chosen species – PowerPoint, poster, report, oral presentation

Activity 1: Results of table





Suggestions for extension activities:

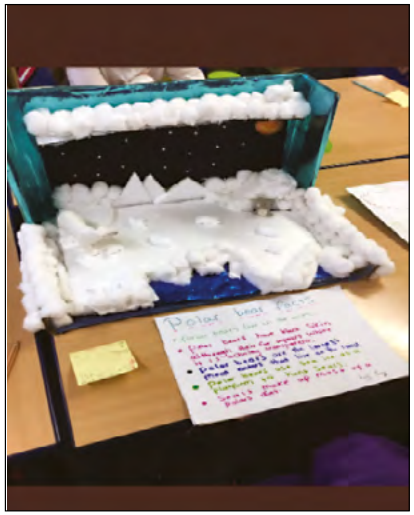
Make a winter habitat

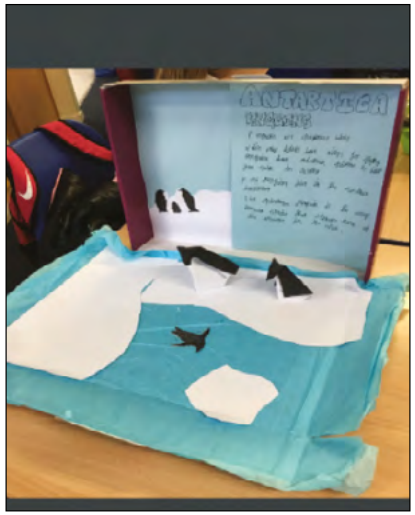
Many animals, particularly those that are less active during the colder months, find quiet, undisturbed areas to spend the winter. Making winter habitats for the species that overwinter in your local area is a great hands-on activity that will get students thinking about how different animals use different habitats within the local environment, and is a practical activity that can easily be carried out in places such as your garden, school playground, wildlife garden or playing field.

1. Identify safe, suitable sites to create the winter habitats, such as behind sheds or school buildings, in a quiet corner of the garden, etc.
2. With the class, brainstorm the different species that are found in the local area. You might also be able to take the class outdoors and make some observations 'in the field'.
3. Discuss which species found in the local area require a different habitat in the winter. Generally, the list of species might include things like small-medium mammals (hedgehogs, mice, voles, squirrels, etc.), reptiles, amphibians, small birds and invertebrates.
4. Think about the different habitats you can create and the materials you need. Ideas for habitats could include:
   a. A pile of logs – great for mini-beasts and small mammals.
   b. A pile of rocks and stones – excellent for lots of different invertebrates, reptiles and amphibians.
   c. A pile of leaves – ideal for invertebrates and some small mammals.

Create a diorama of a habitat (great homework task)

Ask pupils to work in groups to create a diorama of a chosen animal's habitat. Each design should show the environment in which the animal lives as well as what it needs to survive.





Interdisciplinary Learning:

Polar Explorer Programme from STEM learning

Polar Regions

Numeracy:

Information handling	MNU 2-20a, MNU 2-20b

Literacy:

Finding and using information	LIT 2-06a
Organising and Using information	LIT 2-26a

Adapted from

https://www.stem.org.uk/polar-explorer-educational-resources
https://www.stem.org.uk/sites/default/files/collection-pdfs/frozen-oceans-primary-booklet.pdf

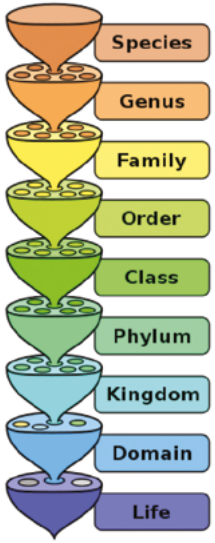
Planet Earth		SCN2-01a
Skill Organiser	**Skills**	**Addressed in Activity**
Inquiry and investigative skills	**Plans and designs scientific investigations and enquiries**	
	Formulates questions and predictions (hypotheses), with assistance, based on observations and information	✓
	Identifies the independent, dependent and controlled variables, with assistance.	✗
	Anticipates some risks and hazards.	✗
	Carries out practical activities in a variety of learning environments	
	Applies appropriate safety measures.	✓
	Contributes to carrying out all the procedures.	✓
	Makes observations and collects information and measurements using appropriate devices and units.	✓
	Manages identified controlled variables to ensure validity of results.	✗
	Analyses, interprets and evaluates scientific findings	
	Selects appropriate methods to record data/information.	✓
	Identifies relationships between the independent and dependent variables.	✗
	Makes links to original questions or predictions.	✓
	Relates findings to the wider world.	✓
	Draws basic conclusions consistent with findings.	✓
	Identifies and discusses additional knowledge and understanding gained.	✓
	Recognises anomalous results and suggests possible sources of error.	✗
	Evaluates the investigation and suggests one way of improving it if it was to be repeated.	✓
	Presents scientific findings	
	Presents data/information by choosing from an extended range of tables, charts, diagrams, graphs, including bar graphs and line graphs.	✓
	Reports collaboratively and individually using a range of methods.	✓
	Collates, organises and summarises findings, with assistance, using headings or questions to provide structure for presentations.	✓
	Uses appropriate scientific vocabulary and acknowledges sources, with assistance.	✓

Skill Organiser	Skills	Addressed in Activity
Scientific analytical thinking skills	Applies scientific analytical thinking skills, with assistance, working with less familiar (or familiar but more complex) contexts.	✓
	Applies understanding, and a combination of more than one science concept, to solve problems and provide solutions.	✓
	Demonstrates further development of creative thinking including through the engineering processes of design, construction, testing and modification.	✓
Skills and attributes of scientifically literate citizens	Presents a reasoned argument based on evidence, demonstrating understanding of underlying scientific concepts, and engages with the views of others.	✗
	Demonstrates understanding of the relevance of science to their future lives and the role of science in an increasing range of careers and occupations.	✗
	Demonstrates increased awareness of creativity and inventiveness in science, the use of technologies in the development of sciences and the impact of science on society.	✗
	Expresses informed views about scientific and environmental issues based on evidence.	✗

Let's Investigate

Classifying living things

How could you classify living things?



Exploring

1. Collect a set of Animal Classification Cards.
2. Use the Classification Branch Diagram.
3. Discuss and organise each animal according to whether they have a matching characteristic or not. Repeat for each animal. Ask the next question and discuss, then decide where they belong on the branch diagram.
4. Continue until all questions are answered.

Results

Draw your own version of a branch key and record your results inside it to show your thinking. Discuss with your classmates.

What do you think?

There are so many animals and plants. How could I sort them into groups?

What is an invertebrate?

What do turtles and birds have in common?

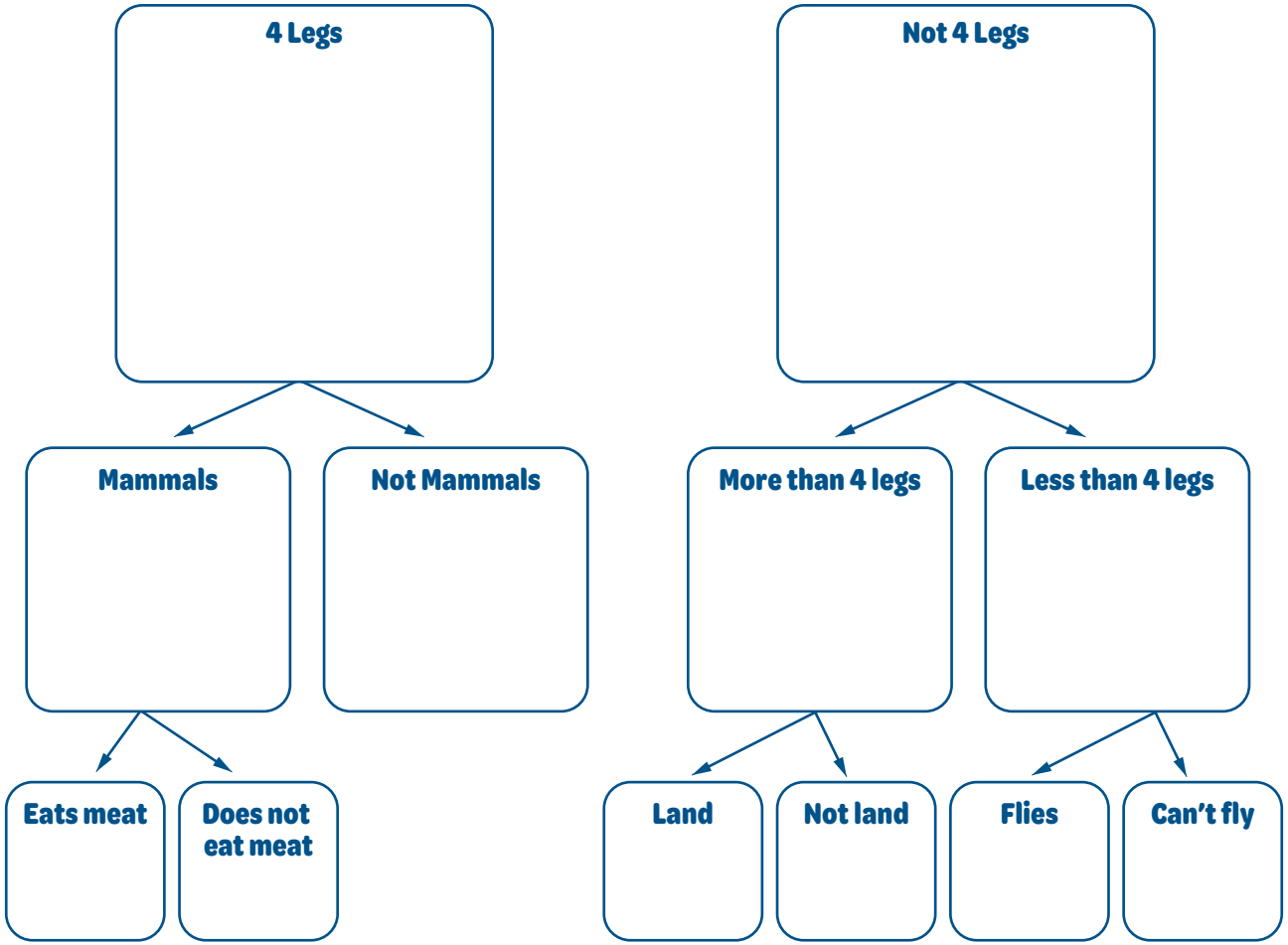
Let's Investigate

Classifying living things

Challenge

Create your own set of questions and sort the animals according to your criteria. Use yes or no statements to help you classify the creatures. Draw your own branch key and record your findings.

Branched classification key



Animal Classification cards
















Teacher Guide: Classification of living things

SCN2-01a

I can classify living things into groups through knowledge of their characteristics.

I can construct and use simple branched keys which can be used to identify particular animals.

This pack supports investigation into the identification and classification of the physical and behavioural characteristics of living things (both past and present) relating to survival and extinction.

Key Vocabulary:

Classification: the arrangement of animals and plants in taxonomic groups according to their observed similarities.

Classification Key: a means of categorising living organisms by identifying and sorting them according to common characteristics.

Physical Characteristic: attributes of an organism that are expressed by genes e.g. hair colour, leaf size.

Behavioural Characteristic: attributes of an organism that are influenced by environment e.g. birds nesting.

Kingdom: a grouping of all forms of life having certain fundamental characteristics in common (there is a five-kingdom classification system adopted by many biologists).

Vertebrate: creatures characterised by having a backbone including fish, amphibians, reptiles, birds and animals.

Invertebrate: multicellular animals that do not have a backbone.

Microorganism: an organism that is microscopic (too small to be seen by the unaided human eye).

Extinction: the death of a kind of organism or a species. Moment of extinction occurs at the death of the last individual, although the capacity to breed and recover may have been lost before this point.

Aim:

To identify, consider and classify the physical and behavioural similarities and differences of living things.

Materials (per group):

- Animal cards (laminated)
- Classification branch diagram template

Lessons:

Introduction

Introduce children to the aims of the session, discussing how they will be working on being able to classify animals based on their similarities and differences. Model to children how they can classify different animals, thinking of different questions with a yes or no answer or categories that group different animals together. Whilst doing this, recap with children different animal groups, getting them to remember what mammals are, amphibians, insects etc., discussing with children how they can then use this to help them split animals up. Whilst showing children how to do a form of classification, remind them that it is important to get them down to individual animals or in as small groups as possible. Remind children that it is important to continually consider what is similar and what is different with the group of animals they are working with so that they can continue to separate the different animals. Once children are confident with how they can classify children, explain their activities to them before setting them off on these.

Activity 1

Get children to collect the animal classification cards and using the classification branch diagram discuss and organise each of the animals depending on their characteristic. Draw own branch key in jotter with name of animal under correct heading.

Challenge

Create own set of questions and sort the animals according to your criteria.

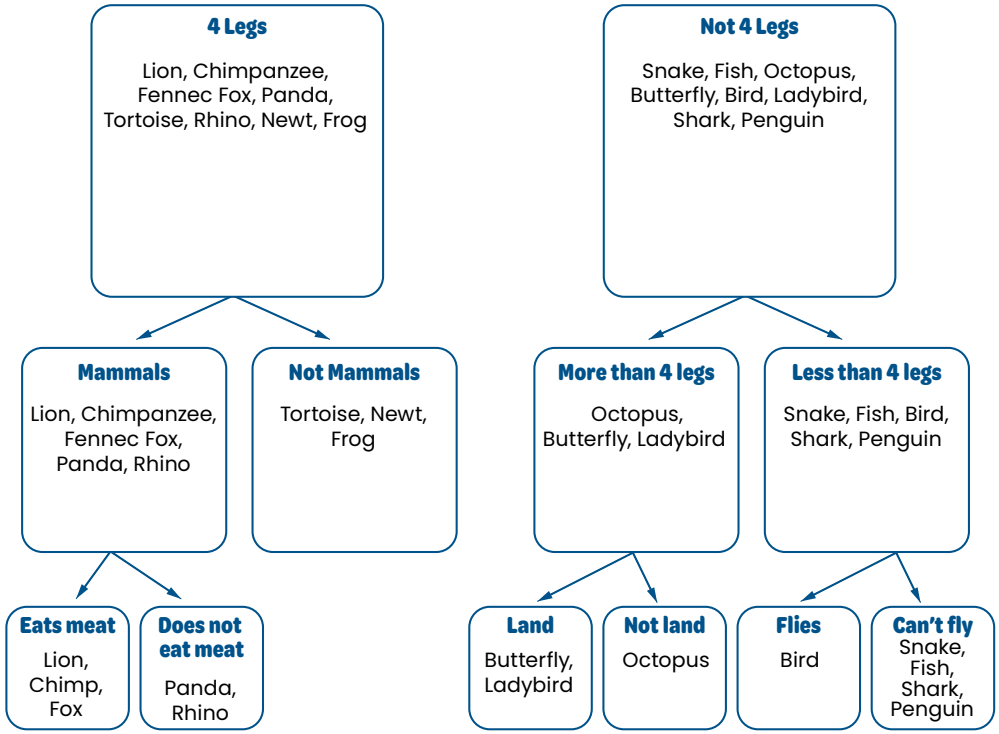
Extension

There are many other classification keys that could be used e.g. vertebrates/invertebrates and other groups through knowledge of their characteristics. It would be a useful challenge activity to have the pupils design their own key and classify animals according to their key. Classifying using yes or no questions is a good way to so this.

Presenting data:

The children should become more confident as they organise and classify animals according to similiarities and differences. Presentation of data should be made in a branch diagram, making sure they have the key included in the diagram. Presentation and explanation of their chosen criteria is a useful discussion point.

Results:



Interdisciplinary Learning:

Literacy:

Tools for listening and talking	LIT 2-02a
Finding and using information	LIT 2-06a

Skill Organiser	Skills	Addressed in Activity
Inquiry and investigative skills	**Plans and designs scientific investigations and enquiries**	
	Formulates questions and predictions (hypotheses), with assistance, based on observations and information	✗
	Identifies the independent, dependent and controlled variables, with assistance.	✗
	Anticipates some risks and hazards.	✗
	Carries out practical activities in a variety of learning environments	
	Applies appropriate safety measures.	✗
	Contributes to carrying out all the procedures.	✗
	Makes observations and collects information and measurements using appropriate devices and units.	✓
	Manages identified controlled variables to ensure validity of results.	✗
	Analyses, interprets and evaluates scientific findings	
	Selects appropriate methods to record data/information.	✓
	Identifies relationships between the independent and dependent variables.	✗
	Makes links to original questions or predictions.	✓
	Relates findings to the wider world.	✓
	Draws basic conclusions consistent with findings.	✓
	Identifies and discusses additional knowledge and understanding gained.	✓
	Recognises anomalous results and suggests possible sources of error.	✗
	Evaluates the investigation and suggests one way of improving it if it was to be repeated.	✗
	Presents scientific findings	
	Presents data/information by choosing from an extended range of tables, charts, diagrams, graphs, including bar graphs and line graphs.	✓
	Reports collaboratively and individually using a range of methods.	✓
	Collates, organises and summarises findings, with assistance, using headings or questions to provide structure for presentations.	✓
	Uses appropriate scientific vocabulary and acknowledges sources, with assistance.	✓

Planet Earth		SCN2-01a
Skill Organiser	**Skills**	**Addressed in Activity**
Scientific analytical thinking skills	Applies scientific analytical thinking skills, with assistance, working with less familiar (or familiar but more complex) contexts.	✓
	Applies understanding, and a combination of more than one science concept, to solve problems and provide solutions.	✗
	Demonstrates further development of creative thinking including through the engineering processes of design, construction, testing and modification.	✗
Skills and attributes of scientifically literate citizens	Presents a reasoned argument based on evidence, demonstrating understanding of underlying scientific concepts, and engages with the views of others.	✗
	Demonstrates understanding of the relevance of science to their future lives and the role of science in an increasing range of careers and occupations.	✗
	Demonstrates increased awareness of creativity and inventiveness in science, the use of technologies in the development of sciences and the impact of science on society.	✗
	Expresses informed views about scientific and environmental issues based on evidence.	✓

Animals of the Arctic

What do animals in the Arctic regions eat?

What do you think?

Let's Investigate

Animals of the Arctic

Method

1. Collect information sheet 1 – Arctic Life or go online to Thinglink Arctic organisms at *https://www.thinglink.com/scene/771445415118635008*.
2. Working with a partner read the information and complete the table:

   (Please note you will not be able to fill in every box based on the information sheet. It is ok to leave it blank.)

Results

Organism	What does it eat?	What eats it?	Producer or Consumer	Predator or Prey
Algae (seaweed)	energy from sun	copepods	producer	prey
Arctic Cod				
Beluga Whale				
Arctic Fox				
Clam				
Copepod				
Polar Bear				
Ringed Seal				
Walrus				

Let's Investigate

Animals of the Arctic

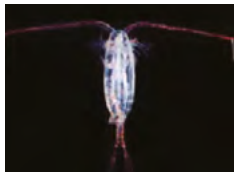
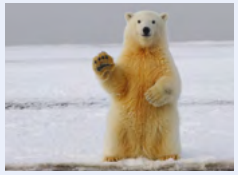
Method

3. Collect Arctic organism cards, cut them out and stick on to card.
4. On the back of each card write down some key facts about the organism.
5. Now use string and tape to link a series of cards together to show a food chain.

Challenge

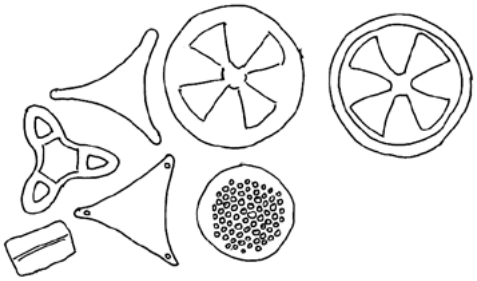
Try to link all of the cards together to show an Arctic food web mobile. Use dowelling or twigs to connect them. Look at the help sheet for ideas about a design.

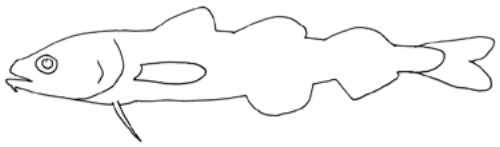
Information sheet 1 – Arctic Life

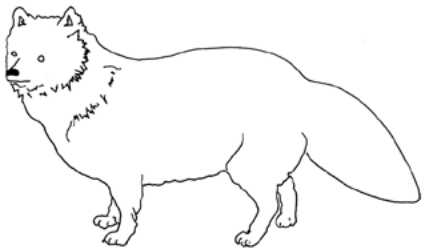
Organism	Description	Organism	Description
	**Algae (al-gee)** is the Latin name for seaweed. Algae can be green, brown or red and they perform photosynthesis like plants. Small algae are eaten by copepods. Size: microscopic – 65m long. That's from the size of a full stop up to 6 buses long		**Copepods (co-puh-pod)** are small animals that live in the sea. They are crustaceans which means they are related to lobsters and shrimps. They feed on algae and are eaten by larger animals like Arctic cod. Size: 1-5mm long. About the size of an exclamation mark!
	**Arctic foxes** are small mammals that have thick fur that changes from white in the winter to brown in the summer. They eat small mammals like lemmings as well as seal pups. Size: 50cm long. That's the same size as a medium dog.		**Polar bears** are the largest land carnivore. They spend so much time at sea hunting seals that their Latin name, Ursus maritimus, means sea bear. They have thick white fur to keep them warm. Size: up to 2.5m tall, standing on their back legs. That's about the height of a classroom.
	**Belugas (bell-loo-guh)** are small whales that hunt for fish in the Arctic waters. They are marine mammal like bump on their head which contains an organ known as the melon. echolocation' to find holes in the sea ice to come up for air. They Size: up to 5.5m long. That's about the height of a two storey house.		**Ringed seals** are a type of seal that live in the Arctic Ocean. They are a marine mammal like dolphins. They give birth on small ice floes and eat fish to survive. Size: 1.8m long. That's the length of a man lying down.
	**Clams** are a type of shellfish. They have soft bodies, so they are related to other molluscs like snails and octopus. They filter algae from the sea for food and are eaten by walruses. Size: 5 cm across. That's the width of a fizzy pop bottle.		**Walruses** are large marine mammals that are easily recognised by their tusks. They have blubber to keep them warm as they spend a lot of time diving into the cold Arctic waters to find shellfish to eat. Size: 3m long, with a mass of 1,700kg. That's the same mass as 74 seven year olds!
	**Arctic cod** are a fish that lives in the cold waters of the Arctic and around Greenland. They feed on small copepods and are eaten by animals like seals and beluga whales. Size: 30cm long. That's the length of a ruler.		

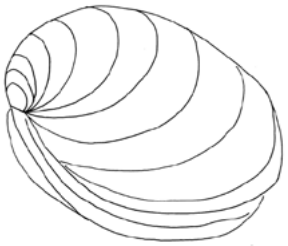
Student Sheet 1b

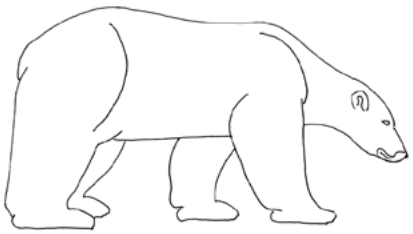
Arctic Life Cards

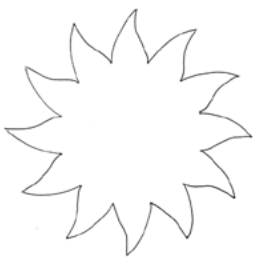


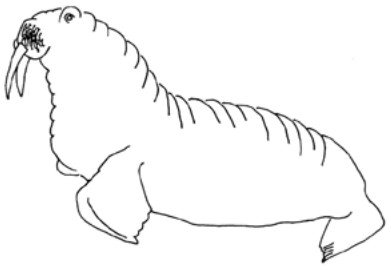












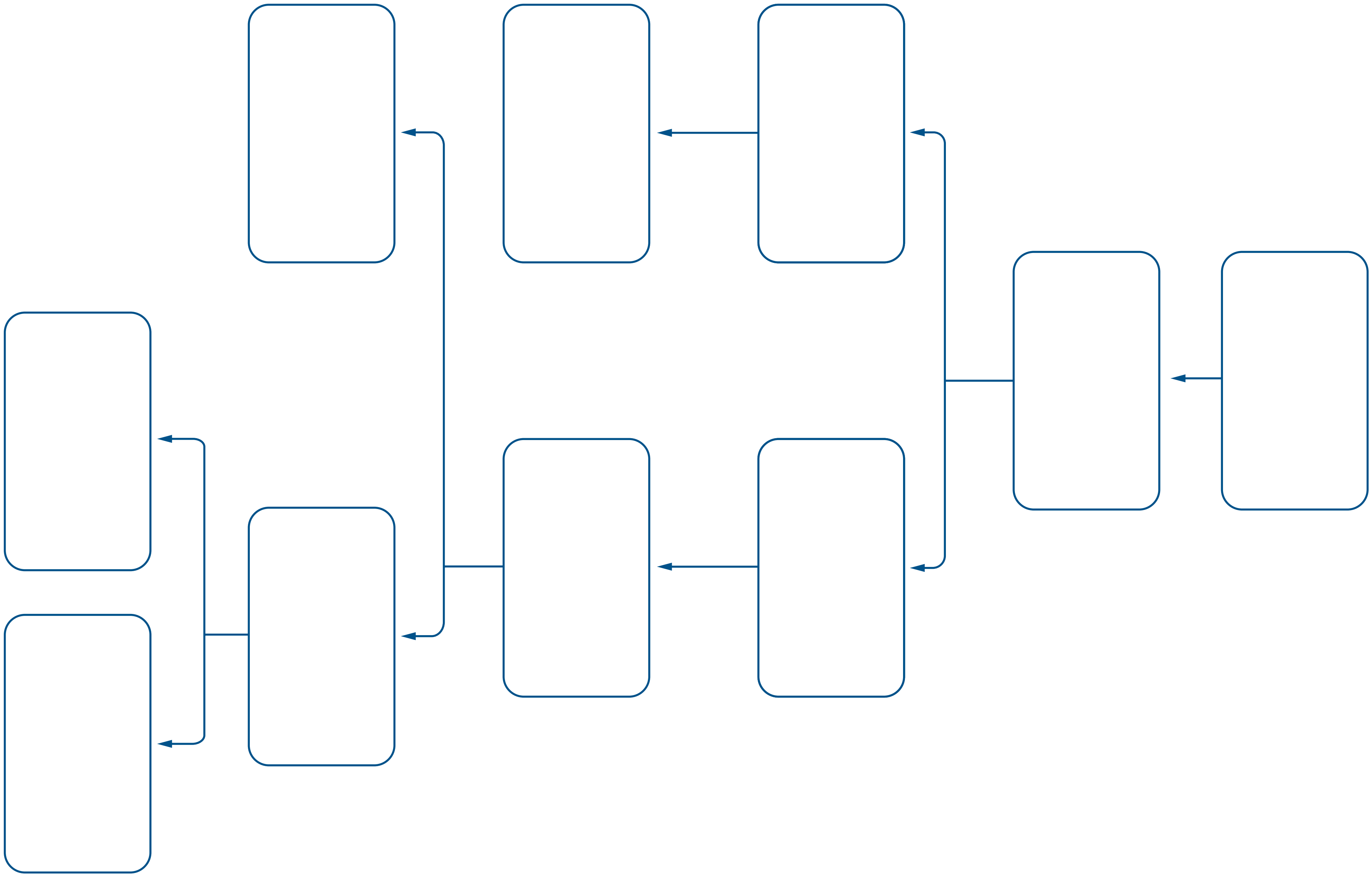
Student Sheet 1b

Arctic Life Cards

Name: Words used to describe this organism:	Name: Words used to describe this organism:
Name: Words used to describe this organism:	Name: Words used to describe this organism:
Name: Words used to describe this organism:	Name: Words used to describe this organism:
Name: Words used to describe this organism:	Name: Words used to describe this organism:
Name: Words used to describe this organism:	Name: Words used to describe this organism:

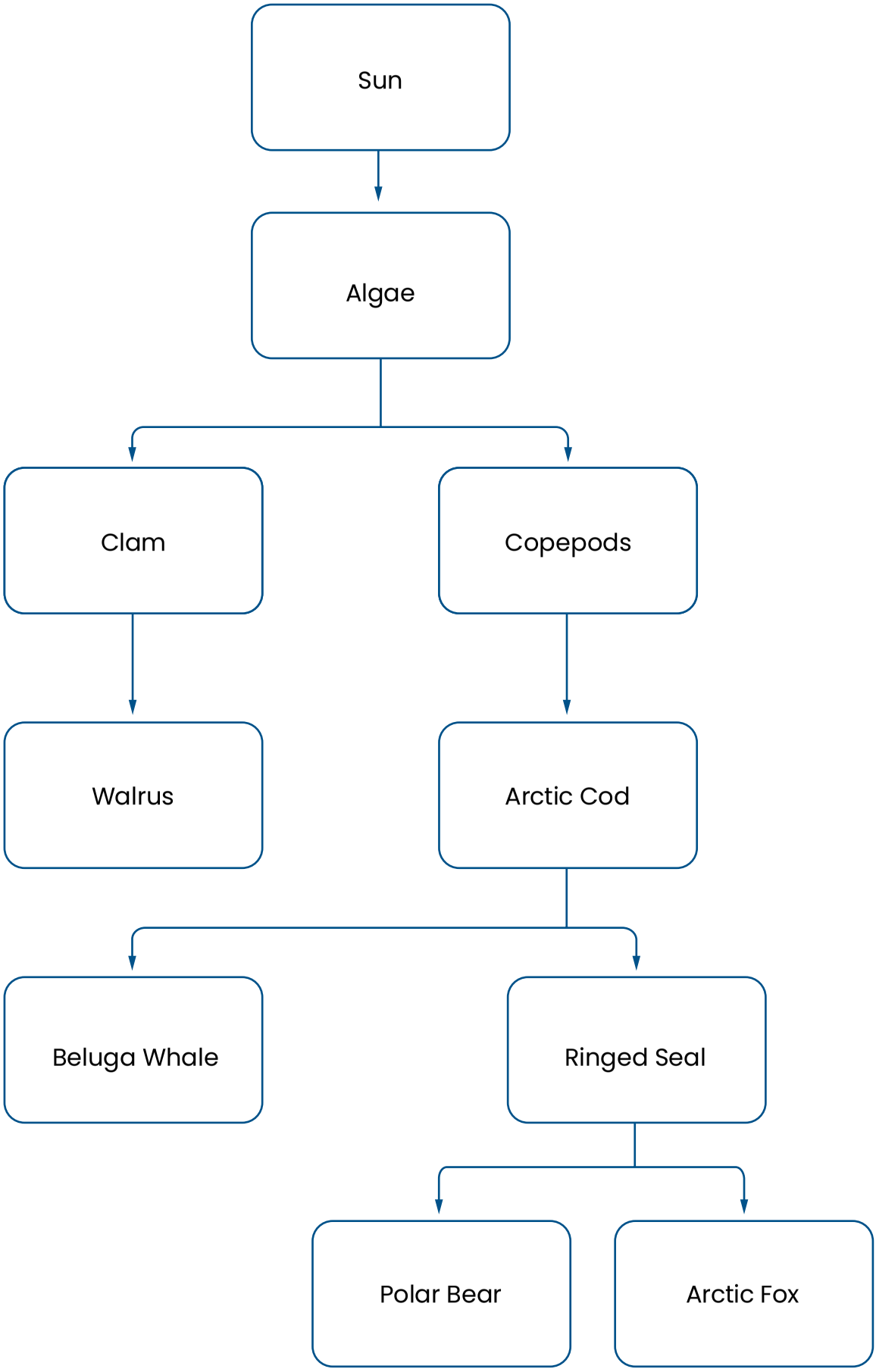
Help Sheet

Arctic Animals



Answer Sheet

Arctic Animals



Teacher Guide: Animals of the Arctic

SCN 2-02a

I can describe how energy flows between plants and animals in more complex food chains and webs and ecosystems, using vocabulary such as 'producers', 'consumers' and 'herbivore'.

Key Vocabulary:

Carnivore: animals and plants that eat animals

Herbivore: animals that eat plants

Omnivore: animal that eat both plants and other animals

Predator: an animal that hunts, kills and eats other animals

Prey: an animal that is hunted and killed by another for food

Producer: an organism usually a green plant or bacterium

Consumer: feeds on animals or plants for energy

Aim:

To develop an understanding of simple food chains or webs.

The Big Questions:

What do different animals in the Arctic regions eat?

Do all animals eat similar things?

Materials:

Pupil card – Arctic Animals

Arctic Organism cards

Dowelling/ sticks

Scissors

Information sheet – Arctic Life

Card

Tape

Help sheet

String

Glue stick

PowerPoint: – 'What organisms live in the Arctic?'

Staff can find this in the digital resource or by visiting *https://www.stem.org.uk/rx4tn9*

Lessons:

Introduction

Show the children the key question from slide 1. Can they guess the missing words from the key question? (Organisms and rely) Read the outcomes on slide 2 and ask the children to show what they can already do. Show children the location of the Arctic on slide 3 and read the topic brief from Dr Ceri Lewis on slide 4 to put the lesson into context.

Activity 1 – Researching Arctic organisms

Show the children the Thinglink on the board. As you roll over the red dots, boxes pop out with more information. Demonstrate picking out the key information from the pop-outs to help children complete their worksheet. Children then use the Thinglink or information sheet if not online, to conduct their research. Children complete pupil card – Animals of the Arctic. Take feedback from the class to check for misconceptions.

Presenting data Activity 1

Complete the table

Results of table

Organism	What does it eat?	What eats it?	Producer or Consumer	Predator or Prey
Algae (seaweed)	energy from sun	copepods	producer	prey
Arctic Cod	copepods	seals, beluga whales	consumer	prey
Arctic Fox	small mammals – lemmings, seal pups		consumer	predator
Beluga Whale	fish – arctic cod		consumer	predator
Clam	algae	walruses	consumer	prey
Copepod	algae	arctic cod	consumer	prey
Polar Bear	Seals		consumer	predator
Ringed Seal	fish – arctic cod	polar bear, arctic fox	consumer	predator/ prey
Walrus	Shellfish, clams		consumer	Predator

*Note that top predators have the 'What eats it?' box empty.

Use results from table to construct a food chain mobile.

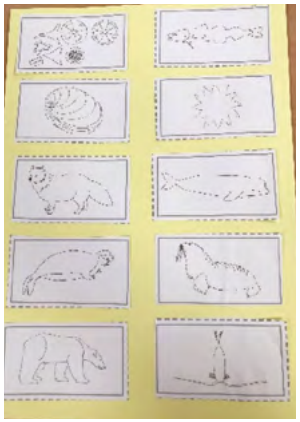
Activity 2

Use slides 7 to 9 to explain how to construct food webs. (Arrows must point in the direction of food flow) Using slide 10 recap the learning outcomes and ask children to draw a food chain. The children use slide 11 to assess themselves.

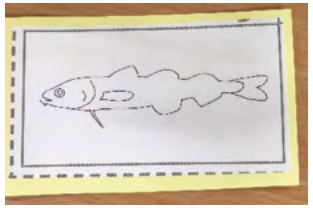
Presenting data Activity 2

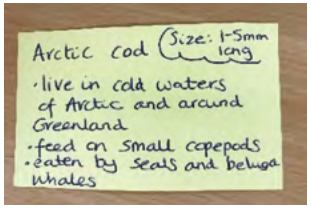
An example of a food chain and steps to make it

Step 1 – cut out and stick on to card.

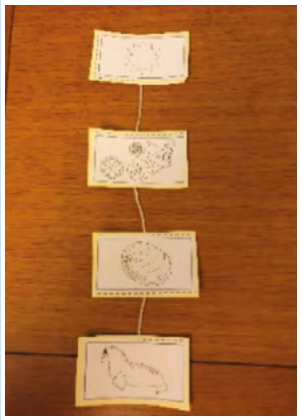


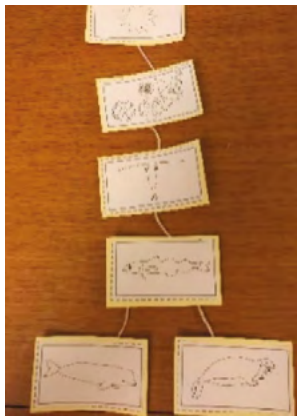
Step 2 – cut out and stick on to card.





Step 3 – Connect different organisms together using string and tape depending on what they eat and what eats them (below are examples of 3 different levels of difficulty).



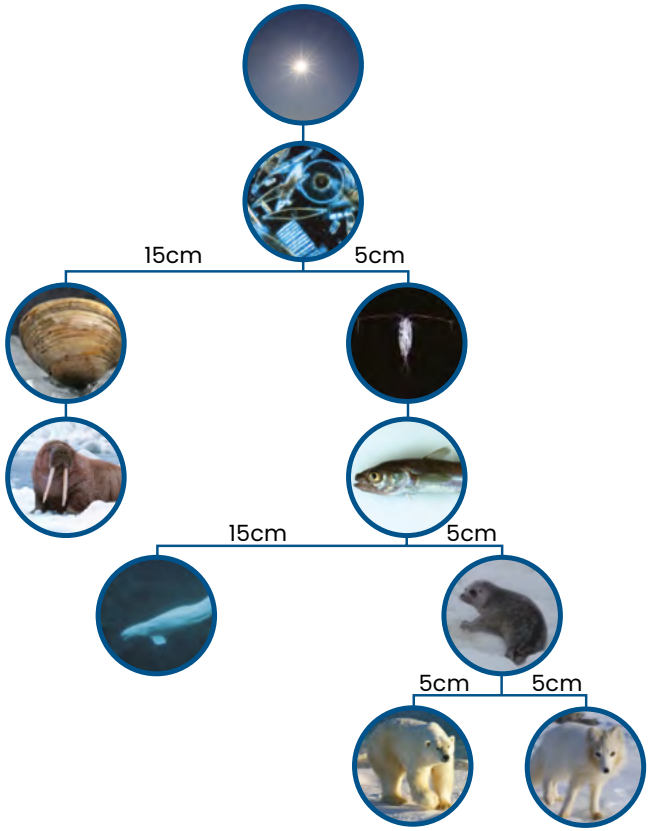


Challenge

To make a food web using all of the cards.

For this pupils will be required to connect all of the cards together using their own design.

Completed Design:



Interdisciplinary Learning:

Polar Explorer Programme from STEM learning

Polar Regions

Numeracy:

Information handling: MNU 2-20a

Literacy:

Finding and using information: LIT 2-06a

Organising and Using information: LIT 2-26a

Adapted from *https://www.stem.org.uk/polar-explorer-educational-resources*

https://www.stem.org.uk/sites/default/files/collection-pdfs/frozen-oceans-primary-booklet.pdf

Skill Organiser	Skills	Addressed in Activity
Inquiry and investigative skills	**Plans and designs scientific investigations and enquiries**	
	Formulates questions and predictions (hypotheses), with assistance, based on observations and information	✓
	Identifies the independent, dependent and controlled variables, with assistance.	✗
	Anticipates some risks and hazards.	✗
	Carries out practical activities in a variety of learning environments	
	Applies appropriate safety measures.	✓
	Contributes to carrying out all the procedures.	✓
	Makes observations and collects information and measurements using appropriate devices and units.	✓
	Manages identified controlled variables to ensure validity of results.	✗
	Analyses, interprets and evaluates scientific findings	
	Selects appropriate methods to record data/information.	✓
	Identifies relationships between the independent and dependent variables.	✗
	Makes links to original questions or predictions.	✓
	Relates findings to the wider world.	✓
	Draws basic conclusions consistent with findings.	✓
	Identifies and discusses additional knowledge and understanding gained.	✓
	Recognises anomalous results and suggests possible sources of error.	✗
	Evaluates the investigation and suggests one way of improving it if it was to be repeated.	✓
	Presents scientific findings	
	Presents data/information by choosing from an extended range of tables, charts, diagrams, graphs, including bar graphs and line graphs.	✗
	Reports collaboratively and individually using a range of methods.	✗
	Collates, organises and summarises findings, with assistance, using headings or questions to provide structure for presentations.	✓
	Uses appropriate scientific vocabulary and acknowledges sources, with assistance.	✓

Planet Earth SCN2-02a

Skill Organiser	Skills	Addressed in Activity
Scientific analytical thinking skills	Applies scientific analytical thinking skills, with assistance, working with less familiar (or familiar but more complex) contexts.	✓
	Applies understanding, and a combination of more than one science concept, to solve problems and provide solutions.	✗
	Demonstrates further development of creative thinking including through the engineering processes of design, construction, testing and modification.	✓
Skills and attributes of scientifically literate citizens	Presents a reasoned argument based on evidence, demonstrating understanding of underlying scientific concepts, and engages with the views of others.	✗
	Demonstrates understanding of the relevance of science to their future lives and the role of science in an increasing range of careers and occupations.	✗
	Demonstrates increased awareness of creativity and inventiveness in science, the use of technologies in the development of sciences and the impact of science on society.	✗
	Expresses informed views about scientific and environmental issues based on evidence.	✗

Let's Investigate

Useful plants

What is the most useful plant?

Task:

Your teacher will assign your group one of the plants below to research. You must find out what it is used for and how it benefits society. You will need to find facts and arguments that will convince the rest of the class that your plant is the most beneficial plant to humans!

Willow

Rice

Rubber

Corn

Cocoa

Cotton

Wheat

Sugar cane

You can present your facts and arguments as a poster or PowerPoint presentation. Make sure you include a reference to your source of information.

What do you think?

Plants that give us food are the most useful!

Do some medicines come from plants?

Plants that give us building materials and textiles are the most useful!

Teacher Guide: Useful plants

SCN 2-02b:

Through carrying out practical activities and investigations, I can show how plants have benefited society.

This task develops scientific and analytical thinking skills, research skills and speaking and listening skills through the context of beneficial plants. Pupils work in groups to research a plant and its uses and compete 'head to head' with other groups to convince the audience the plant they have researched is the most useful. It is a knockout competition until only one plant remains and is crowned the most useful plant to humankind!

The suggested list of plants is a guide, an editable copy of the pupil card is available allowing staff to make changes to the 8 suggested plants to reflect pupil interest or topics of study.

A useful website that details the general benefits of plants is The Woodland Trust – 'Why plants are important.' *https://www.woodlandtrust.org.uk/blog/2018/04/why-plants-are-important/*

How to:

Introduce the task as described above as a knockout competition that relies on the pupils' research skills and their ability to persuade an audience. During the research phase, encourage pupils to find out world production figures for each plant, its different uses and the impact it has on our daily lives. Staff may also like to do mini-debates and encourage pupils to complete research to discredit other plants.

Once pupils have completed their research, pupils should prepare a 1-2 minute presentation for the class. There is an opportunity here to create a PowerPoint or poster to display information. Display the knockout league table (included below) and start the presentations. At the end of each pair of presentations the class should vote on which is the most beneficial plant. This proceeds to the next round. The process is repeated until 1 plant is deemed to be the most beneficial plants for humans.

Useful information:

During the research phase, staff may wish to direct pupils to the following facts:

Plant	Uses	Facts and figures	Disadvantages
Rice	World population's biggest source of carbohydrate.	700million tonnes produce annually. Over half of the world's population depend on rice for more than 20% of their daily calories.	Rice Paddies release methane which is a harmful greenhouse gas.
Wheat	Major food source. Flour for bread. Fermented to make beer.	It is the primary source of calories for low and middle income economies in the world. By 2050, demand for wheat in developing countries will increase by 60%.	Requires large areas to grow crops. Causes loss of habitat.
Sugar Cane	Source of Sugar Biomass for energy production. Ethanol as a carbon neutral fuel.	180 million tonnes produced globally. Ethanol Fuel from sugar cane releases 90% less Carbon Dioxide than petrol and diesel.	Requires large areas to grow crops. Causes loss of habitat.
Corn	Food source Animal feed Ethanol as a carbon neutral fuel.	Over 1 billion tonnes of corn are produced globally each year.	Requires large areas to grow crops. Causes loss of habitat.
Rubber	Thousands of rubber products. Tyres, medical equipment, industrial equipment.	3 billion rubber tyres are sold each year.	Requires large areas to grow crops. Causes loss of habitat.
Willow	Original source of Aspirin	Approximately 20 million Kgs of aspirin are produced annually.	Aspirin is now produced commercially without use of the willow tree. Is Willow still a useful plant?
Cotton	Textiles – Clothing	29 million tons of cotton is produced each year. = 29 t-shirts for every person on earth.	Uses lots of water. Loss of habitat. Pesticides are used. Reports of child labour in some countries.
Cocoa plant	Used to make chocolate. Husks can be used for animal feed.	Over 5 million tonnes of cocoa beans produced each year. 7.7million tonnes of chocolate is consumed each year.	Land clearing, deforestation, loss of habitat.

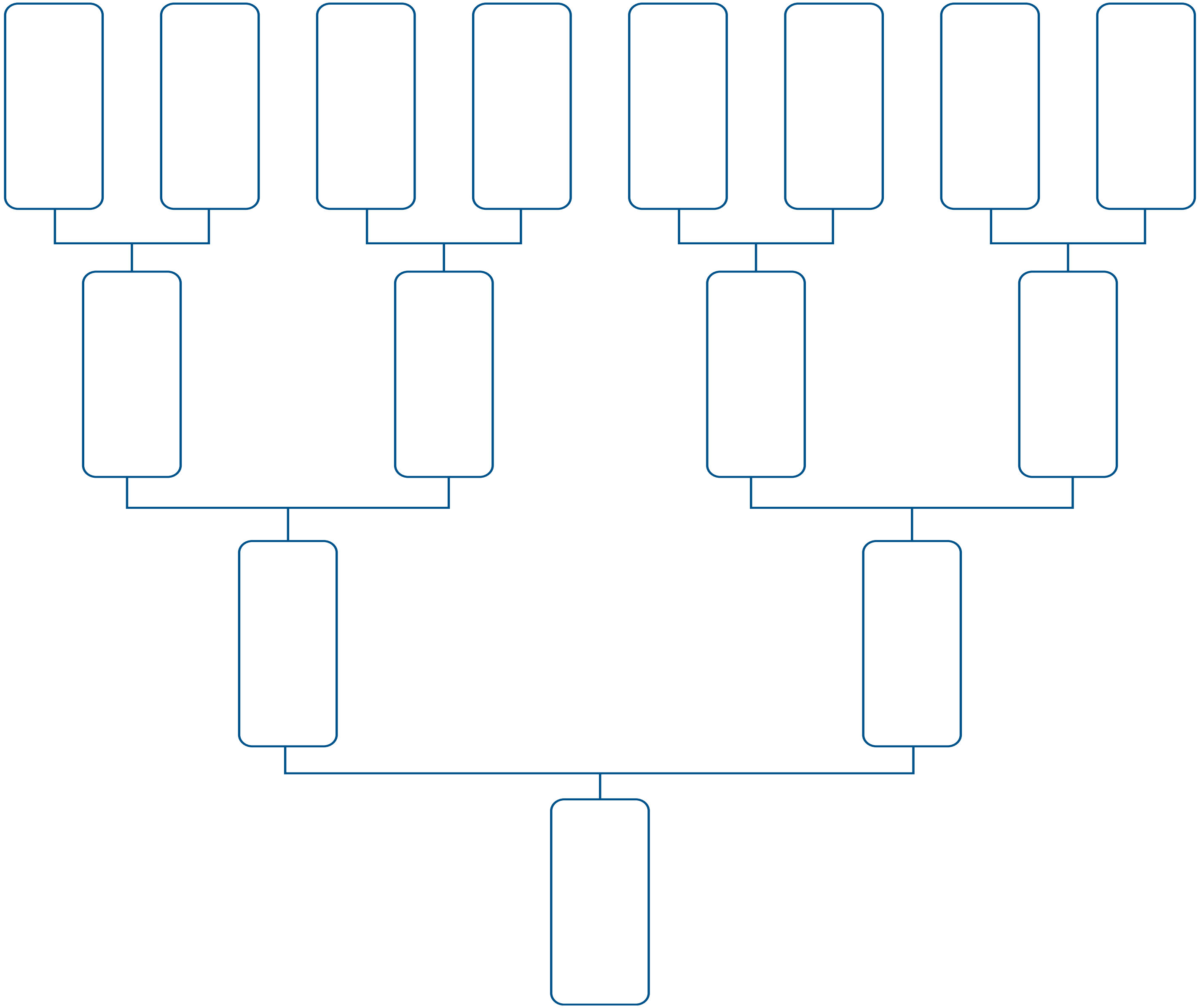
Useful Research questions:

What are the uses of your plant? How much of your plant is produced each year?

Persuasive Arguments:

What makes your plant more essential that the others on the list? What would life be like without your plant?

Knockout competition table



Interdisciplinary Learning:

Literacy and English:

Tools for listening and talking	LIT 2-02a, LIT 2-03a
Understanding, analysing and evaluating	LIT 2-07a, LIT 2-08a
Creating Texts (listening and talking)	LIT 2-09a, LIT 2-10a
Tools for Writing	LIT 2-23a
Creating texts (writing)	LIT 2-28a

Digital Literacy:

Using digital products and services	TCH 2-01a
Searching, processing and managing information	TCH 2-02a

Planet Earth		SCN2-02b
Skill Organiser	**Skills**	**Addressed in Activity**
Inquiry and investigative skills	**Plans and designs scientific investigations and enquiries**	
	Formulates questions and predictions (hypotheses), with assistance, based on observations and information	✗
	Identifies the independent, dependent and controlled variables, with assistance.	✗
	Anticipates some risks and hazards.	✗
	Carries out practical activities in a variety of learning environments	
	Applies appropriate safety measures.	✗
	Contributes to carrying out all the procedures.	✗
	Makes observations and collects information and measurements using appropriate devices and units.	✗
	Manages identified controlled variables to ensure validity of results.	✗
	Analyses, interprets and evaluates scientific findings	
	Selects appropriate methods to record data/information.	✓
	Identifies relationships between the independent and dependent variables.	✗
	Makes links to original questions or predictions.	✗
	Relates findings to the wider world.	✓
	Draws basic conclusions consistent with findings.	✗
	Identifies and discusses additional knowledge and understanding gained.	✓
	Recognises anomalous results and suggests possible sources of error.	✗
	Evaluates the investigation and suggests one way of improving it if it was to be repeated.	✗
	Presents scientific findings	
	Presents data/information by choosing from an extended range of tables, charts, diagrams, graphs, including bar graphs and line graphs.	✗
	Reports collaboratively and individually using a range of methods.	✓
	Collates, organises and summarises findings, with assistance, using headings or questions to provide structure for presentations.	✓
	Uses appropriate scientific vocabulary and acknowledges sources, with assistance.	✓

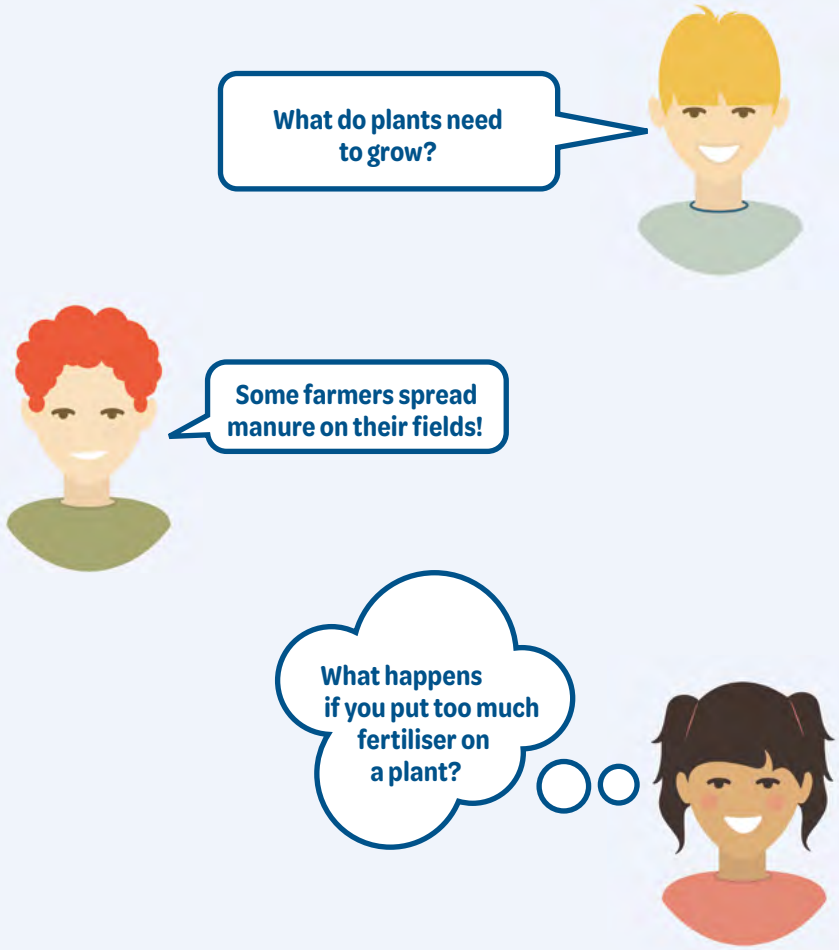
Skill Organiser	Skills	Addressed in Activity
Scientific analytical thinking skills	Applies scientific analytical thinking skills, with assistance, working with less familiar (or familiar but more complex) contexts.	✓
	Applies understanding, and a combination of more than one science concept, to solve problems and provide solutions.	✗
	Demonstrates further development of creative thinking including through the engineering processes of design, construction, testing and modification.	✗
Skills and attributes of scientifically literate citizens	Presents a reasoned argument based on evidence, demonstrating understanding of underlying scientific concepts, and engages with the views of others.	✓
	Demonstrates understanding of the relevance of science to their future lives and the role of science in an increasing range of careers and occupations.	✓
	Demonstrates increased awareness of creativity and inventiveness in science, the use of technologies in the development of sciences and the impact of science on society.	✓
	Expresses informed views about scientific and environmental issues based on evidence.	✓

Let's Investigate

Fertilisers & Plant Growth

Investigating the effect of fertilisers on plant growth

What do you think?



Let's Investigate

Fertilisers & Plant Growth

Method

1. Add 20cm^3 of water cup A.
2. Add 20cm^3 of water to cup B and 1 drop of Baby Bio®.
3. Add 20cm^3 of water to cup C and 10 drops Baby Bio®.
4. Add 20cm^3 of water to cup D and 20 drops Baby Bio®.
5. Put duckweed plants into each cup.
6. Count the number of leaves in each cup. Record appearance (e.g. colour).
7. Leave cups in a well-lit, warm place.
8. After one week count the number of leaves in each cup and record appearance.

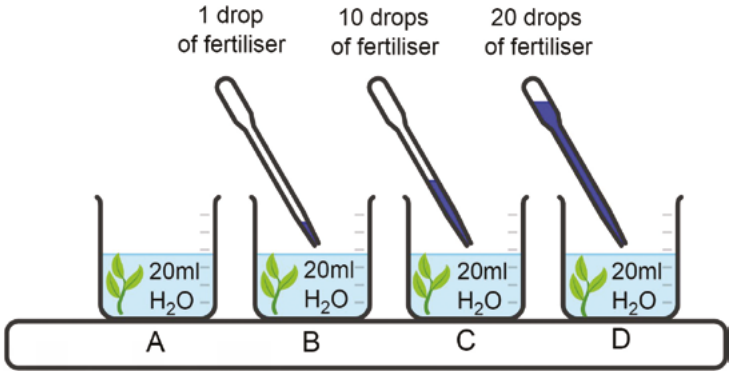


Image courtesy of chemix.org

Results

Cup	Appearance of the plants	Number of Drops of Baby Bio®	Number of leaves at start	Number of leaves after a week	Change in number of leaves
A					
B					
C					
D					

Teacher Guide: Investigating the effect of fertilisers on plant growth

SCN 2-03a

I have investigated the effects of fertilisers on the growth of plants. I can talk about the risks and benefits of their use.

Background:

Fertilisers contain the mineral nutrients needed by plants. Fertilisers help plants to grow and are used by farmers, horticulturalists and gardeners. All plants need elements, including nitrogen to make proteins, magnesium to make chlorophyll and a range of other elements such as potassium for protein synthesis and phosphorous for membranes and DNA. These are essential for the plant to make the compounds it needs. Without these the plant would be unhealthy and growth would be affected. Using fertilisers, farmers can increase the yield of their crops which means they can feed more people. Fertilisers also improve the soil texture. It replaces nutrients that are lost from the environment when plants are removed during harvest.

Farmers have to replace the minerals in the soil after they have harvested their food crop.

They add fertilisers before planting a new crop. They can choose to add natural fertilisers or artificial fertilisers.

Natural Fertilisers:

Green manure

'Green' manure is the remains of plants. Farmers grow plants such as clover in a field before ploughing it in and planting their next crop.

This is because clover is one of those lucky plants which have root nodules (lumps on their roots full of bacteria) and so can make their own supply of nitrates without having to wait for the action of the decomposers.

Ploughing in the 'green manure'

Animal manure

Farmers collect urine and faeces from their farm animals. They mix it with water to make slurry and spray it over the farm land. The decomposers (bacteria and fungi) break it down to make nitrates to feed the new food crop which the farmer plants.

Artificial Fertilisers:

Artificial fertilisers are chemicals which are manufactured and bought by farmers.

Most are solid – crystals or pellets – which dissolve in rain.

Liquid fertilisers are diluted in water and sprayed over the fields.

Problems caused by Fertilisers in the Environment:

Fertilisers are being washed out of fields and getting into rivers and lakes. This means that there are lots more nutrients in the water, particularly nitrates and phosphates. The additional nutrients results in increased algal growth.

The algae cover the surface of the water, blocking light from reaching other life in the water. Plants die because they have no light and organisms die because there are no plants to eat.

The algae and other organisms die and are broken up by bacteria. The bacteria increase more than usual because there is so much dead material for them to feed on. When the bacteria grow, they use up oxygen in the water. This means that other organisms die from lack of oxygen.

This problem for the environment is sometimes called **eutrophication**.

Children swim in a river affected by 'algal bloom'

Lobsters, starved of oxygen, are washed up on the shore.

Key Vocabulary:

Fertilisers: Provide nutrients needed for healthy plant growth.

Algal Bloom: An increase in algal growth in water ways.

Eutrophication: Water pollution due to fertilisers entering waterways and causing an algal bloom.

Aim:

To investigate how fertilisers affect plant growth.

Independent Variable (the variable that is changing):

Concentration of fertiliser (number of drops).

Dependent Variable (the variable that is measured):

Number of leaves.

Control Variables:

Volume of water

Type of plant

Number of plants.

Materials (per group):

4 plastic cups (clear)

distilled water

Liquid fertiliser (Baby Bio®)

measuring cylinder

dropper or syringe.

3-4 Duckweed plants (local garden centre will stock these)

Method:

1. Add 20cm^3 of water cup A.
2. Add 20cm^3 of water to cup B and 1 drops Baby Bio®.
3. Add 20cm^3 of water to cup C and 10 drops Baby Bio®.
4. Add 20cm^3 of water to cup D and 20 drops Baby Bio®.
5. Put duckweed plants into each cup.
6. Count the number of leaves in each cup. Record appearance (e.g. colour).
7. Leave cups in a well-lit, warm place.
8. After one week count the number of leaves in each cup and estimate the growth of the duckweed. Again, record appearance.

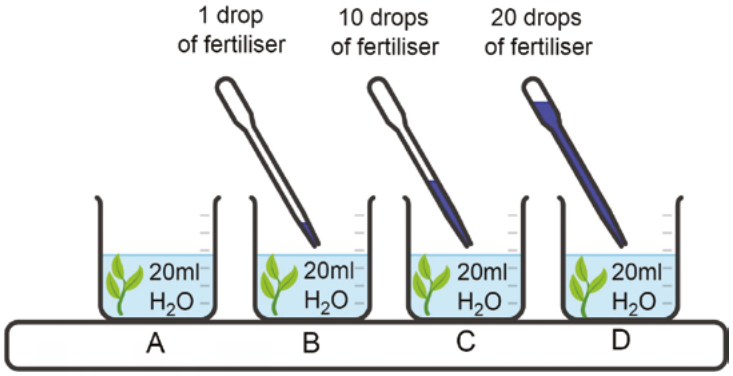


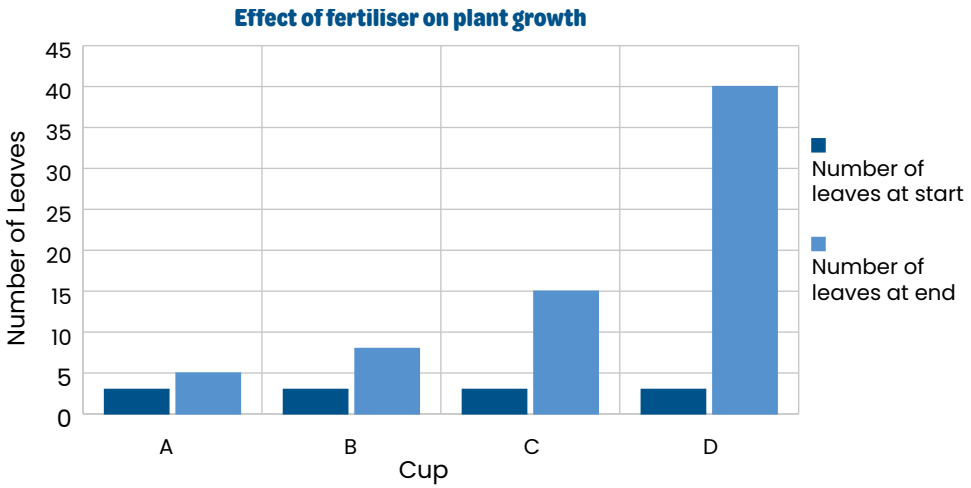
Image courtesy of chemix.org

Results:

Cup	Appearance of the plants	Number of Drops of Baby Bio® (independent variable)	Number of leaves at start (independent variable)	Number of leaves after a week (independent variable)	Change in number of leaves (independent variable)
A	Water clear not much growth	0	3	5	2
B	More growth than cup A, still able to see through the water	1	3	8	5
C	Lots of plants, still able to see through the water	10	3	15	12
D	Water discoloured hard to see through	20	3	40	37

Presenting data:

This can be presented as a bar graph showing the number of leaves in each cup at the start and end of the experiment. Expected results will show a pattern similar to bar chart below.



Conclusion:

For expected results:

The conclusion should state the trend shown in the results. E.g. As the concentration of fertiliser increases the number of plants increased.

For unexpected results:

At level 2, if there is no trend, an answer to the aim is sufficient.

At level 3 and above, a conclusion should state that no trend has been shown.
E.g. The results do not show a trend with concentration and plant growth. This can be used to extend more able pupils.

Evaluation:

Are there any common errors that would affect the results?

- the volume of the drops could not be measured.

Are there any alternative methods that would give more accurate results?

- using a syringe to add the fertiliser would improve the accuracy of the experiment.

Interdisciplinary Learning:

Numeracy:

Data and Analysis	MNU1-20b, MTH 1-21a, MNU 2-20b, MTH 2-21a

for the more able you could ask them to calculate the percentage change in number of leaves. ((number of leaves after a week /number of leaves at the start) x100)

Literacy:

Tools for Writing	LIT 2-23a
Creating texts (writing)	LIT 2-28a

Planet Earth

SCN2-03a

Skill Organiser	Skills	Addressed in Activity
Inquiry and investigative skills	**Plans and designs scientific investigations and enquiries**	
	Formulates questions and predictions (hypotheses), with assistance, based on observations and information	✓
	Identifies the independent, dependent and controlled variables, with assistance.	✓
	Anticipates some risks and hazards.	✓
	Carries out practical activities in a variety of learning environments	
	Applies appropriate safety measures.	✓
	Contributes to carrying out all the procedures.	✓
	Makes observations and collects information and measurements using appropriate devices and units.	✓
	Manages identified controlled variables to ensure validity of results.	✓
	Analyses, interprets and evaluates scientific findings	
	Selects appropriate methods to record data/information.	✓
	Identifies relationships between the independent and dependent variables.	✓
	Makes links to original questions or predictions.	✓
	Relates findings to the wider world.	✓
	Draws basic conclusions consistent with findings.	✓
	Identifies and discusses additional knowledge and understanding gained.	✓
	Recognises anomalous results and suggests possible sources of error.	✓
	Evaluates the investigation and suggests one way of improving it if it was to be repeated.	✓
	Presents scientific findings	
	Presents data/information by choosing from an extended range of tables, charts, diagrams, graphs, including bar graphs and line graphs.	✓
	Reports collaboratively and individually using a range of methods.	✓
	Collates, organises and summarises findings, with assistance, using headings or questions to provide structure for presentations.	✓
	Uses appropriate scientific vocabulary and acknowledges sources, with assistance.	✓

Skill Organiser	Skills – Fertilisers	Addressed in Activity
Scientific analytical thinking skills	Applies scientific analytical thinking skills, with assistance, working with less familiar (or familiar but more complex) contexts.	✓
	Applies understanding, and a combination of more than one science concept, to solve problems and provide solutions.	✗
	Demonstrates further development of creative thinking including through the engineering processes of design, construction, testing and modification.	✗
Skills and attributes of scientifically literate citizens	Presents a reasoned argument based on evidence, demonstrating understanding of underlying scientific concepts, and engages with the views of others.	✗
	Demonstrates understanding of the relevance of science to their future lives and the role of science in an increasing range of careers and occupations.	✗
	Demonstrates increased awareness of creativity and inventiveness in science, the use of technologies in the development of sciences and the impact of science on society.	✗
	Expresses informed views about scientific and environmental issues based on evidence.	✓

Planet Earth SCN2-03a

Risk Assessment

Task/Activity/Process Description	Investigating fertilisers	**Service**	Communitites
Location	School Name	**Reference**	To be completed by school

Types of Injury/Loss/Ill Health	possible skin and eye irritation

For each hazard, please identify the person at risk (direct and indirect)
Consider those especially vulnerable (young or inexperienced workers, members of the public, school pupils, the elderly, residents and contractors)
NOTE: New and expectant mothers require a separate risk assessment

Haz No.	Hazard	Source of Hazard	Persons at Risk	Current Control Measures in Place	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Risk Rating (1-25)
1	Chemicals	Liquid plant food/fertiliser	Employee/Pupil	Safety goggle must be worn. Pipettes/droppers must be used to transfer the fertiliser to the plant cups. Staff should be provide groups with a small amount of fertiliser to minimise an spills. Students should not be handling the bottle of fertiliser. Instructions for safe use should be followed as directed on the label.	1	1	1
2	Slip/Trip/Fall	spilled water	Employee/Pupil	Paper towel available to clean spills. This experiment can be performed in a tote tray to catch any spills.	2	2	4
3	Slip/Trip/Fall	Classroom furniture	Employee/Pupil	Chairs should be tucked neatly under desks, pupil movement should be managed.	1	2	2
4	Other (please identify)	Pupil behavior		School to complete			0
5	Other (please identify)	Pupil additional needs		School to complete			0
6							0
7							0
8							0
9							0
10							0
11							0
12							0
13							0
14							0

Risk Reduction

Haz No.	Additional Control Measures	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Final Risk Rating (1-25)	Action By (name and target date)	Date Control Implemented	Sign to Confirm
1	As low as reasonably possible			0			
2	As low as reasonably possible			0			
3	As low as reasonably possible			0			
4	As low as reasonably possible			0			
5	As low as reasonably possible			0			
6				0			
7				0			
8				0			
9				0			
10				0			
11				0			
12				0			
13				0			
14				0			

Assessor(s) Name (print)	Assessment Date	Manager Name (print)

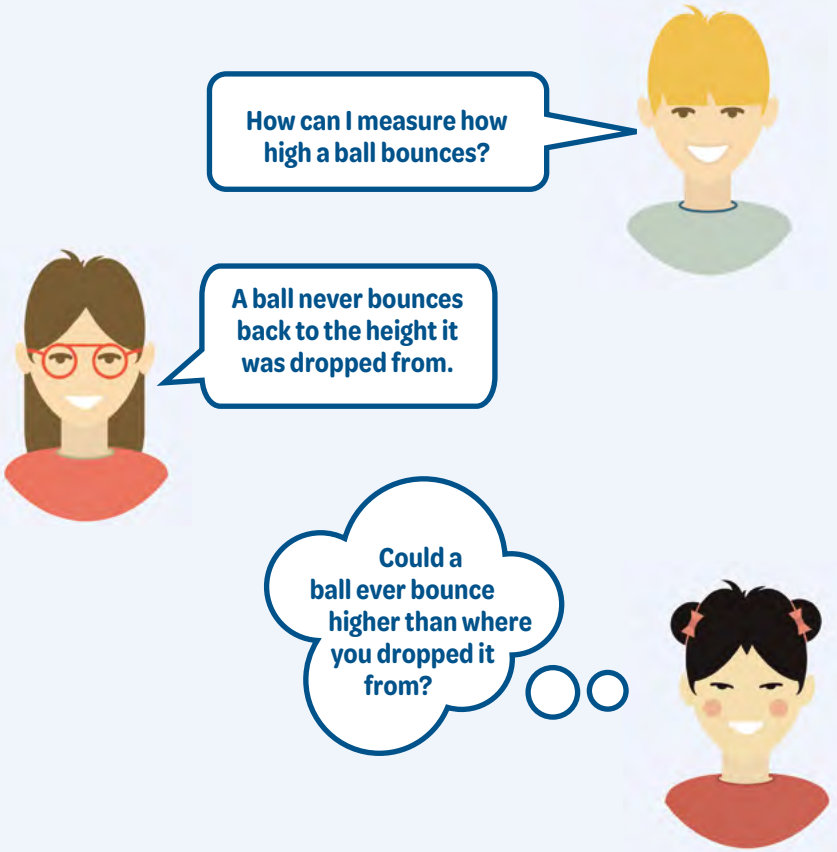
Assessor(s) Signature	Review Date	Manager Signature	Date

Let's Investigate

Bounce Height

Does dropping a ball from a greater height make it bounce higher?

What do you think?



Let's Investigate

Bounce Height

Method:

1. Collect a ball, a metre ruler and some tape.
2. Stick the ruler to a wall or table so that 0cm is on the floor.
3. Drop the ball from a height of 20cm and observe the maximum height it bounces to.
4. Record the maximum height in the results table.
5. Repeat 2 more times and calculate the average height.
6. Repeat for drop heights of 40cm, 60cm and 80cm.

Results:

Drop height (cm)	Maximum bounce height (cm)			
	Trial 1	Trial 2	Trial 3	Average
20				
40				
60				
80				

Teacher Guide: Investigating Bounce Height

SCN 2-04a

'I can Identify common types of energy.'

'I can explain that when energy transfers take place, energy is converted into useful and wasted energy'

This is a simple experiment that can be used to develop science inquiry skills and support the teaching and learning of SCN 2-04a 'Energy Types and Transfer'.

Key Vocabulary:

Gravitational Potential Energy: The higher an object is above the ground, the more gravitational potential energy it has.

Kinetic Energy: The energy of a moving object.

Sound Energy: Produced when an object vibrates

Conservation of energy: Energy cannot be created or destroyed. It can only be transferred from one form to another. E.g. A light bulb does not create energy, it transfers electrical energy into light energy.

Energy transfer: An energy transfer occurs when an object changes one type of energy into another. E.g. a hairdryer changes electrical energy into heat, sound and kinetic energy.

Useful energy: Energy that is required to perform an intended task. E.g. In a hairdryer, heat and kinetic energy is useful. The sound is not needed to dry your hair, this is wasted energy.

Wasted energy: Energy transfers that are not required to perform an intended task. See hairdryer example above.

Aim:

To investigate how the height a ball is dropped from affects the height the ball bounces to.

Independent Variable (the variable that is changing):

The height the ball is dropped from

Dependent Variable (the variable that is measured):

Bounce height

Control Variables:

1. Surface the ball is dropped onto
2. Type of ball
3. Method of measurement

Materials (per group):

A ball that bounces well (tennis ball, golf ball, table tennis ball, bouncy ball).

A metre ruler.

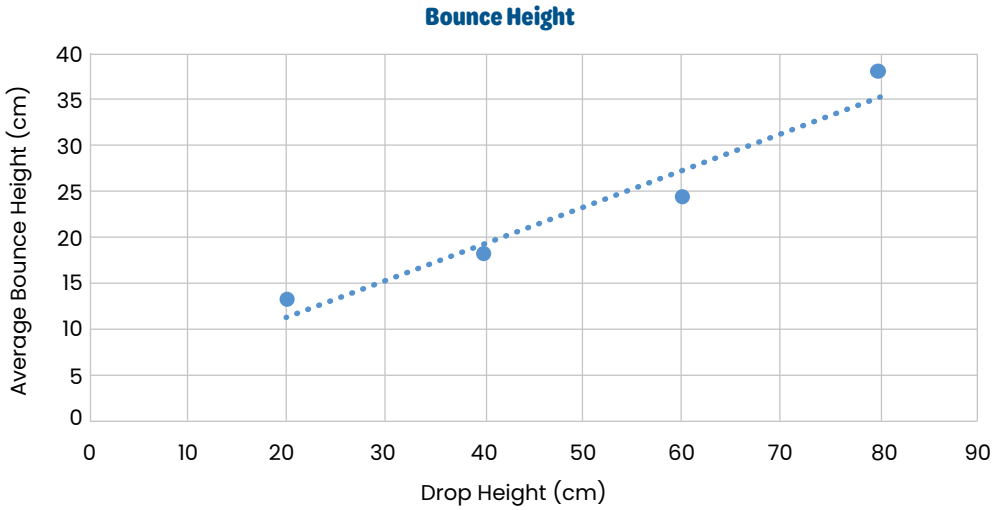
Results:

It is expected that the higher the ball is dropped from, the higher the ball will bounce. Results should be similar to the example below:

Drop Height (cm)	Bounce Height (cm)			
	Trial 1	Trial 2	Trial 3	Average.
20	14	13	12	13
40	19	18	18	18
60	25	24	22	24
80	39	36	38	38

Presenting data:

Data should be presented as a **line graph** as the Drop Height is *continuous* data.



Conclusion:

For expected results:

The conclusion should state the trend shown in the results. E.g. As the drop height increased, the bounce height increased.

At second level, if there is no trend, an answer to the aim is sufficient. E.g. When the ball bounced the highest when it was dropped from 40cm.

At third level and above, a conclusion should state that no trend has been shown. E.g. The results do not show a trend between the height the ball is dropped from and the height of bounce. This can be used to extend more able pupils.

Evaluation:

The most common source of error in this experiment is the ability to read and record the height of bounce accurately. Challenge pupils to think of a way to make this more accurate. Pupils might suggest that using a digital camera would allow them to record the ball bouncing and then replay the footage in slow motion to read the maximum height reached accurately.

Misconceptions:

The ball will bounce to the same height it was dropped from.

This experiment shows that energy can be transferred from one form to another.

Before the ball is released it has Gravitational Potential energy, if no energy was wasted, 100% of the energy would convert to Kinetic energy as it fell. If no energy was wasted when it bounced, 100% of the energy would be converted back to Gravitational Potential Energy and it would reach the same height it was dropped from.

It does not reach the same height because some energy is wasted in the following transfers:

- Wasted heat energy from air resistance (friction) between the falling ball and air particles.
- Wasted sound energy when the ball bounces with a 'thud'.
- Wasted heat energy from air resistance (friction) between the rising ball and air particles.

The ball can never bounce higher than it was dropped from as this would require more energy than the ball started with. This would require the 'creation' of additional energy. This demonstrates the conservation of energy; '*Energy cannot be created or destroyed, it can only be transferred from one form to another.*'

Interdisciplinary Learning:

Maths and Numeracy:

Measurement	MNU 1-11a
Data and Analysis	MNU 1-20b, MTH 1-21a, MNU 2-20b, MTH 2-21a

Literacy:

Tools for Writing	LIT 2-23a
Creating texts (writing)	LIT 2-28a

Skill Organiser	Skills	Addressed in Activity
Inquiry and investigative skills	**Plans and designs scientific investigations and enquiries**	
	Formulates questions and predictions (hypotheses), with assistance, based on observations and information	✓
	Identifies the independent, dependent and controlled variables, with assistance.	✓
	Anticipates some risks and hazards.	✓
	Carries out practical activities in a variety of learning environments	
	Applies appropriate safety measures.	✓
	Contributes to carrying out all the procedures.	✓
	Makes observations and collects information and measurements using appropriate devices and units.	✓
	Manages identified controlled variables to ensure validity of results.	✓
	Analyses, interprets and evaluates scientific findings	
	Selects appropriate methods to record data/information.	✓
	Identifies relationships between the independent and dependent variables.	✓
	Makes links to original questions or predictions.	✓
	Relates findings to the wider world.	✓
	Draws basic conclusions consistent with findings.	✓
	Identifies and discusses additional knowledge and understanding gained.	✓
	Recognises anomalous results and suggests possible sources of error.	✓
	Evaluates the investigation and suggests one way of improving it if it was to be repeated.	✓
	Presents scientific findings	
	Presents data/information by choosing from an extended range of tables, charts, diagrams, graphs, including bar graphs and line graphs.	✓
	Reports collaboratively and individually using a range of methods.	✓
	Collates, organises and summarises findings, with assistance, using headings or questions to provide structure for presentations.	✓
	Uses appropriate scientific vocabulary and acknowledges sources, with assistance.	✓

Planet Earth		SCN2-04a
Skill Organiser	**Skills**	**Addressed in Activity**
Scientific analytical thinking skills	Applies scientific analytical thinking skills, with assistance, working with less familiar (or familiar but more complex) contexts.	✓
	Applies understanding, and a combination of more than one science concept, to solve problems and provide solutions.	✗
	Demonstrates further development of creative thinking including through the engineering processes of design, construction, testing and modification.	✗
Skills and attributes of scientifically literate citizens	Presents a reasoned argument based on evidence, demonstrating understanding of underlying scientific concepts, and engages with the views of others.	✗
	Demonstrates understanding of the relevance of science to their future lives and the role of science in an increasing range of careers and occupations.	✗
	Demonstrates increased awareness of creativity and inventiveness in science, the use of technologies in the development of sciences and the impact of science on society.	✗
	Expresses informed views about scientific and environmental issues based on evidence.	✗

Risk Assessment

Task/Activity/Process Description	Bounce Height	**Service**	Communitites
Location	School Name	**Reference**	To be completed by school

Types of Injury/Loss/Ill Health	Minor injuries, cuts, scratches, bruising

For each hazard, please identify the person at risk (direct and indirect)

Consider those especially vulnerable (young or inexperienced workers, members of the public, school pupils, the elderly, residents and contractors)

NOTE: New and expectant mothers require a separate risk assessment

Haz No.	Hazard	Source of Hazard	Persons at Risk	Current Control Measures in Place	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Risk Rating (1-25)
1	Tools/Equipment	Inappropriate use of the metre ruler.	Employee/Pupil	Pupil behaviour should be managed in accordance with school behaviour policy.	1	2	2
2	Tools/Equipment	Inappropriate use of the tennis ball.	Employee/Pupil	Pupil behaviour should be managed in accordance with school behaviour policy.	1	2	2
3	Slip/Trip/Fall	Classroom furntiure	Employee/Pupil	Tables and chairs should be kept in a tidy manner to allow pupil movement during this activity.	1	2	2
4	Other (please identify)	Pupil Behaviour	Employee/Pupil	Pupil behaviour should be managed in accordance with school behaviour policy.	1	1	1
5							
6							0
7							0
8							0
9							0
10							0
11							0
12							0
13							0
14							0

Planet Earth	SCN2-04a

Risk Reduction

Haz No.	Additional Control Measures	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Final Risk Rating (1-25)	Action By (name and target date)	Date Control Implemented	Sign to Confirm
1	As low as reasonably possible			0			
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6				0			
7				0			
8				0			
9				0			
10				0			
11				0			
12				0			
13				0			
14				0			

Assessor(s) Name (print)	Assessment Date	Manager Name (print)

Assessor(s) Signature	Review Date	Manager Signature	Date

Let's Investigate

Non-renewable Energy

What are the advantages and disadvantages of non-renewable energy sources?

Task:

Create a fact sheet for one type of non-renewable energy.

Your fact sheet must include:

- a sentence that describes the origins of the fuel source.
- a diagram showing how electricity is generated from the non-renewable source.
- a list of advantages and disadvantages of generating electricity from this non-renewable source.
- two references to show where you found your information and images.

Examples of non- renewable energy sources you might like to choose from include:

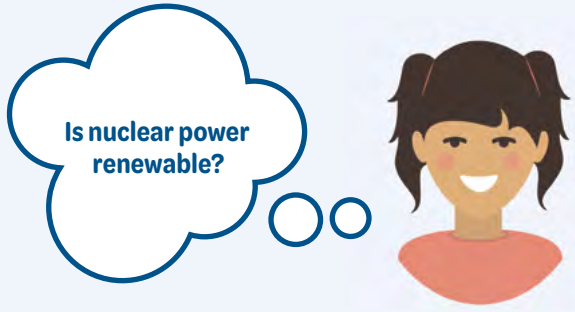

Coal


Gas


Nuclear


Oil

What do you think?



Geothermal Energy

Geothermal Energy converts the thermal energy of rocks below the surface of the Earth into electrical energy.

This is achieved by pumping water at high pressures deep into the ground. The high temperatures of the underground rocks causes the water to boil and creates steam. This steam then rises to the surface at very high pressures where it is used to spin a turbine and generate electricity. The steam is condensed back into water to be used again.

Energy transfers that occur in the generation of electricity are as follows:

Heat energy in underground rocks is converted to Kinetic energy in steam. The kinetic energy of the steam moving back to the surface spins a turbine. The turbine spins a generator where a magnet moves inside a copper coil converting kinetic energy into electrical energy.

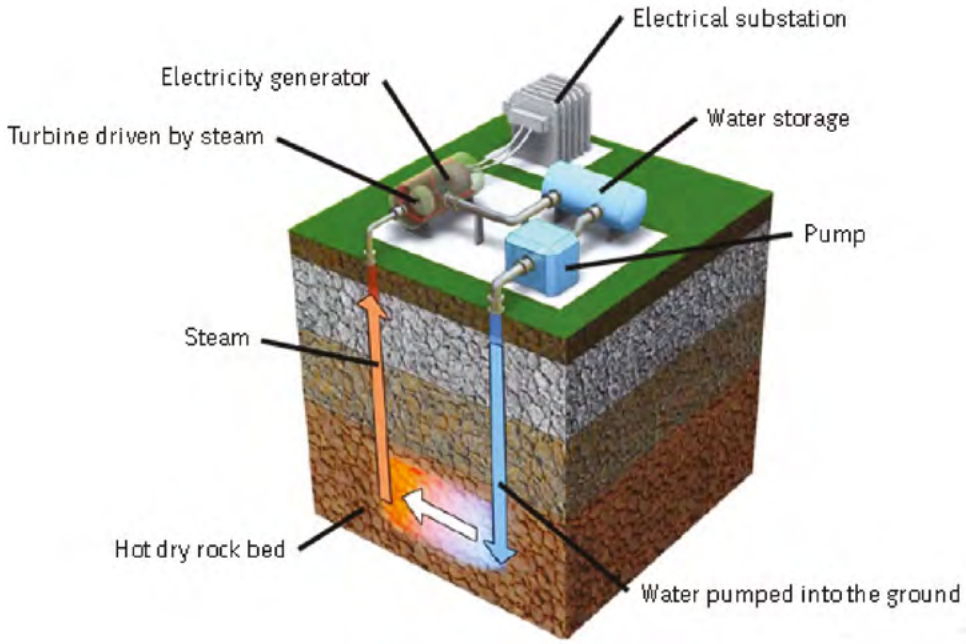
Advantages:

- Reduced reliance on Fossil Fuels.
- Does not release any harmful Greenhouse gases.

Disadvantages:

- High installation costs.
- Temperature of underground rocks can drop, making the site unusable for generating electricity.
- Only suited to particular areas where the temperature below ground allows steam to be produced over a long period of time.

www.conserve-energy-future.com



www.cleanenergycouncil.org.au

Teacher Guide: Renewable Energy

SCN2-04b

Through exploring non-renewable energy sources, I can describe how they are used in Scotland today and express an informed view on the implications of their future use.

This is a research task that can be used to address the benchmarks associated with SCN2-04b, non-renewable energy sources. It requires pupils to create a fact sheet about one type of non-renewable energy source. The fact sheet should include:

- a brief explanation of the origins of the energy source.
- a diagram showing how electricity is generated from the renewable source.
- a list of advantages and disadvantages of generating electricity from this non-renewable source.
- two references to show where you found your information and images.

An example fact sheet is included. Note: Geothermal energy is a renewable energy source. It can be used as an example of what the final product should look like without giving away any key information.

Key Vocabulary:

Non-Renewable: Energy sources that have a limited life span and will run out. E.g. Coal, Oil, Gas, Uranium

Renewable: Energy sources that have an infinite supply, e.g. wind and tidal power, or can be renewed, e.g. Biomass crops.

Useful information:

Formation of Oil and Gas:

Oil and gas were formed from the remains of animals and plants that lived millions of years ago in the sea. These remains were covered by layers of sand and silt. Heat and pressure from the Earth's core turned them into oil and gas.

Formation of Coal and Peat:

Coal was formed from dead plants about 300 million years ago. Back then, much of the Earth was covered by swamps. As the vegetation died, it decayed, slowly forming layers of peat. Over time this was covered with more sediment and compressed and heated to form coal.

Advantages of fossil fuels

- They generate large amounts of energy quite cheaply.
- As technology improves, more reserves can be accessed.
- Locating where fossil fuels are is quite easy.
- Oil and gas can be transported through pipelines.
- The means for extracting fossil fuels is already in existence.

Disadvantages of fossil fuels

- They release carbon dioxide when they are burnt, creating pollution.
- Carbon dioxide contributes to the greenhouse effect and global warming.
- Mining can create ugly scars on the landscape.
- Mining can be dangerous, especially as the most easily accessible deposits are used up.
- Oil spills can cause environmental damage.
- Supplies are running out and new sources are harder to get to. Oil and gas are both predicted to run out within 100 years.
- Oil is mainly produced outside the UK, so prices are set by other countries.

Nuclear power

Nuclear power is created from the release of energy from nuclear reactions. These reactions usually use uranium or plutonium. A relatively small amount of fuel is required to produce the energy. Most by-products of the reactions are radioactive. There is a debate about whether or not nuclear power should be used.

Advantages of nuclear power

- Only small amounts of fuel needed to produce lots of energy compared to fossil fuels.
- Low carbon emissions.
- Tends to be supported by large companies and governments.
- Once up and running it is cheap to produce electricity.
- There has been a lot of investment in making sure it is as safe as possible.

Disadvantages of nuclear power

- Nuclear waste is highly radioactive.
- Accidents and leaks can be deadly and last for a long time.
- Storing nuclear waste is very expensive.
- Decommissioning nuclear power stations is very expensive.
- Uranium and plutonium are not renewable so will run out.

Differentiation:

This task can be differentiated by adding or removing criteria to suit the ability of the pupil.

Possible additional criteria:

- include a map of non-renewable energy power stations in the UK.
- describe the energy transfers that occur from burning coal to using an appliance. E.g. Chemical energy in coal → Thermal energy in boiler → Kinetic energy in turbine → Electrical energy in generator → Electrical energy in National Grid → Heat and sound energy in Kettle.
- create a second fact sheet for a renewable energy source.

Useful Resources:

As a starting point, teachers may like to show their pupils videos from the 'Student Energy' YouTube channel. There are short and simple descriptions of renewable and non-renewable energy sources.

https://www.youtube.com/playlist?list=PL7b293q4n8alo87lK74wa2iuJRVGmBxvH

To search for the videos on YouTube enter 'Student Energy Wind power 101' into the search box. You will be able to use this as a starting point to access all renewable energy videos from their Energy Literacy playlist.

Websites:

https://ourfuture.energy/curriculum-link/scn-2-04b/page/2/

https://www.bbc.co.uk/bitesize/guides/zh7hvcw/revision/1

Misconceptions:

Power stations 'make energy'.

Energy cannot be created or destroyed, it can only be transferred from one form to another. All non-renewable energy power stations use chemical or nuclear energy to heat water creating steam. The energy of the high pressure steam is then transferred to a turbine which is connected to a generator. Inside a generator a coil of wire spins inside a magnetic field. This causes an electric current to flow inside the wire.

The sun is the original source of most of our energy. It provided the light needed for prehistoric plants to grow which then turned into coal, oil, gas and peat. Heat from the Sun causes wind for wind turbines, and surface waves for wave energy. It also provides the energy for evaporation which is essential for the water cycle and hydroelectric power plants.

The moon's gravity is the source of energy for tidal power.

Interdisciplinary Learning:

Digital Literacy

Using digital products and services	TCH 2-01a
Searching, processing and managing information	TCH 2-02a
Awareness of technological developments	TCH 2-06a, TCH 2-07a

Literacy:

Tools for Writing	LIT 2-23a
Creating texts (writing)	LIT 2-28a

Planet Earth		SCN2-04b
Skill Organiser	**Skills**	**Addressed in Activity**
Inquiry and investigative skills	**Plans and designs scientific investigations and enquiries**	
	Formulates questions and predictions (hypotheses), with assistance, based on observations and information	✗
	Identifies the independent, dependent and controlled variables, with assistance.	✗
	Anticipates some risks and hazards.	✗
	Carries out practical activities in a variety of learning environments	
	Applies appropriate safety measures.	✗
	Contributes to carrying out all the procedures.	✗
	Makes observations and collects information and measurements using appropriate devices and units.	✗
	Manages identified controlled variables to ensure validity of results.	✗
	Analyses, interprets and evaluates scientific findings	
	Selects appropriate methods to record data/information.	✗
	Identifies relationships between the independent and dependent variables.	✗
	Makes links to original questions or predictions.	✗
	Relates findings to the wider world.	✓
	Draws basic conclusions consistent with findings.	✗
	Identifies and discusses additional knowledge and understanding gained.	✓
	Recognises anomalous results and suggests possible sources of error.	✗
	Evaluates the investigation and suggests one way of improving it if it was to be repeated.	✗
	Presents scientific findings	
	Presents data/information by choosing from an extended range of tables, charts, diagrams, graphs, including bar graphs and line graphs.	✗
	Reports collaboratively and individually using a range of methods.	✓
	Collates, organises and summarises findings, with assistance, using headings or questions to provide structure for presentations.	✓
	Uses appropriate scientific vocabulary and acknowledges sources, with assistance.	✓

Skill Organiser	Skills	Addressed in Activity
Scientific analytical thinking skills	Applies scientific analytical thinking skills, with assistance, working with less familiar (or familiar but more complex) contexts.	✓
	Applies understanding, and a combination of more than one science concept, to solve problems and provide solutions.	✗
	Demonstrates further development of creative thinking including through the engineering processes of design, construction, testing and modification.	✗
Skills and attributes of scientifically literate citizens	Presents a reasoned argument based on evidence, demonstrating understanding of underlying scientific concepts, and engages with the views of others.	✓
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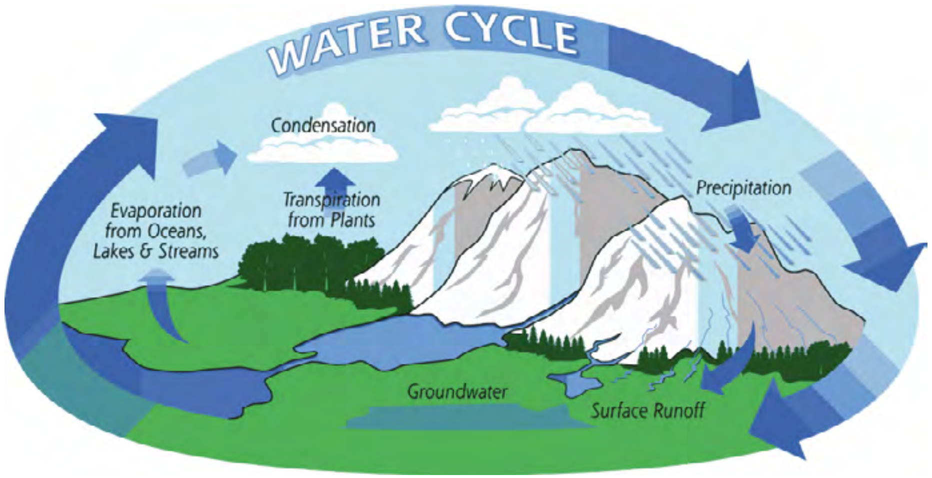
	Demonstrates increased awareness of creativity and inventiveness in science, the use of technologies in the development of sciences and the impact of science on society.	✓
	Expresses informed views about scientific and environmental issues based on evidence.	✓

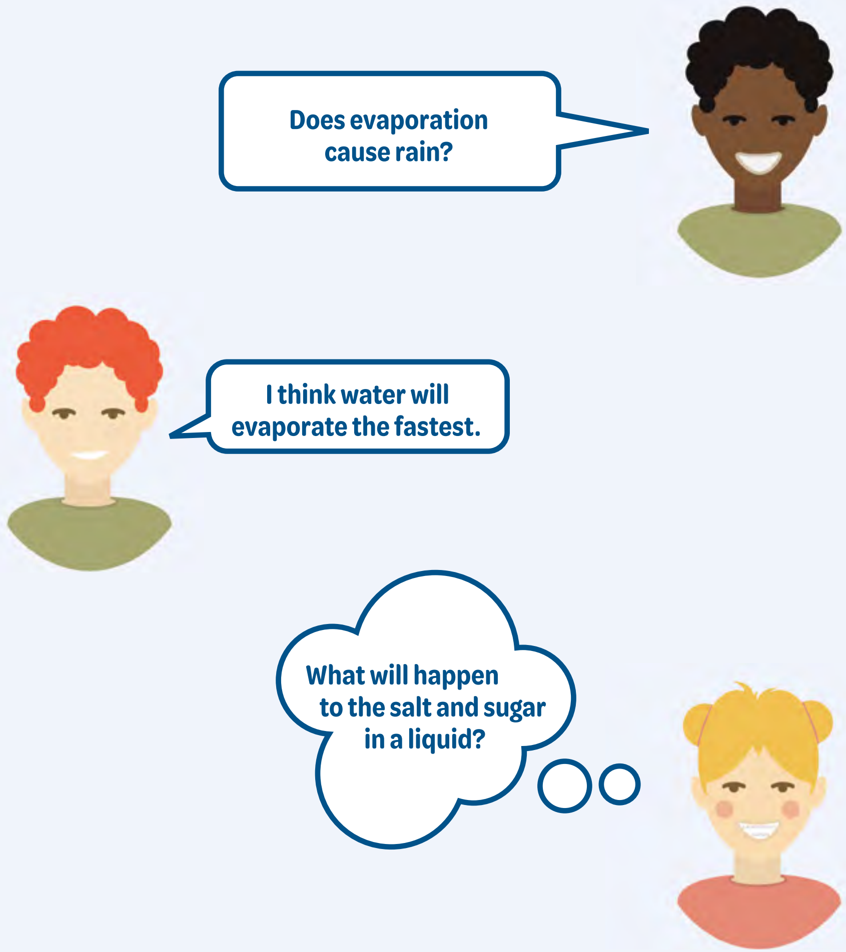
Let's Investigate

Evaporation

Do all liquids evaporate at the same rate?



What do you think?



Let's Investigate

Evaporation

Method:

1. Use a measuring cylinder to add 50mL of each liquid into separate beakers.
2. Use a measuring cylinder to measure and record the volume of each liquid every day for one week.

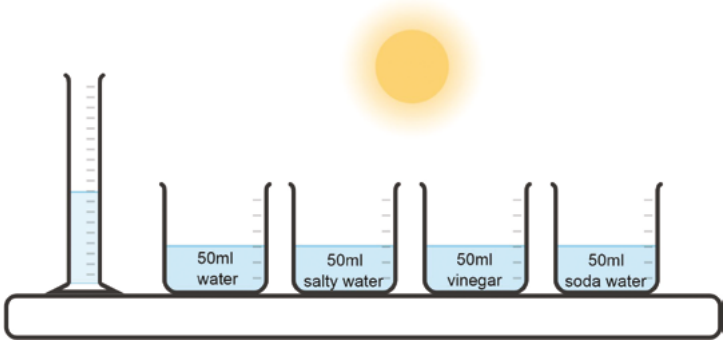


Image courtesy of chemix.org

Results:

Liquid	Volume of water				
	Day 1	Day 2	Day 3	Day 4	Day 5
Water					
Salty water					
Vinegar					
Soda water					

Teacher Guide: Evaporation

SCN2-05a

I can apply my knowledge of how water changes state to help me understand the processes involved in the water cycle.

This activity can be used to develop investigative and inquiry skills within the context of the water cycle, SCN2-05a. It can also be used to support the learning of physical changes, SCN2-15a.

Key Vocabulary:

Evaporation: The change of state that occurs when a liquid changes to a gas.

Dissolve: To mix with a liquid.

Solution: A solution is made when a substance dissolves in a liquid.

Soluble: Substances that can dissolve in a liquid. E.g. Salt is soluble in water.

Insoluble: Substances that do not dissolve in a liquid. E.g. Sand is insoluble in water.

Aim:

To find out if different liquids evaporate at the same rate.

Independent Variable (the variable that is changing):

The type of liquid

Dependent Variable (the variable that is measured):

The volume of liquid

Control Variables:

Surface area of the container

The starting volume of liquids

Room temperature

Materials (per group):

4 plastic beakers (any plastic container is fine. E.g. 4 plastic butter tubs)

1 measuring cylinder

Tap water

Saltwater

Soda water

Vinegar

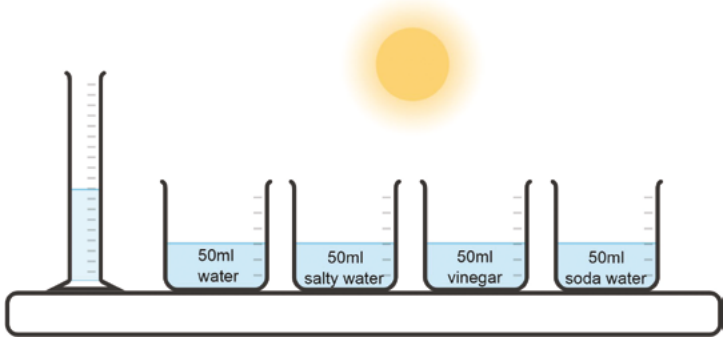


Image courtesy of chemix.org

How to:

Pupils can prepare a solution of saltwater by measuring 50cm^3 of water into a beaker and then adding a teaspoon of salt and stirring until dissolved. Repeat this process until no more salt dissolves in the water. You will know this has happened when solid salt is still visible in the beaker after 30 seconds of stirring.

Students should then remeasure the volume of the solution. Adding the salt will increase the volume, students should remeasure 50cm^3 of saltwater solution and discard any excess. The starting volume of liquids is a control measure in this experiment.

Alternatively, the teacher could prepare a large quantity of saltwater in advance. 500cm^3 is enough for 10 groups of pupils. Pupils could just measure 50cm^3 of the prepared solution.

Once pupils have measured 50cm^3 of each liquid into separate beakers they should be positioned together somewhere in the room where they won't cause obstruction for the next 5 days.

Pupils should use a measuring cylinder to measure the volume of each beaker each day. At the same time if possible. They should be careful not to spill any of the liquids when measuring and transferring back to the beaker.

This experiment can be adapted to investigate any liquids you have easy access to that are safe for pupils to handle. Pupils could extend the time of the investigation, the number of times per day they measure volume, or even the unit of time. Some pupils may like to record their time in hours rather than days.

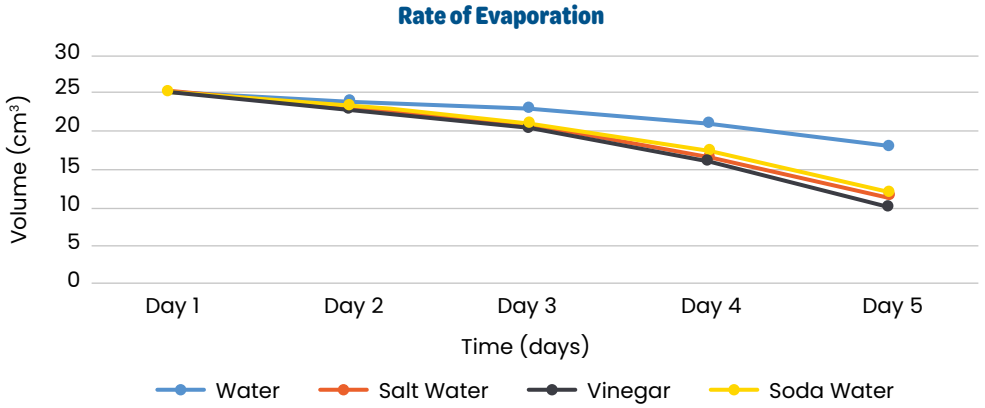
Results:

Data should be recorded in a table similar to the one below. More able pupils can be asked to design their own table. Results will vary, the example below has been produced to show how data can be presented as a line graph.

Liquid	Volume of Liquid (cm3)				
	Day 1	Day 2	Day 3	Day 4	Day 5
Water	50	48	46	42	36
Saltwater	50	47	41	33	23
Vinegar	50	46	40	32	20
Soda water	50	47	42	35	24

Presenting data:

This data should be presented as a line graph as it is 'continuous data'. Depending on pupil ability they may graph the data for 1 liquid or all 4 liquids. Different coloured lines can be used to show the data for each liquid.



Conclusion:

For this experiment a statement of results is sufficient. E.g. Vinegar evaporated fastest, followed by saltwater and soda water. Tap water was the slowest to evaporate.

Please note, results will vary, and pupil conclusions may not match the example above.

Evaluation:

Common errors that occur in this experiment are the loss of liquids due to spills when measuring volume each day. An alternative method is to use a digital scale to measure the mass of liquid lost each day.

Pupils may come up with other sources of errors, encourage them to suggest methods to improve the experiment to minimise these errors they have identified.

Misconceptions:

Salt disappears when it dissolves.

At second level the following explanation is enough: 'The salt particles have mixed with the water particles. The salt particles are still there but they are too small to see.'

Water only evaporates from puddles.

Water evaporates from all water sources, including puddles, rivers, lakes and oceans.
A good demonstration is to leave a small piece of cheese out for a few hours and observe the changes that occur to its texture as its water evaporates.

Water is absorbed by the container, disappears, changes into or has dried up.

The water has evaporated and changed from a liquid into a gas.

Interdisciplinary Learning:

Maths and Numeracy:

Measurement	MNU 1-11a
Data and Analysis	MNU 1-20b, MTH 1-21a, MNU 2-20b, MTH 2-21a

Literacy:

Tools for Writing	LIT 2-23a
Creating texts (writing)	LIT 2-28a

Skill Organiser	Skills	Addressed in Activity
Inquiry and investigative skills	**Plans and designs scientific investigations and enquiries**	
	Formulates questions and predictions (hypotheses), with assistance, based on observations and information	✓
	Identifies the independent, dependent and controlled variables, with assistance.	✓
	Anticipates some risks and hazards.	✓
	Carries out practical activities in a variety of learning environments	
	Applies appropriate safety measures.	✓
	Contributes to carrying out all the procedures.	✓
	Makes observations and collects information and measurements using appropriate devices and units.	✓
	Manages identified controlled variables to ensure validity of results.	✓
	Analyses, interprets and evaluates scientific findings	
	Selects appropriate methods to record data/information.	✓
	Identifies relationships between the independent and dependent variables.	✓
	Makes links to original questions or predictions.	✓
	Relates findings to the wider world.	✓
	Draws basic conclusions consistent with findings.	✓
	Identifies and discusses additional knowledge and understanding gained.	✓
	Recognises anomalous results and suggests possible sources of error.	✓
	Evaluates the investigation and suggests one way of improving it if it was to be repeated.	✓
	Presents scientific findings	
	Presents data/information by choosing from an extended range of tables, charts, diagrams, graphs, including bar graphs and line graphs.	✓
	Reports collaboratively and individually using a range of methods.	✓
	Collates, organises and summarises findings, with assistance, using headings or questions to provide structure for presentations.	✓
	Uses appropriate scientific vocabulary and acknowledges sources, with assistance.	✗

Planet Earth SCN2-05a

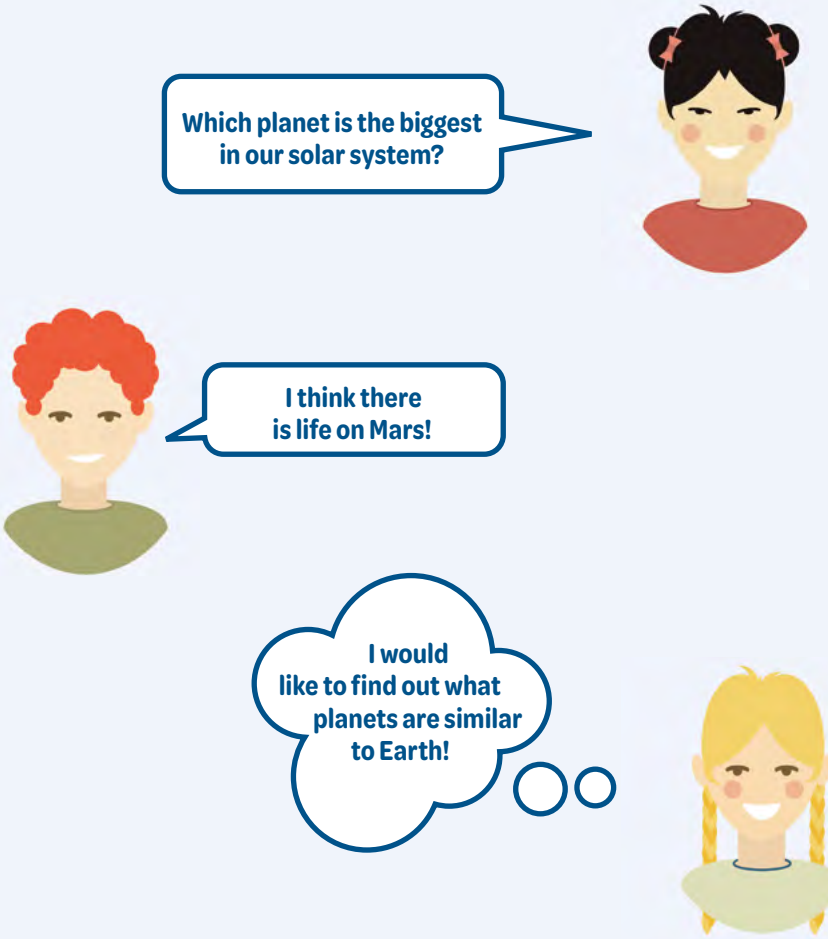
Skill Organiser	Skills	Addressed in Activity
Scientific analytical thinking skills	Applies scientific analytical thinking skills, with assistance, working with less familiar (or familiar but more complex) contexts.	✓
	Applies understanding, and a combination of more than one science concept, to solve problems and provide solutions.	✗
	Demonstrates further development of creative thinking including through the engineering processes of design, construction, testing and modification.	✗
Skills and attributes of scientifically literate citizens	Presents a reasoned argument based on evidence, demonstrating understanding of underlying scientific concepts, and engages with the views of others.	✓
	Demonstrates understanding of the relevance of science to their future lives and the role of science in an increasing range of careers and occupations.	✓
	Demonstrates increased awareness of creativity and inventiveness in science, the use of technologies in the development of sciences and the impact of science on society.	✓
	Expresses informed views about scientific and environmental issues based on evidence.	✓

Let's Investigate

Space

How big is Earth compared to other planets in our solar system?

What do you think?

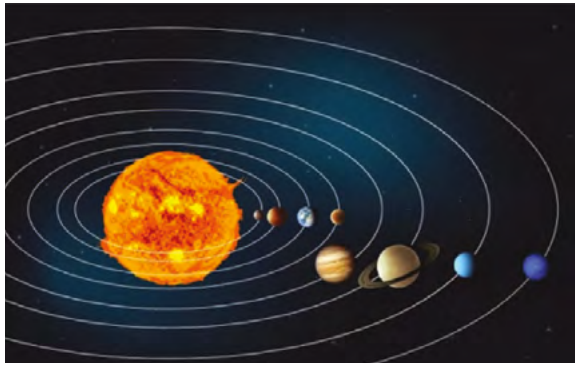


Let's Investigate

Space

Method:

1. Collect a planets research sheet and suggested websites sheet.
2. Look on a range of websites to complete table (make sure you double check your information).
3. Choose one piece of information from the table e.g. Distance from sun and create a graph to compare the different planets (look at graphing options sheets for ideas of which graph to create).



Results – Planets Research Sheet:

Planet	Distance from sun	Average temp (facing sun)	Diameter	Time to orbit sun	Time to rotate on axis	Type of planet	Atmosphere	Other info
Mercury								
Venus								
Earth	149.6 million km	15°C	12,756km	365.25 days	24 hours	rocky	nitrogen and oxygen	
Mars								
Jupiter								
Saturn								
Uranus								
Neptune								

Teacher Guide: Space

SCN 2-06a

I can report collaboratively on the key features of the planets

I can use simple models to communicate understanding of size

This pack supports investigation into the features of the solar system using simple models to communicate understanding of size and scale.

Key Vocabulary:

Earth, planets, Sun, solar system, celestial body, sphere/spherical, Mercury, Venus, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto, 'dwarf' planet, orbit, opinion/fact, accuracy, precision, scatter graphs, line graphs, support/refute

Aim:

- Use ratios for scale and calculate and measure distances using a scaled system
- Select and use an effective medium to create an artistic representation of a chosen planet

The Big Question?

How big is Earth compared to other planets in our solar system?

Materials (per group):

Blank circular planet pages	various sized fruit
graph descriptions	planet images
results sheet	toilet roll and questions

scale model of solar system using fruit:

http://www.bbc.co.uk/programmes/p00n6zgy

make your own solar system:

http://nrich.maths.org/7753

Further resources to support these activities are available at:

https://www.hamilton-trust.org.uk/science/year-5-science/earth-and-space-space-presenters/

Lessons:

Introduction

Have a range of different sized fruit out in bowls on the tables and ask children to decide which one is which planet! See what they do and note discussions about size and relative size. The children need to know where they are starting from, so in groups give them a circular 'planet' page to write down as much as they know about the planets. Share thoughts and hang each groups 'planet' in the classroom for reference. Did children suggest there were any more than the 8 planets? Did they suggest planets were spherical? Did they suggest that the planets orbit the Sun? Ask children how they know this – have they visited space themselves? Did any of the children include Pluto? Explain that this was 'declassified' as a planet in 2006 and as of 2016 is still officially a dwarf planet (explain that this is a 'planet' that has not 'cleared the neighbourhood of its orbit' – meaning that it is still influenced by another planet's gravity). Ask children what the Sun is – clarify that it is a star, not a planet and that it has the largest mass (check understanding of this term) in our solar system, which is why the planets all orbit it (explain that the larger the mass the greater the gravitational force, so because the sun has the greatest gravitational force the planets are all kept in orbit by it.). Discuss how scientists have used a range of equipment from powerful telescopes to probes, to make observations of our solar system and that much of the information we know is from 'secondary sources' rather than our own experience. Explain that as far back as the 10th and 11th centuries the scientist Alhazen completed early work on the reflecting telescope, the principles of which are still used today – for over 25 years the Hubble Space Telescope (a reflecting telescope) has been collecting data and images about our solar system and the universe for scientists to analyse. When exploring space, some phenomenon we can investigate here on Earth, but other knowledge comes from what others have seen and analysed.

Activity – Scale models:

Show children the BBC clip – do they think this is a helpful approach to explaining the scale of the solar system? Why? (It relates to what they know and can see.) Carry out this challenge directly with your class – help children to use the 'nrich' data (see link) to measure out their own model. Work out a scale (distance represented by one section of toilet roll) and use the questions to support children's learning. Ask children to film and explain how they have 'modelled' a 'scale' solar system.

Activity – Planets online

Encourage children to research the planets and solar system in order to identify some key data (see sample data table) and general information. Ask children to represent it graphically using the 'graphing options' to help choose the best graph.

Extension – Paint the planets

Using the images for inspiration, focus on colour mixing and texture to create their own 'artistic versions' of all the planets.

Results:

Depending on which graph children choose depends on how their results look. They should use a table to collect information first then focussing on one aspect e.g. distance from sun they can then produce a graph of their choice. Answers may vary depending on which website children use for their information. Some websites round numbers so as long as their answers are around the same as the figures shown then they are correct.

Planetary Data:

Planet	Distance from sun	Average temp (facing sun)	Diameter	Time to orbit sun	Time to rotate on axis	Type of planet	Atmosphere	Other info
Mercury	57.91 million km	428°C	4,878km	88 days	59 days	rocky	sodium and helium	
Venus	108.2 million km	464°C	12,104km	224 days	243 days	rocky	carbon dioxide and nitrogen	
Earth	149.6 million km	15°C	12,756km	365.3 days	24 hours	rocky	nitrogen and oxygen	
Mars	227.9 million km	-65°C	6,794km	687 days	24hrs 37mins	rocky	carbon dioxide and argon	
Jupiter	778.5 million km	-110°C	142,984km	11.86 years	9hrs 55mins	gas	hydrogen and helium	
Saturn	1.434 billion km	-140°C	120,536km	29 years	10hrs 39mins	gas	hydrogen and helium	
Uranus	2.871 billion km	-195°C	51,118km	84 years	17hours 14mins	ice	hydrogen, helium and methane	
Neptune	4.495 billion km	-200°C	49,532km	164.8 years	16hrs 7mins	ice	hydrogen, helium and methane	

Planet Earth SCN2-06a

Interdisciplinary Learning:

Numeracy:

Estimation and rounding	MNU 2-01a
Measurement	MNU 2-11a
Information handling	MNU 2-20a, MTH 2-21a

Literacy:

Tools for listening and talking	LIT 2-02a
Finding and using information	LIT 2-06a
Organising and Using information	LIT 2-26a

Expressive Arts:

Art and Design	EXA 2-02a, EXA 2-03a, EXA 2-04a

Adapted from Hamilton Trust – Space Presenters

https://www.hamilton-trust.org.uk/science/year-5-science/earth-and-space-space-presenters/

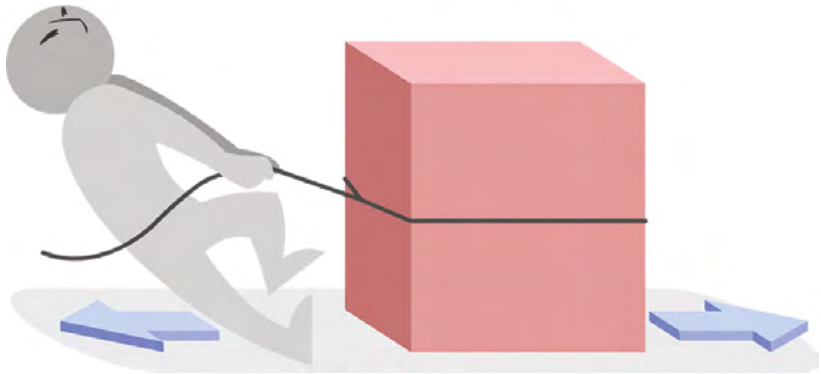
Skill Organiser	Skills	Addressed in Activity
Inquiry and investigative skills	**Plans and designs scientific investigations and enquiries**	
	Formulates questions and predictions (hypotheses), with assistance, based on observations and information	✓
	Identifies the independent, dependent and controlled variables, with assistance.	✗
	Anticipates some risks and hazards.	✗
	Carries out practical activities in a variety of learning environments	
	Applies appropriate safety measures.	✗
	Contributes to carrying out all the procedures.	✓
	Makes observations and collects information and measurements using appropriate devices and units.	✗
	Manages identified controlled variables to ensure validity of results.	✗
	Analyses, interprets and evaluates scientific findings	
	Selects appropriate methods to record data/information.	✓
	Identifies relationships between the independent and dependent variables.	✗
	Makes links to original questions or predictions.	✗
	Relates findings to the wider world.	✓
	Draws basic conclusions consistent with findings.	✓
	Identifies and discusses additional knowledge and understanding gained.	✓
	Recognises anomalous results and suggests possible sources of error.	✗
	Evaluates the investigation and suggests one way of improving it if it was to be repeated.	✗
	Presents scientific findings	
	Presents data/information by choosing from an extended range of tables, charts, diagrams, graphs, including bar graphs and line graphs.	✓
	Reports collaboratively and individually using a range of methods.	✓
	Collates, organises and summarises findings, with assistance, using headings or questions to provide structure for presentations.	✓
	Uses appropriate scientific vocabulary and acknowledges sources, with assistance.	✓

Planet Earth		SCN2-06a
Skill Organiser	**Skills**	**Addressed in Activity**
Scientific analytical thinking skills	Applies scientific analytical thinking skills, with assistance, working with less familiar (or familiar but more complex) contexts.	✗
	Applies understanding, and a combination of more than one science concept, to solve problems and provide solutions.	✗
	Demonstrates further development of creative thinking including through the engineering processes of design, construction, testing and modification.	✗
Skills and attributes of scientifically literate citizens	Presents a reasoned argument based on evidence, demonstrating understanding of underlying scientific concepts, and engages with the views of others.	✗
	Demonstrates understanding of the relevance of science to their future lives and the role of science in an increasing range of careers and occupations.	✗
	Demonstrates increased awareness of creativity and inventiveness in science, the use of technologies in the development of sciences and the impact of science on society.	✗
	Expresses informed views about scientific and environmental issues based on evidence.	✗

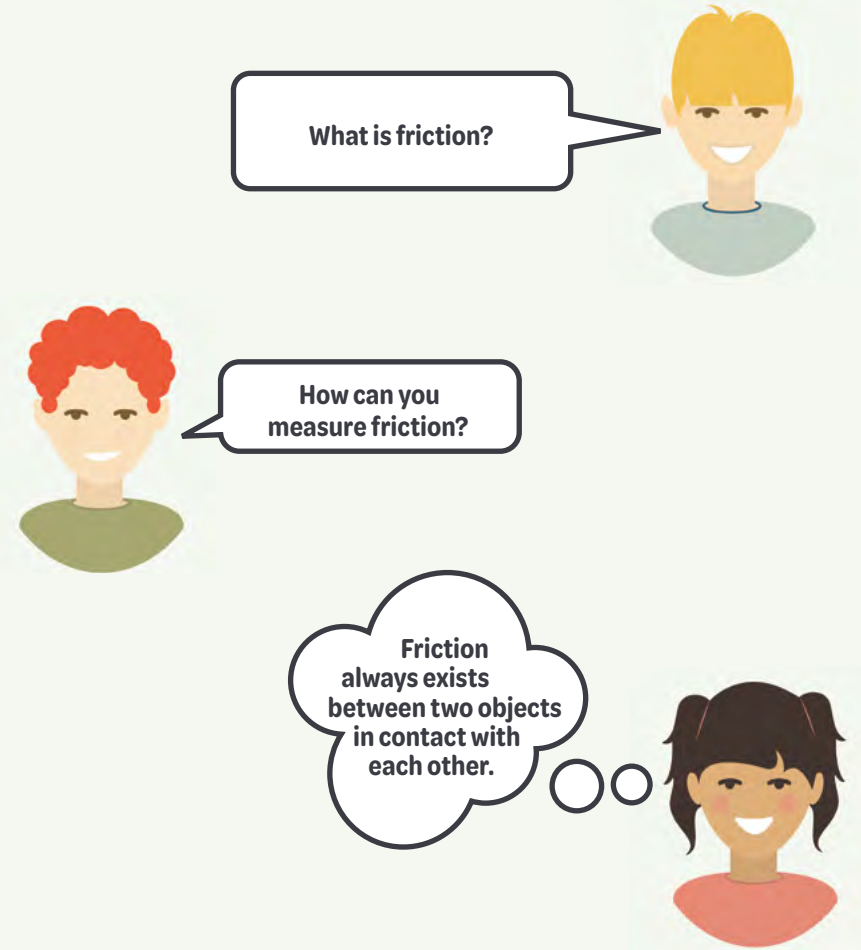
Let's Investigate

Friction and Air Resistance

How can you increase friction between materials?



What do you think?

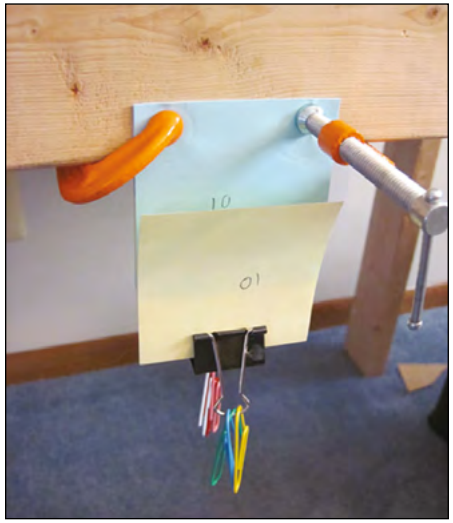


Let's Investigate

Friction and Air Resistance

Method:

1. Overlap an equal number of pages in 2 bundles of post it notes
2. Suspend these from a surface
3. Add a small weight to the bottom
4. Continue to increase weight
5. Record the weight held before the pages separate
6. Repeat for different numbers of overlapping pages



Results:

Number of overlapped pages	Number of paper clips held			
	Trial 1	Trial 2	Trial 3	Average
10				
20				
30				

Teacher Guide: Friction and Air Resistance

SCN 2-07a

By investigating how friction, including air resistance, affects motion, I can suggest ways to improve efficiency in moving objects

This experiment investigates how the force of friction changes with increasing surface area. The following video can be watched as context for pupils: *https://www.youtube.com/watch?v=AX_ICOjLCTo (or search 'Mythbusters phonebook friction').*

The experiment will develop investigative and inquiry skills within the context of friction. 2-07a. It is suggested pupils carry out this experiment when learning that friction is a force which opposes the motion of moving objects and prior to their investigations on streamlining.

This experiment requires the use of G-clamps. These could be borrowed from the Design and Technology department of your cluster secondary school, or alternatively a set can be borrowed from Elderbank Primary School.

Key Vocabulary:

Friction: Friction is the resistance to motion of one object moving relative to another.

Interleave: To put layers or flat pieces of something between layers or flat pieces of something else.

How to:

Introduce the investigation with the following activity. Take two stacks of sticky notes with 5 pages each, and interleave the pages, or overlap them one by one. Then try to pull them apart, like in Figure 1. Easy, right? Now try it with 20 pages per stack. Can you pull them apart at all? Why is it so much harder?

Ask students to consider the following discussion questions:

- What is friction? What does friction depend on?
- Why can two phone books with interleaved pages support so much weight?

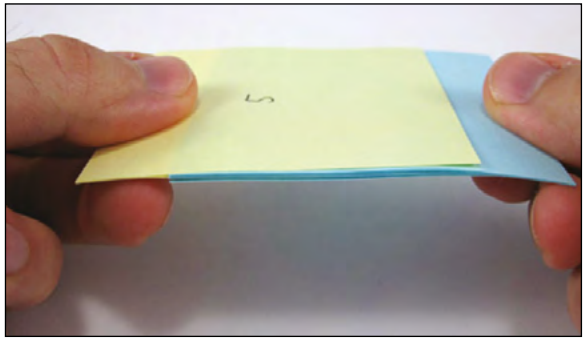


Figure 1. Try to pull apart two small stacks of sticky notes with interleaved pages.

The pages of the sticky note pads are held together by friction. Even a small number of interleaved pages can result in a surprisingly large amount of friction, making the sticky notes impossible to pull apart.

Aim:

How does the number of interleaved sticky notes affect the number of paperclips held.

Independent Variable (the variable that is changing):

The number of interleaved sticky notes.

Dependent Variable (the variable that is measured):

The number of paper clips held.

Control Variable:

The size of sticky notes

The type of paper clip

Overlap distance.

Materials (per group):

2 Pads of sticky notes with 15 pages in each pad

Mini C-clamps or spring clamps (2)

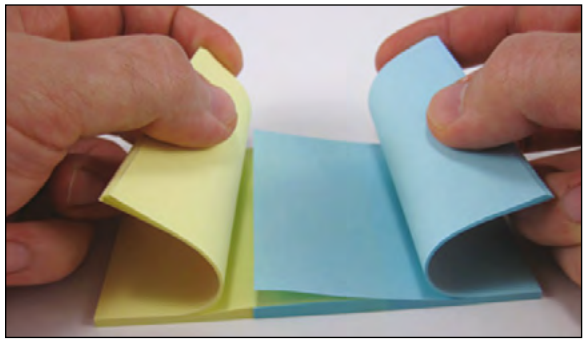
Large binder clip

Paper clips (at least 20)

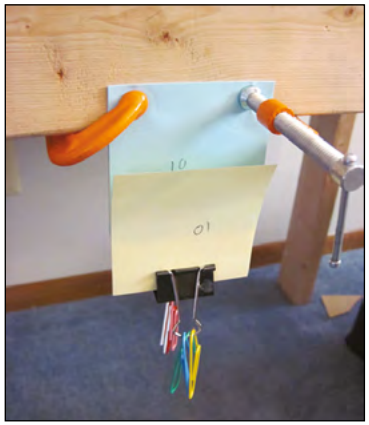
Vertical surface to clamp the sticky notes to, like the edge of a table or desk.

Method:

1. To save resources, pupils should first test their pads of 15 sticky notes. Overlap each page 1 at a time as shown in the diagram below.



2. Use a two G-clamps to attach one of the pads to a vertical surface as shown in the diagram below.



3. Attach a large binder clip to the bottom pad and add paper clips one at a time until the sticky note pads are pulled apart. If groups run out of paper clips they could work together.
4. Record the number of paper clips held by 30 overlapped sticky notes in the results table.
5. From each pad of 15 sticky notes, remove 5 sticky notes to create a pad of 5 sticky notes and a pad of 10 sticky notes.
6. Using the pads of 10 sticky notes, repeat the procedure to find out how many paper clips are held by 20 overlapped sticky notes.
7. Using the pads of 5 sticky notes, repeat the procedure to find out how many paper clips are held by 10 overlapped sticky notes.

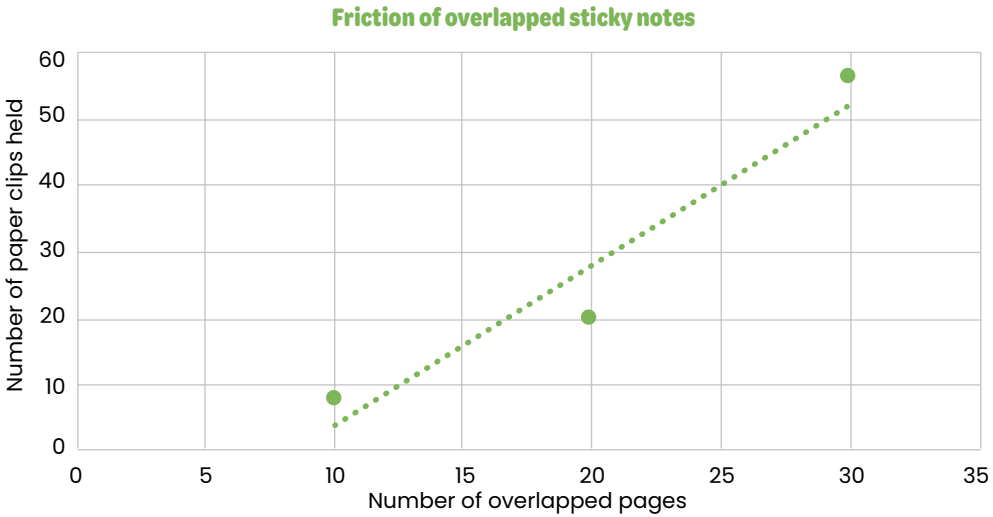
Results:

The table shows 'Number of overlapped pages'. This is the total pages in 2 equal pads. Pupils might prefer to use the heading 'Pages per pad'.

Number of overlapped pages	Number of paper clips held			
	Trial 1	Trial 2	Trial 3	Average
10				
20				
30				

Presenting Data:

The data produced in this investigation is *continuous* data and should therefore be presented as a line graph. Individual results will vary, however expected results should produce a graph similar to the one below.



Conclusion:

For expected results the conclusion should state the trend shown in the results e.g. The more pages overlapping, the more paperclips that could be held.

For unexpected results (i.e. there is no obvious trend), a statement of the strongest number of overlapped pages is all that is required. E.g. 20 overlapping pages held the most paper clips.

Evaluation:

An evaluation is a discussion around how this experiment could be even more accurate. Pupils might raise the following issues:

- Distance of overlap
- Placement of weights
- Weight increments
- Effect of clips

For each cause of possible inaccuracy, pupils should try to think of a method that would minimise errors.

Alternative methods:

To save resources, this can be scaled down to investigate the following overlapped pages: 2 pads of 8 sticky notes, 2 pads of 6 sticky notes, and 2 pads of 4 sticky notes.

If there are limited paper clips, pupils could suspend a plastic cup from the bottom sticky note pad and slowly fill it with counters/marbles/pencils etc.

Interdisciplinary Learning:

Numeracy:

Data Analysis:	2-20a, 2-20b, 2-21a
Number and Number Processes:	2-03a

Literacy:

Tools for Writing	LIT 2-23a
Creating texts (writing)	LIT 2-28a

This activity has been adapted from sciencebuddies.com
https://www.sciencebuddies.org/

Skill Organiser	Skills	Addressed in Activity
Inquiry and investigative skills	**Plans and designs scientific investigations and enquiries**	
	Formulates questions and predictions (hypotheses), with assistance, based on observations and information	✓
	Identifies the independent, dependent and controlled variables, with assistance.	✓
	Anticipates some risks and hazards.	✓
	Carries out practical activities in a variety of learning environments	
	Applies appropriate safety measures.	✓
	Contributes to carrying out all the procedures.	✓
	Makes observations and collects information and measurements using appropriate devices and units.	✓
	Manages identified controlled variables to ensure validity of results.	✓
	Analyses, interprets and evaluates scientific findings	
	Selects appropriate methods to record data/information.	✓
	Identifies relationships between the independent and dependent variables.	✓
	Makes links to original questions or predictions.	✓
	Relates findings to the wider world.	✓
	Draws basic conclusions consistent with findings.	✓
	Identifies and discusses additional knowledge and understanding gained.	✓
	Recognises anomalous results and suggests possible sources of error.	✓
	Evaluates the investigation and suggests one way of improving it if it was to be repeated.	✓
	Presents scientific findings	
	Presents data/information by choosing from an extended range of tables, charts, diagrams, graphs, including bar graphs and line graphs.	✓
	Reports collaboratively and individually using a range of methods.	✓
	Collates, organises and summarises findings, with assistance, using headings or questions to provide structure for presentations.	✓
	Uses appropriate scientific vocabulary and acknowledges sources, with assistance.	✓

Forces, Electricity and Waves

SCN2-07a

Skill Organiser	Skills	Addressed in Activity
Scientific analytical thinking skills	Applies scientific analytical thinking skills, with assistance, working with less familiar (or familiar but more complex) contexts.	✓
	Applies understanding, and a combination of more than one science concept, to solve problems and provide solutions.	✗
	Demonstrates further development of creative thinking including through the engineering processes of design, construction, testing and modification.	✗
Skills and attributes of scientifically literate citizens	Presents a reasoned argument based on evidence, demonstrating understanding of underlying scientific concepts, and engages with the views of others.	✗
	Demonstrates understanding of the relevance of science to their future lives and the role of science in an increasing range of careers and occupations.	✗
	Demonstrates increased awareness of creativity and inventiveness in science, the use of technologies in the development of sciences and the impact of science on society.	✗
	Expresses informed views about scientific and environmental issues based on evidence.	✗

Risk Assessment

Task/Activity/Process Description	Friction Experiment	**Service**	Communitites
Location	School Name	**Reference**	To be completed by school

Types of Injury/Loss/Ill Health	trips and slips, falling objects

For each hazard, please identify the person at risk (direct and indirect)

Consider those especially vulnerable (young or inexperienced workers, members of the public, school pupils, the elderly, residents and contractors)

NOTE: New and expectant mothers require a separate risk assessment

Haz No.	Hazard	Source of Hazard	Persons at Risk	Current Control Measures in Place	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Risk Rating (1-25)
1	Tools/Equipment	G-Clamps	Employee/Pupil	Staff should demonstrate how to securely attached the G-clamps to the table. G-clamps may fall from the table onto the floor. Pupils should not sit or have any part of their body beneath the G clamp. When not in use they should be placed in the centre of the table.	2	2	4
2	Slip/Trip/Fall	Post it notes on floor	Employee/Pupil	Discarded post it notes on the floor pose a risk of slipping. Pupils should be instructed to keep their work space clean.	2	2	4
3	Slip/Trip/Fall	Classroom furniture	Employee/Pupil	Chairs should be tucked neatly under desks, pupil movement should be managed.	1	2	2
4	Other (please identify)	Pupil behavior		School to complete			
5	Other (please identify)	Pupil additional needs		School to complete			0
6							
7							
8							0
9							0
10							0
11							0
12							0
13							0
14							0

Risk Reduction

Haz No.	Additional Control Measures	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Final Risk Rating (1-25)	Action By (name and target date)	Date Control Implemented	Sign to Confirm
1	As low as reasonably possible			0			
2	As low as reasonably possible			0			
3	As low as reasonably possible			0			
4	As low as reasonably possible			0			
5	As low as reasonably possible			0			
6				0			
7				0			
8				0			
9				0			
10				0			
11				0			
12				0			
13				0			
14				0			

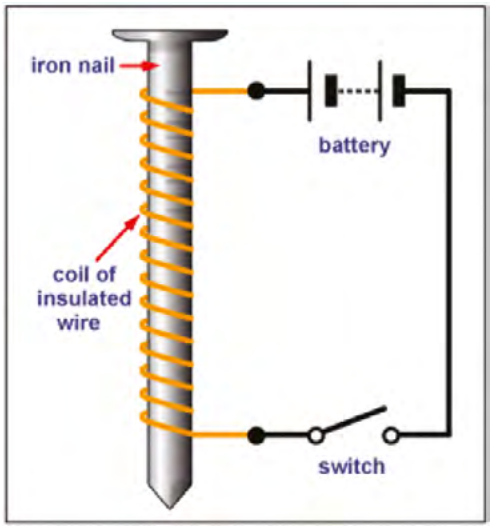
Assessor(s) Name (print)	Assessment Date	Manager Name (print)

Assessor(s) Signature	Review Date	Manager Signature	Date

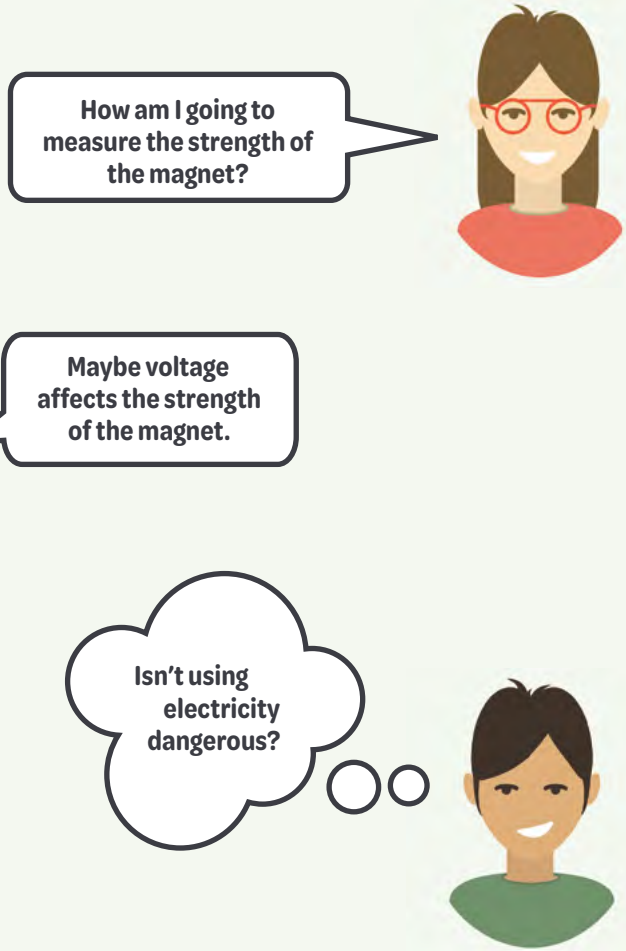
Let's Investigate

Electromagnets

What might affect the strength of an electromagnet?



What do you think?



Let's Investigate

Electromagnets

Method

1. Build your electromagnet circuit as shown in the diagram.
2. Coil the 60cm length of wire around the nail 10 times.
3. Turn on the switch and move the nail through a pile of paperclips.
4. Record the number of paper clips held by the electromagnet.
5. Repeat 2 more times and calculate the average number of paper clips held.
6. Repeat for an electromagnet made with 20, 30 and 40 coils of wire.

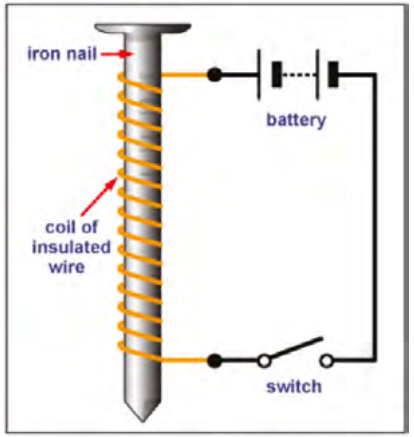


Image: Rajiv1840478 Wikimedia creative commons

Results:

Coils of wire	Number of paper clips held			
	Trial 1	Trial 2	Trial 3	Average
10				
20				
30				
40				

Teacher Guide: Electromagnets

SCN 2-08a

I have collaborated in investigations to compare magnetic, electrostatic and gravitational forces and have explored their practical applications.

This experiment develops investigative and inquiry skills through the context of electromagnets. It can be supported by researching the industrial applications of electromagnets which include circuit breakers and sorting scrap metal. This experiment can also be used to support SCN2-09a *(I have used a range of electrical components to help make a variety of circuits for differing purposes)*.

Key Vocabulary:

Electromagnet: A magnetic field created when electricity flows through wire coiled around an iron core. The ability to switch the electricity on and off makes electromagnets temporary magnets.

Aim:

To investigate how the number of coils of wire an electromagnet has affects the number of paperclips it can hold.

Independent Variable (the variable that is changing):

Number of coils of wire around nail.

Dependent Variable (the variable that is measured):

Number of paper clips held by electromagnet.

Control Variables:

The voltage should be kept the same (same number of cells/batteries)

The same nail should be used each time.

The same size of paperclip should be used each time.

Materials (per group):

1 x 1.5V cell

1 x Switch

1 x Large nail

1 x 60cm insulated wire with stripped ends

3 x crocodile clips

12 steel paperclips

Set up the circuit as shown.

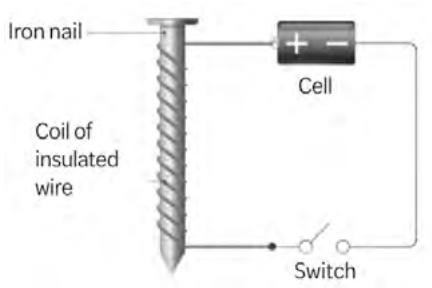


Image: http://www.hartschool.org.uk/wp-content/uploads/2018/10/HSC_KeyCurric_Sci_Y8_KO_Magnets.pdf

Results:

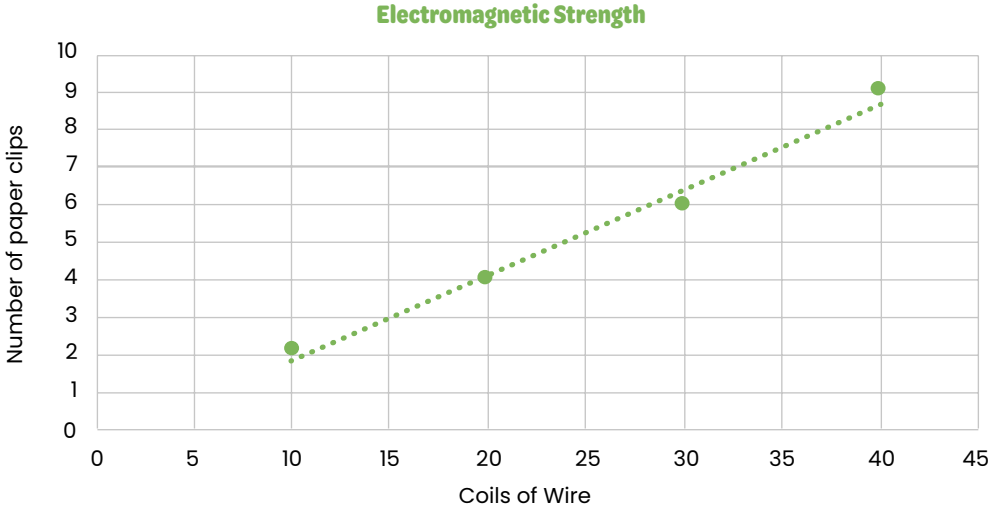
It is expected that as the number of coils of wire increases, the number of paper clips held by the electromagnet increases.

Expected results would show a similar pattern to those shown below. They are not likely to be identical as voltage supplied by individual cells will decrease over time.

Number of coils of wire	Number of paper clips held by electromagnet			
	Trial 1	Trial 2	Trial 3	Average
10	2	3	2	2
20	4	5	4	4
30	6	6	6	6
40	9	10	9	9

Presenting data:

This data should be presented as a line graph as the 'number of coils of wire' is continuous data.



Conclusion:

For expected results such as those shown above, the conclusion should state the trend shown in the results. E.g. As the number of coils of wire increased, the number of paper clips held by the electromagnet increased.

Unexpected results

At second level, if there is no trend in results, an answer to the aim is sufficient. For data like the example above an appropriate conclusion is '20 coils of wire held the most paperclips.'

At third level and above, a conclusion should state that no trend has been shown. E.g. the results do not show a trend with the number of coils and the strength of the electromagnet. This can be used to extend more able pupils.

Number of coils of wire	Number of paper clips held by electromagnet			
	Trial 1	Trial 2	Trial 3	Average
10	2	3	2	2
20	11	13	12	12
30	6	6	6	6
40	9	10	9	9

Table showing Unexpected results.

Evaluation:

Common factors that might affect the results are:

1. The cell loses voltage during the experiment.
2. The coils of wire don't stay tightly coiled around the nail.

Through discussion, pupils might come up with the following improvements:

- make sure the cell is disconnected between experiments to save power.
- new cells could be used every time (expensive option, but valid improvement).
- a voltmeter could be used to measure the voltage and make sure the same volts are used every time.
- tape could be used to fix the coils of wire tightly to the iron nail.

Misconceptions:

Electromagnets still have a north and a south pole. This can be investigated by placing a bar magnet near your electromagnet.

Interdisciplinary Learning:

Science:

Electrical Circuits	SCN 2-09a

Literacy:

Tools for writing	LIT 2-23a
Creating texts	LIT 2-28a

Numeracy:

Data and Analysis	MNU1-20b, MTH 1-21a, MNU 2-20b, MTH 2-21a

Forces, Electricity and Waves

SCN2-08a

Skill Organiser	Skills	Addressed in Activity
Inquiry and investigative skills	**Plans and designs scientific investigations and enquiries**	
	Formulates questions and predictions (hypotheses), with assistance, based on observations and information	✓
	Identifies the independent, dependent and controlled variables, with assistance.	✓
	Anticipates some risks and hazards.	✓
	Carries out practical activities in a variety of learning environments	
	Applies appropriate safety measures.	✓
	Contributes to carrying out all the procedures.	✓
	Makes observations and collects information and measurements using appropriate devices and units.	✓
	Manages identified controlled variables to ensure validity of results.	✓
	Analyses, interprets and evaluates scientific findings	
	Selects appropriate methods to record data/information.	✓
	Identifies relationships between the independent and dependent variables.	✓
	Makes links to original questions or predictions.	✓
	Relates findings to the wider world.	✓
	Draws basic conclusions consistent with findings.	✓
	Identifies and discusses additional knowledge and understanding gained.	✓
	Recognises anomalous results and suggests possible sources of error.	✓
	Evaluates the investigation and suggests one way of improving it if it was to be repeated.	✓
	Presents scientific findings	
	Presents data/information by choosing from an extended range of tables, charts, diagrams, graphs, including bar graphs and line graphs.	✓
	Reports collaboratively and individually using a range of methods.	✓
	Collates, organises and summarises findings, with assistance, using headings or questions to provide structure for presentations.	✓
	Uses appropriate scientific vocabulary and acknowledges sources, with assistance.	✓

Skill Organiser	Skills	Addressed in Activity
Scientific analytical thinking skills	Applies scientific analytical thinking skills, with assistance, working with less familiar (or familiar but more complex) contexts.	✓
	Applies understanding, and a combination of more than one science concept, to solve problems and provide solutions.	✗
	Demonstrates further development of creative thinking including through the engineering processes of design, construction, testing and modification.	✗
Skills and attributes of scientifically literate citizens	Presents a reasoned argument based on evidence, demonstrating understanding of underlying scientific concepts, and engages with the views of others.	✗
	Demonstrates understanding of the relevance of science to their future lives and the role of science in an increasing range of careers and occupations.	✗
	Demonstrates increased awareness of creativity and inventiveness in science, the use of technologies in the development of sciences and the impact of science on society.	✗
	Expresses informed views about scientific and environmental issues based on evidence.	✗

Risk Assessment

Task/Activity/Process Description	Electrical Circuits – Electromagnet	**Service**	Communitites
Location	School Name	**Reference**	To be completed by school

Types of Injury/Loss/Ill Health	minor electric shock, cuts and abrasions

For each hazard, please identify the person at risk (direct and indirect)

Consider those especially vulnerable (young or inexperienced workers, members of the public, school pupils, the elderly, residents and contractors)

NOTE: New and expectant mothers require a separate risk assessment

Haz No.	Hazard	Source of Hazard	Persons at Risk	Current Control Measures in Place	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Risk Rating (1-25)
1	Electricity	Electric shock from high voltages	Employee/Pupil	Only 1 x 1.5V cell is needed for this experiment. If pupils investigate affect of increasing voltage, a maximum of 3 x 1.5V cells should be used, and a switch must be included in the circuit. Pupils should still be instructed to disconnect the cell (battery) before making any changes to the circuit.	1	2	2
2	Sharps	Broken light bulbs	Employee/Pupil	Pupils should report any broken light bulbs to staff who should dispose of them in general waste bins. They should be wrapped in sufficient paper to protect cleaning staff from cuts.	1	2	2
3	Sharps	Crocodile clips	Employee/Pupil	Crocodile clips should only be used as intended and not connected to any part of the body.	2	2	4
4	Sharps	Iron nail	Employee/Pupil	The iron nail should only be used as intended.	2	2	4
5	Temperature	Burns from heated wires/ melted plastic.	Employee/Pupil	If the circuit remains on for extended periods of time the wire wrapped around the iron nail will start to heat up and may cause the insulating plastic to melt. A switch should be included in the circuit so that it can be turned off easily when not in use.	2	2	4
6	Slip/Trip/Fall	Classroom furniture	Employee/Pupil	Ensure pupils have adequate space to carry out the experiement and move about the room without risk of tripping on chairs.	2	2	4
7	Other (please identify)	Pupil additional needs	Employee/Pupil	to be completed by school			0
8	Other (please identify)	pupil behaviour	Employee/Pupil	to be completed by school			0
9							
10							
11							0
12							0
13							0
14							0

Risk Reduction

Haz No.	Additional Control Measures	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Final Risk Rating (1-25)	Action By (name and target date)	Date Control Implemented	Sign to Confirm
1	As low as reasonably possible			0			
2	As low as reasonably possible			0			
3	As low as reasonably possible			0			
4	As low as reasonably possible			0			
5	As low as reasonably possible			0			
6	As low as reasonably possible			0			
7	As low as reasonably possible			0			
8	As low as reasonably possible			0			
9				0			
10				0			
11				0			
12				0			
13				0			
14				0			

Assessor(s) Name (print)	Assessment Date	Manager Name (print)

Assessor(s) Signature	Review Date	Manager Signature	Date

Let's Investigate

Flotation and Buoyancy

What causes a boat to say upright in the water?

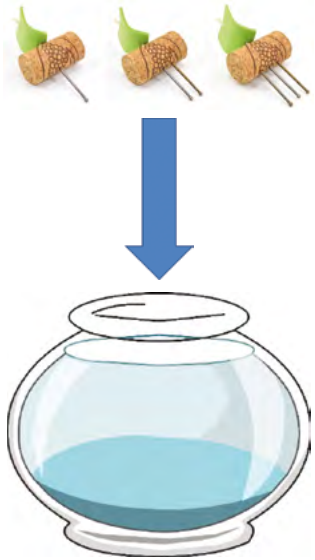
What do you think?

Let's Investigate

Floatation and buoyancy

Method:

1. Collect the items needed to build a boat.
2. Construct a boat with a 4cm x 4cm sail.
3. Test this boat in the water to see if it floats upright.
4. Add nails to the bottom of the boat and test until it floats.
5. Re-test a further two times and record the average number of nails.
6. Repeat the procedure for a boat with a 6 x 6 cm sail, and a boat with an 8 x 8 cm sail.



Results:

Sail dimensions	Number of nails required to float upright			
	Trial 1	Trial 2	Trial 3	Average
4 × 4 cm				
6 × 6 cm				
8 × 8 cm				

Teacher Guide: Flotation and Buoyancy

SCN 2-08b

By investigating floating and sinking of objects in water, I can apply my understanding of buoyancy to solve a practical challenge.

This experiment develops investigative and inquiry skills through the context of Buoyancy and the role of a keel on a boat.

Key Vocabulary:

Balance: An even distribution of weight enabling someone or something to remain upright and steady.

Capsize: To be overturned in the water.

Centre of mass: The centre of mass of an object is the point at which the object can be balanced.

Ballast: Ballast is material that is used to provide stability to a vehicle or structure.

Keel: The lengthwise timber or steel structure along the base of a ship, supporting the framework of the whole, in some vessels extended downwards as a ridge to increase stability.

Aim:

How does the size of sail affect the size of the keel needed to stop a boat capsizing?

Independent Variable (the variable that is changing):

Size of sail

Dependent Variable (the variable that is measured):

Number of nails

Control Variables (the variables that are not changing):

Size/shape of cork

material of mast

depth of water

Materials (per group):

- Identical wine corks (3)
- Wooden skewers (5)
- Craft foam or paper milk cartons (material to make a sail)
- Identical nails or screws that are roughly the length of your corks (about 10–20, exactly how many you need will vary depending on their size)
- Sink, bathtub, or a large container you can fill with water. The container should be deeper than the length of your nails/screws.
- Water
- Ruler
- Scissors

Method:

1. If you haven't already, watch the YouTube video to show you how to make the sail boats. Search 'DIY Toy Sailboat' and watch the videos by *Science Buddies*.
2. Fill your container with water. Make sure the water is deeper than the length of your longest nail/screw.
3. Cut a 4-centimetre (cm) section from the pointy end of a wooden skewer. The skewer will be your mast (the part that supports the sail).
4. Cut a 4×4 cm square of your sail material.
5. Poke the pointy end of the skewer through the edges of the sail, then poke it into the cork to make your first sailboat.

7. Put your sailboat in water and watch what happens.
8. Poke a nail into the bottom of your boat to form a ballast, directly opposite the mast.

Sailboat with a nail for ballast.

8. Put your boat back in water and watch what happens.
9. If your boat still doesn't stay upright, add a second nail in a straight line with the first one (see image below) and put it in the water again.
10. Keep adding nails, one at a time, and re-testing until your boat stays upright.
11. Record the number of nails it took to keep your boat upright in your data table.

This picture shows how to add more nails to the bottom of your boat. Try to make sure the nails are approximately centred on the cork-front to back. Put the first nail in the middle of the cork. If you put the second nail *behind* the first nail, then you should put the third nail in *front* of the first nail, and so on.

12. Repeat steps 4–11 two more times, for a total of three trials for this sail size (make a new boat for each trial). Remember to record your results in your data table.
13. Repeat steps 4–12 for sail sizes of 6×6 cm (use a 6 cm mast) and 8×8 cm (use an 8 cm mast). If necessary, you can re-use the same three corks (remove the nails and previous sails from the corks first).
14. Make a graph of your data, with sail dimensions on the horizontal axis and the average number of nails you needed to keep the boat upright on the vertical axis.

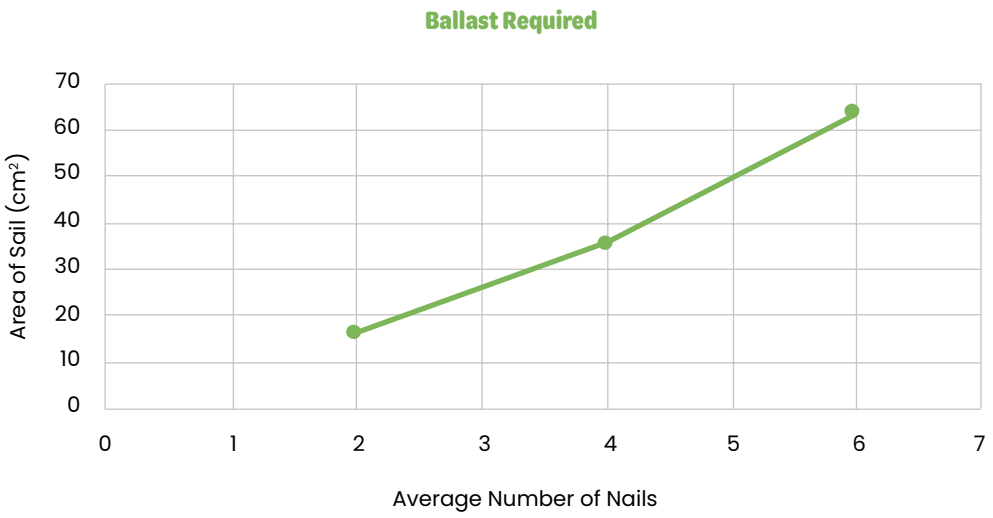
Results:

It is expected that the larger the sail size, the more nails would be required to make it float. Class discussion around variables and fair testing should lead to pupils deciding that the point of balance is when the boat sits upright in a stable manner.

Sail Dimensions	Number of nails required to keep boat upright			
	Trial 1	Trial 2	Trial 3	Average
4 × 4 cm				
6 × 6 cm				
8 × 8 cm				

Presenting data:

This investigation produces *continuous data* which should be presented as a line graph and would look similar to that below.



Conclusion:

For expected results: The conclusion should state the trend shown in the results e.g. The larger the sail, the greater the greater the number of nails required.

For unexpected results, a statement indicating the largest keel size is sufficient. E.g. The 6 x 6 cm sail required the most nails to stop it capsizing.

Evaluation:

An evaluation is a discussion around how this experiment could be even more accurate. Pupils might raise the following issues:

- Depth of water
- Placement of nails
- Determining what is upright and stable
- Accuracy of sail size

For each cause of possible inaccuracy, pupils should try to think of a method that would minimise errors.

Interdisciplinary Learning:

Numeracy:

Data Analysis:	2-20a, 2-20b, 2-21a
Number and Number Processes:	2-03a

Literacy:

Tools for Writing	LIT 2-23a
Creating texts (writing)	LIT 2-28a

This activity has been adapted from sciencebuddies.org
https://www.sciencebuddies.org/

The method shown was taken from sciencebuddies.org, however to reduce the materials needed and waste produced, pupils can start with a sail and mast size of 8cm. Once that part of the experiment has been completed they can be trimmed to a sail and mast size of 6cm, then trimmed again to a sail and mast size of 4cm.

Health and Safety note:

This investigation should be carried out with nails of a similar size to the corks. Plastic corks should not be used. When placing the nails in the corks, the corks should be placed on the table and the nail pressed down into the cork. Pupils can press the cork into a large piece of plasticine to hold it still, they should not hold the cork with their other hand as if the nail slips they may cut themselves. Pupils should be able to press the nails into the corks without using a large force. This experiment should not be carried out if pupils are finding it difficult to press nails into corks.

Forces, Electricity and Waves SCN2-08b

Skill Organiser	Skills	Addressed in Activity
Inquiry and investigative skills	**Plans and designs scientific investigations and enquiries**	
	Formulates questions and predictions (hypotheses), with assistance, based on observations and information	✓
	Identifies the independent, dependent and controlled variables, with assistance.	✓
	Anticipates some risks and hazards.	✓
	Carries out practical activities in a variety of learning environments	
	Applies appropriate safety measures.	✓
	Contributes to carrying out all the procedures.	✓
	Makes observations and collects information and measurements using appropriate devices and units.	✓
	Manages identified controlled variables to ensure validity of results.	✓
	Analyses, interprets and evaluates scientific findings	
	Selects appropriate methods to record data/information.	✓
	Identifies relationships between the independent and dependent variables.	✓
	Makes links to original questions or predictions.	✓
	Relates findings to the wider world.	✓
	Draws basic conclusions consistent with findings.	✓
	Identifies and discusses additional knowledge and understanding gained.	✓
	Recognises anomalous results and suggests possible sources of error.	✗
	Evaluates the investigation and suggests one way of improving it if it was to be repeated.	✓
	Presents scientific findings	
	Presents data/information by choosing from an extended range of tables, charts, diagrams, graphs, including bar graphs and line graphs.	✓
	Reports collaboratively and individually using a range of methods.	✓
	Collates, organises and summarises findings, with assistance, using headings or questions to provide structure for presentations.	✓
	Uses appropriate scientific vocabulary and acknowledges sources, with assistance.	✓

Skill Organiser	Skills	Addressed in Activity
Scientific analytical thinking skills	Applies scientific analytical thinking skills, with assistance, working with less familiar (or familiar but more complex) contexts.	✓
	Applies understanding, and a combination of more than one science concept, to solve problems and provide solutions.	✗
	Demonstrates further development of creative thinking including through the engineering processes of design, construction, testing and modification.	✗
Skills and attributes of scientifically literate citizens	Presents a reasoned argument based on evidence, demonstrating understanding of underlying scientific concepts, and engages with the views of others.	✗
	Demonstrates understanding of the relevance of science to their future lives and the role of science in an increasing range of careers and occupations.	✗
	Demonstrates increased awareness of creativity and inventiveness in science, the use of technologies in the development of sciences and the impact of science on society.	✗
	Expresses informed views about scientific and environmental issues based on evidence.	✗

Risk Assessment

Task/Activity/Process Description	buoyancy Investigation	**Service**	Communitites
Location	School Name	**Reference**	To be completed by school

Types of Injury/Loss/Ill Health	slips and trips, cuts and scratches

For each hazard, please identify the person at risk (direct and indirect)

Consider those especially vulnerable (young or inexperienced workers, members of the public, school pupils, the elderly, residents and contractors)

NOTE: New and expectant mothers require a separate risk assessment

Haz No.	Hazard	Source of Hazard	Persons at Risk	Current Control Measures in Place	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Risk Rating (1-25)
1	Sharps	Nails and wooden skewers	Employee/Pupil	This investigation should be carried out with nails of a similar size to the corks. Plastic corks should not be used. When placing the nails in the corks, the corks should be placed on the table and the nail pressed down into the cork. Pupils can press the cork into a large piece of plasticine to hold it still, they should not hold the cork with their other hand as if the nail slips they may cut themselves. Pupils should be able to press the nails into the corks without using lots of force. This experiment should not be carried out if pupils are finding it difficult to press nails into corks.	3	2	6
2	Slip/Trip/Fall	spilled water	Employee/Pupil	Paper towel available to clean spills. This experiment can be performed in a tote tray to catch any spills.	2	2	4
3	Slip/Trip/Fall	Classroom furniture	Employee/Pupil	Chairs should be tucked neatly under desks, pupil movement should be managed.	1	2	2
4	Other (please identify)	Pupil behavior	Employee/Pupil	School to complete			0
5	Biological	Pupil additional needs	Employee/Pupil	School to complete			0
6							0
7							0
8							0
9							0
10							0
11							0
12							0
13							0
14							0

Risk Reduction

Haz No.	Additional Control Measures	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Final Risk Rating (1-25)	Action By (name and target date)	Date Control Implemented	Sign to Confirm
1	As low as reasonably possible			0			
2	As low as reasonably possible			0			
3	As low as reasonably possible			0			
4	As low as reasonably possible			0			
5	As low as reasonably possible			0			
6				0			
7				0			
8				0			
9				0			
10				0			
11				0			
12				0			
13				0			
14				0			

Assessor(s) Name (print)	Assessment Date	Manager Name (print)

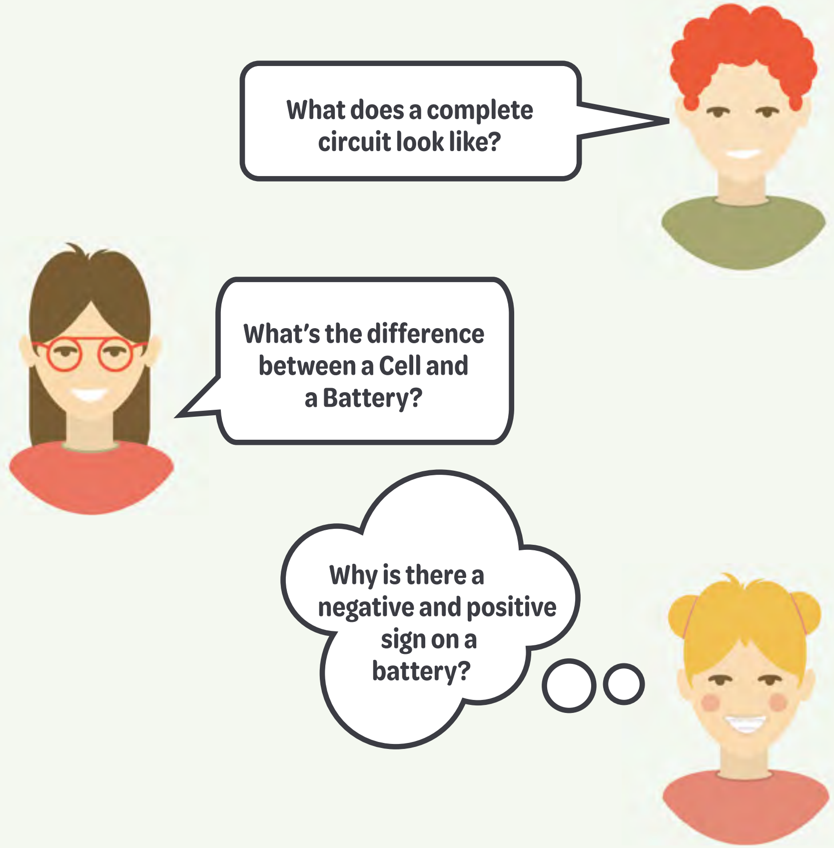
Assessor(s) Signature	Review Date	Manager Signature	Date

Let's Investigate

It's Electric!

How can I make a light bulb light using a cell, wires and crocodile clips?

What do you think?



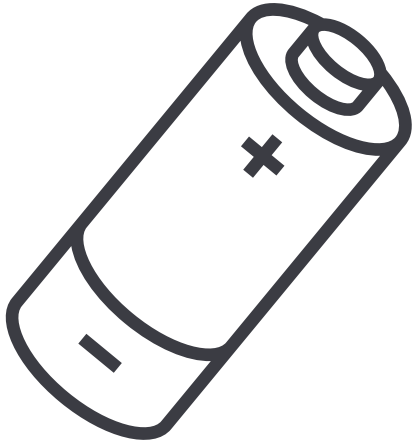
Let's Investigate

It's Electric!

Activity 1

Method:

1. Collect a cell and holder, bulb and holder and wires with crocodile clips.
2. Build a working circuit to show bulb lighting up.
3. Discuss with your group how you managed to make the bulb light.
4. Report back to class.



Activity 2

Method:

1. Collect buzzer and/or motor.
2. Investigate with your partner how you can change the previous circuit to either make the buzzer buzz or the motor spin.
3. Draw a diagram of your working circuit using symbols to represent the buzzer or motor (see circuit help sheet for different symbols).

Teamwork

Let's Investigate

It's Electric!

Activity 3

Method:

1. Collect a circuit card – any number is fine.
2. With your group predict whether the bulb will or will not light (remember to justify your prediction).
3. Draw a table similar to the one below in your jotter and write your prediction on the table next to correct card number.
4. Construct the circuit to test your prediction.
5. Put a tick or cross in the result table to show if the bulb did or did not light.

Results:

Circuit	Prediction	Result
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Card 1

Is it a circuit? Predict then test!

Card 2

Is it a circuit? Predict then test!

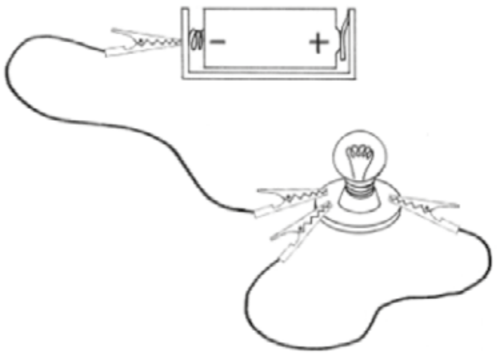
Card 3

Is it a circuit? Predict then test!

Card 4

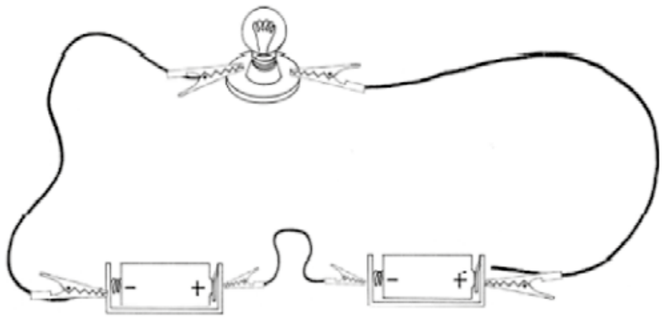
Is it a circuit? Predict then test!

Card 5



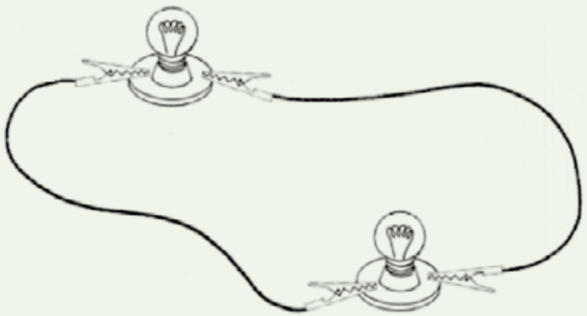
Is it a circuit? Predict then test!

Card 6



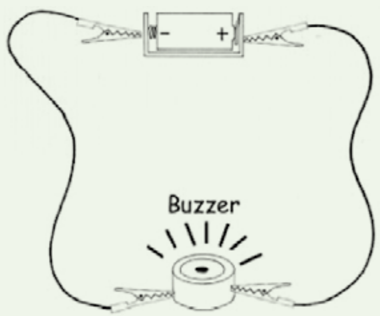
Is it a circuit? Predict then test!

Card 7



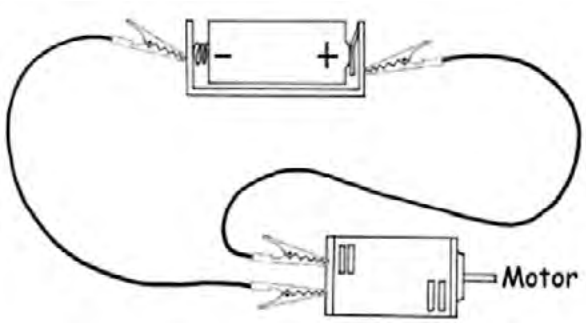
Is it a circuit? Predict then test!

Card 8



Is it a circuit? Predict then test!

Card 9



Is it a circuit? Predict then test!

Card 10

Is it a circuit? Predict then test!

Teacher Guide: It's Electric!

SCN 2-09a

I can design and build a variety of electrical circuits for differing purposes, using an increasing range of components.

I can draw circuit diagrams using appropriate symbols to denote a bulb, buzzer, wires and cell.

Key Vocabulary and symbols:

electricity, circuit, switch, battery, plug, mains, appliance, device, wire, crocodile clip, bulb, buzzer, connection, power, cell, energy, flow, current

buzzer

motor

bulb

cell

wire

switch

Aim:

- To construct a simple circuit, identifying the basic parts and to label a diagram of the circuit.
- To predict if different 'circuit' layouts will light a bulb, and then test their predictions.

The Big Questions:

How can I make a light bulb light using a cell, wires and crocodile clips?

Materials (per group):

Wires, cells (batteries), crocodile clips, bulbs, buzzers, motors, diagram sheet, 'Is it a circuit?' sheets (laminate a number of sets before the session if possible)

Lessons:

Introduction

Set out a range of resources for making a circuit, including wires, crocodile clips, cells (batteries), bulbs, buzzers and motors. Ask one child from each group to hold up a wire. Repeat with all the resources, encouraging the correct use of language. Children may be confused when asked to hold up a cell. The difference between a cell and a battery is that a cell is a single unit that converts chemical energy into electrical energy, and a battery is a collection of cells. A simple explanation for difference between cell and a battery can be found at: *https://www.bbc.co.uk/bitesize/guides/zsfgr82/revision/2*

Activity 1 – Building a circuit using a bulb

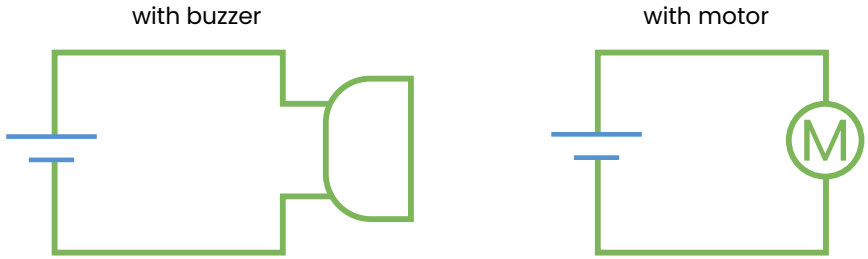
Model building a simple series electrical circuit including wires, a battery holder, a cell, a bulb holder and a bulb (possibly crocodile clips). Children repeat the circuit with their partner. Explain that the cell converts the chemical energy stored within it, into electrical energy which, in turn, makes the bulb light up. Demonstrate what happens when you make a break in the circuit, explain that the electrical current flows around the circuit, and the circuit must be complete for the bulb to light.

Activity 2 – Building and drawing a circuit using a motor or buzzer

Show them a motor and a buzzer and explain that the bulb can be replaced with either. Ask children to make a circuit with a working buzzer or motor. Encourage them to explain to their partner what has made the device work using scientific language. Show a diagram of a simple circuit (see resources). Explain that in science they would use clear diagrams rather than sketches – point out the symbol for bulb and cell, and the straight lines for the wires. On their sheet, ask children to draw a scientific diagram of the circuit for a buzzer or a motor – display the symbols for each.

Activity 3 – Circuit cards

Working in mixed ability groups of 2/3 children look at a range of simple circuits drawn on cards to predict whether or not the circuits will work. They must first explain why they think that and then construct the circuits to test their prediction. Explain that they must record their predictions and findings on the sheet. Encourage use of scientific language.



Presenting data Activity 3

Complete the table

Results of table:

Circuit	Prediction	Result
1	Not connected to negative to make complete circuit	✗
2	Not connected to negative to make complete circuit	✗
3	Complete circuit	✓
4	Complete circuit	✓
5	Not connected to positive to make complete circuit	✗
6	Complete circuit	✓
7	Not connected to power supply	✗
8	Complete circuit	✓
9	Complete circuit	✓
10	Not connected to power supply	✗

Interdisciplinary Learning:

Numeracy:

Information handling MNU 2-20a

Literacy:

Finding and using information LIT 2-06a

Adapted from:
https://www.hamilton-trust.org.uk/science/year-4-science/electricity-its-electric/

Forces, Electricity and Waves

SCN2-09a

Skill Organiser	Skills	Addressed in Activity
Inquiry and investigative skills	**Plans and designs scientific investigations and enquiries**	
	Formulates questions and predictions (hypotheses), with assistance, based on observations and information	✓
	Identifies the independent, dependent and controlled variables, with assistance.	✗
	Anticipates some risks and hazards.	✓
	Carries out practical activities in a variety of learning environments	
	Applies appropriate safety measures.	✓
	Contributes to carrying out all the procedures.	✓
	Makes observations and collects information and measurements using appropriate devices and units.	✓
	Manages identified controlled variables to ensure validity of results.	✗
	Analyses, interprets and evaluates scientific findings	
	Selects appropriate methods to record data/information.	✓
	Identifies relationships between the independent and dependent variables.	✗
	Makes links to original questions or predictions.	✓
	Relates findings to the wider world.	✓
	Draws basic conclusions consistent with findings.	✓
	Identifies and discusses additional knowledge and understanding gained.	✓
	Recognises anomalous results and suggests possible sources of error.	✓
	Evaluates the investigation and suggests one way of improving it if it was to be repeated.	✗
	Presents scientific findings	
	Presents data/information by choosing from an extended range of tables, charts, diagrams, graphs, including bar graphs and line graphs.	✓
	Reports collaboratively and individually using a range of methods.	✓
	Collates, organises and summarises findings, with assistance, using headings or questions to provide structure for presentations.	✓
	Uses appropriate scientific vocabulary and acknowledges sources, with assistance.	✓

Skill Organiser	Skills	Addressed in Activity
Scientific analytical thinking skills	Applies scientific analytical thinking skills, with assistance, working with less familiar (or familiar but more complex) contexts.	✓
	Applies understanding, and a combination of more than one science concept, to solve problems and provide solutions.	✓
	Demonstrates further development of creative thinking including through the engineering processes of design, construction, testing and modification.	✓
Skills and attributes of scientifically literate citizens	Presents a reasoned argument based on evidence, demonstrating understanding of underlying scientific concepts, and engages with the views of others.	✗
	Demonstrates understanding of the relevance of science to their future lives and the role of science in an increasing range of careers and occupations.	✗
	Demonstrates increased awareness of creativity and inventiveness in science, the use of technologies in the development of sciences and the impact of science on society.	✗
	Expresses informed views about scientific and environmental issues based on evidence.	✗

Forces, Electricity and Waves SCN2-09a

Risk Assessment

Task/Activity/Process Description	Electric Circuits	**Service**	Communitites
Location	School Name	**Reference**	To be completed by school

Types of Injury/Loss/Ill Health	minor electric shock, cuts and abrasions

For each hazard, please identify the person at risk (direct and indirect)

Consider those especially vulnerable (young or inexperienced workers, members of the public, school pupils, the elderly, residents and contractors)

NOTE: New and expectant mothers require a separate risk assessment

Haz No.	Hazard	Source of Hazard	Persons at Risk	Current Control Measures in Place	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Risk Rating (1-25)
1	Electricity	Electric shock from high voltages	Employee/Pupil	1.5V cells are used. No more than 3 cells should be connected in any 1 circuit. The voltages used in these activities are low enough not to pose any significan risk of electrical shock. Pupils should still be instructed to disconnect the cell (battery) before making any changes to the circuit.	1	2	2
2	Sharps	Broken light bulbs	Employee/Pupil	Pupils should report any broken light bulbs to staff who should dispose of them in general waste bins. They should be wrapped in sufficient paper to protect cleaning staff from cuts.	1	2	2
3	Sharps	Crocodile clips	Employee/Pupil	Crocodile clips should only be used as intended and not connected to any part of the body.	2	2	4
4	Slip/Trip/Fall	Classroom furniture	Employee/Pupil	Ensure pupils have adequate space to carry out the experiement and move about the room without risk of tripping on chairs.	2	2	4
5	Other (please identify)	Pupil additional needs	Employee/Pupil	to be completed by school			0
6	Other (please identify)	pupil behaviour	Employee/Pupil	to be completed by school			0
7							0
8							0
9							0
10							0
11							0
12							0
13							0
14							0

Risk Reduction

Haz No.	Additional Control Measures	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Final Risk Rating (1-25)	Action By (name and target date)	Date Control Implemented	Sign to Confirm
1	As low as reasonably possible			0			
2	As low as reasonably possible			0			
3	As low as reasonably possible			0			
4	As low as reasonably possible			0			
5	As low as reasonably possible			0			
6	As low as reasonably possible			0			
7				0			
8				0			
9				0			
10				0			
11				0			
12				0			
13				0			
14				0			

Assessor(s) Name (print)	Assessment Date	Manager Name (print)

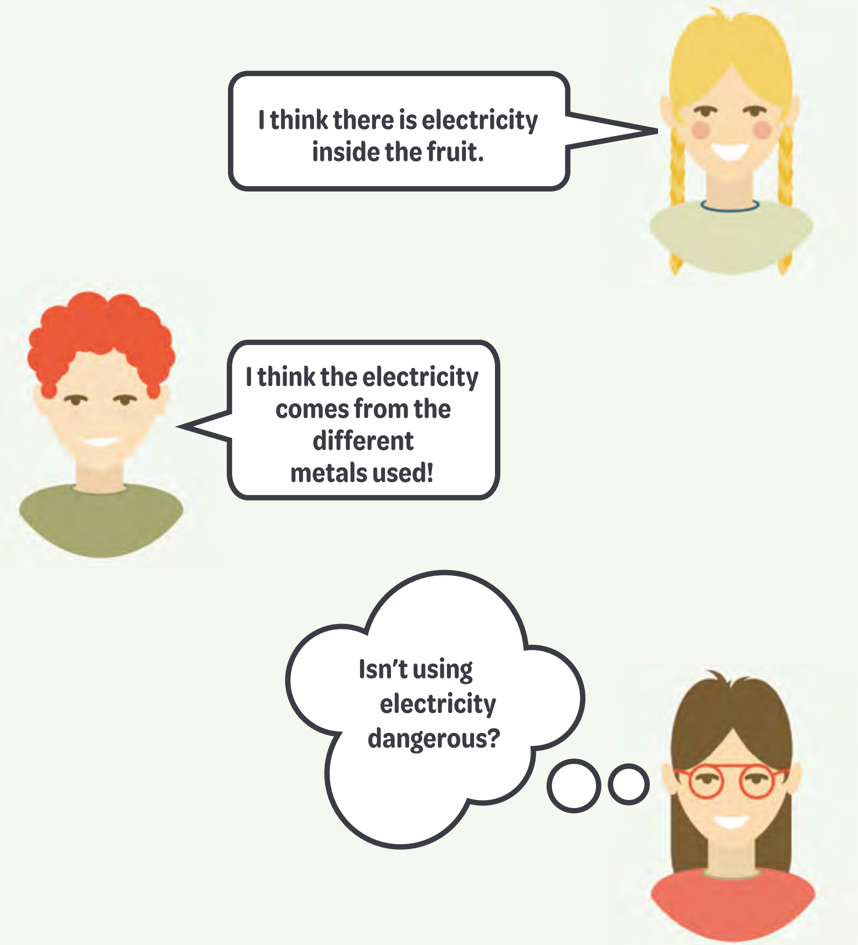
Assessor(s) Signature	Review Date	Manager Signature	Date

Let's Investigate

Fruit Cells

Can fruit produce electricity?

What do you think?



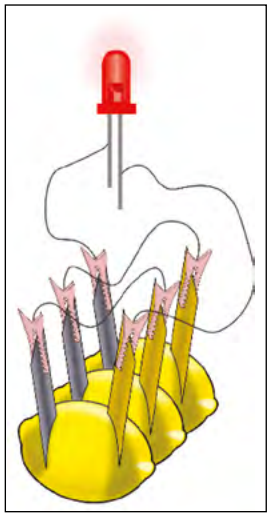
Let's Investigate

Fruit Cells

Method:

1. Carefully insert a piece of copper foil and an iron nail into a piece of fruit.
2. Use a crocodile clip to connect each metal to the voltmeter.
3. Record the voltage produced in the results table.
4. Repeat for different types of fruit.

Extension: Work with another group to connect 2 fruit cells together, how does this affect the voltage produced.



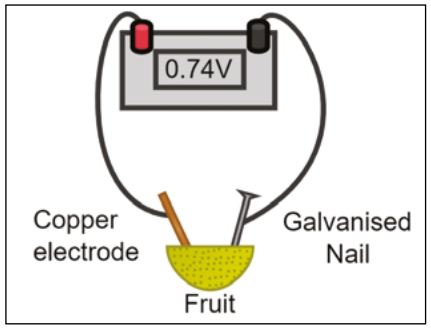


Image: chemix.org , Rupert Swarbrick; Wikimedia Commons

Results:

Type of Fruit/vegetable	Voltage produced (V)

Teacher Guide: Fruit Batteries

SCN 2-09a

I can design and build a variety of electrical circuits for differing purposes using an increasing range of components.

SCN 2-10a

I can apply knowledge and understanding to build simple batteries (cells).

This activity uses two different metals placed in a fruit or vegetable to generate an electric current and voltage. This is a simple model of how chemical cells (batteries) work. This has been designed for SCN 2-10a *build simple chemical cells, but can be used to address SCN 2-09a use a range of electrical components to help make a variety of circuits for differing purposes.*

Please note – A kit containing 10 Voltmeters, copper foil, Iron nails and connecting leads has been created for each cluster.

Background Information:

The electricity is produced when electrons transfer from the Iron nail to the copper foil. More details can be found in the *misconceptions* section near the end of this document.

Many online diagrams show this experiment as lighting a light bulb. This experiment has been intentionally designed without this feature as the fruit batteries often generate the required voltage to power a light bulb, but not the required current to allow charge to flow through the circuit.

Any fruit that is in season can be used in this experiment. Save costs by cutting the fruit in halves or quarters to share between groups of pupils.

Key Vocabulary:

Chemical Cell: A device that generates electricity from chemical reactions. They are commonly referred to as batteries.

Battery: 2 or more chemical cells joined to increase the voltage in a circuit.

Aim:

To investigate the voltage produced by chemical cells made with different fruits.

Independent Variable (the variable that is changing):

The type of fruit or vegetable.

Dependent Variable (the variable that is measured):

The voltage produced by the chemical cell.

Control Variables:

Variables that should be kept the same to give valid results (fair test):

- metals used to make the chemical cell
- distance between metals
- voltmeter used.

Materials (per group):

Variety of different fruits to test.

1 length of copper foil

1 iron nail or galvanised nail

2 crocodile leads

1 voltmeter

How to:

1. Place a length of copper foil and a nail into a piece of fruit. Make sure they are not touching.
2. Check the voltmeter is switched on. The switch is found on the bottom of the voltmeter.
3. Use a crocodile clip to connect each metal to the voltmeter as shown in the diagram. If the voltmeter gives a negative value you can swap the connecting leads to different sides.
4. Record the voltage shown on the voltmeter.

Results:

The voltage produced is dependent on the metals used and the concentration of electrolytes (charged particles including salts, acids, metal ions) in the fruit juice. If an iron nail and copper are used, the maximum expected voltage is 0.78 volts.

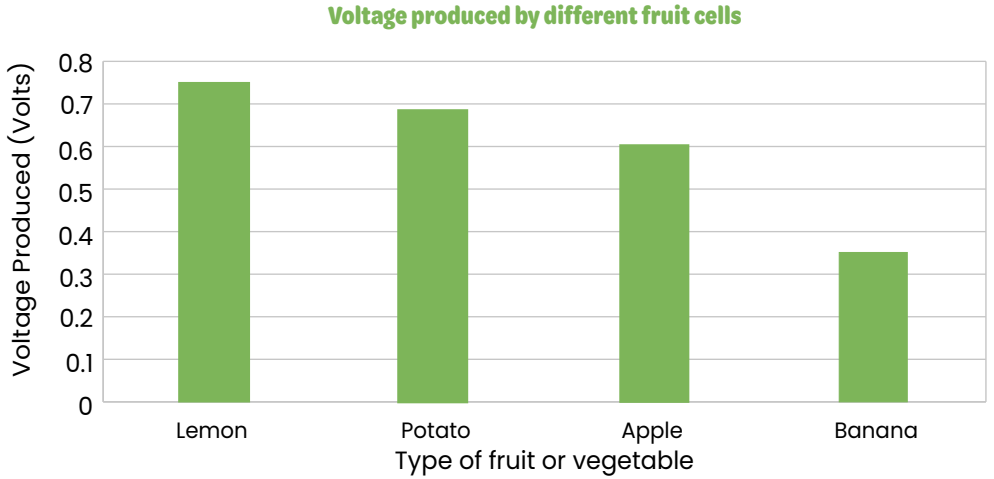
Factors that will affect the voltage produced will be the distance between the metals and how well the juice of the fruit or vegetable can carry charge.

Results will be similar, but not identical to those shown below. Pupils are not trying to identify a trend between the type of fruit and voltage produced, therefore it does not matter if there are significant differences between pupil results and those shown in the table.

Type of fruit or vegetable	Voltage produced (V)
Lemon	0.74
Potato	0.68
Apple	0.60
Banana	0.35

Presenting data:

This experiment produces 'discrete' data. It should be presented as a bar chart like the one shown below.



Conclusion:

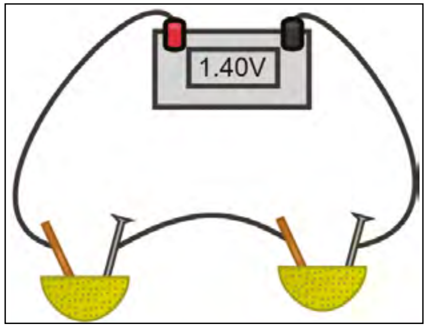
For this experiment a simple statement of results is sufficient, E.g. The lemon produced the highest voltage and the banana produced the lowest voltage.

Evaluation:

Any valid suggestion for improving the experiment if it were to be repeated is acceptable. Pupils may suggest ways to measure the voltage qualitatively such as connecting a lightbulb and recording the brightness.

They may suggest changing the metals used to investigate the size of the voltage produced by different combinations of metals.

Pupils can investigate the affect of increasing the number of cells on voltage produced by building the circuit shown below:



Misconceptions:

Many pupils will believe the electricity comes from the fruit. The electricity is produced when electrons flow from the iron nail to the copper foil. The juice of the fruit contains charged particles which complete the circuit. Electrons flow from the iron nail through the wires to the copper foil. Charged particles (acids and salts) flow between the iron nail and the copper foil in the juice of the fruit or vegetable.

Why can't I charge my phone?

- the voltage produced is very low
- the current produced is 'Direct Current', this means it flows in one direction. The current that powers our electrical appliances is an 'Alternating Current', it changes direction 50 times every second!

The pictures online show lemons powering a light bulb. This experiment often does not produce the required current to get the voltage flowing around a circuit. A small digital clock or time could be used as they require a much lower current. Another option is to use an LED but be aware they need to be connected in the right orientation, so you may need to swap the connections over if it doesn't work.

Why don't I get an electric shock?

The voltage and current produced are very low.

Interdisciplinary Learning:

Maths and Numeracy:

Data and Analysis	MNU 2-20b, MTH 2-21a

Literacy:

Tools for writing	LIT 2-23a
Creating texts	LIT 2-28a

Skill Organiser	Skills	Addressed in Activity
Inquiry and investigative skills	**Plans and designs scientific investigations and enquiries**	
	Formulates questions and predictions (hypotheses), with assistance, based on observations and information	✓
	Identifies the independent, dependent and controlled variables, with assistance.	✓
	Anticipates some risks and hazards.	✓
	Carries out practical activities in a variety of learning environments	
	Applies appropriate safety measures.	✓
	Contributes to carrying out all the procedures.	✓
	Makes observations and collects information and measurements using appropriate devices and units.	✓
	Manages identified controlled variables to ensure validity of results.	✓
	Analyses, interprets and evaluates scientific findings	
	Selects appropriate methods to record data/information.	✓
	Identifies relationships between the independent and dependent variables.	✓
	Makes links to original questions or predictions.	✓
	Relates findings to the wider world.	✓
	Draws basic conclusions consistent with findings.	✓
	Identifies and discusses additional knowledge and understanding gained.	✓
	Recognises anomalous results and suggests possible sources of error.	✓
	Evaluates the investigation and suggests one way of improving it if it was to be repeated.	✓
	Presents scientific findings	
	Presents data/information by choosing from an extended range of tables, charts, diagrams, graphs, including bar graphs and line graphs.	✓
	Reports collaboratively and individually using a range of methods.	✓
	Collates, organises and summarises findings, with assistance, using headings or questions to provide structure for presentations.	✓
	Uses appropriate scientific vocabulary and acknowledges sources, with assistance.	✓

Forces, Electricity and Waves

SCN2-10a

Skill Organiser	Skills	Addressed in Activity
Scientific analytical thinking skills	Applies scientific analytical thinking skills, with assistance, working with less familiar (or familiar but more complex) contexts.	✓
	Applies understanding, and a combination of more than one science concept, to solve problems and provide solutions.	✓
	Demonstrates further development of creative thinking including through the engineering processes of design, construction, testing and modification.	✓
Skills and attributes of scientifically literate citizens	Presents a reasoned argument based on evidence, demonstrating understanding of underlying scientific concepts, and engages with the views of others.	✗
	Demonstrates understanding of the relevance of science to their future lives and the role of science in an increasing range of careers and occupations.	✗
	Demonstrates increased awareness of creativity and inventiveness in science, the use of technologies in the development of sciences and the impact of science on society.	✗
	Expresses informed views about scientific and environmental issues based on evidence.	✗

Risk Assessment

Task/Activity/Process Description	Fruit Cells	**Service**	Communitites
Location	School Name	**Reference**	To be completed by school

Types of Injury/Loss/Ill Health	Minor injuries, cuts, scratches, bruising

For each hazard, please identify the person at risk (direct and indirect)

Consider those especially vulnerable (young or inexperienced workers, members of the public, school pupils, the elderly, residents and contractors)

NOTE: New and expectant mothers require a separate risk assessment

Haz No.	Hazard	Source of Hazard	Persons at Risk	Current Control Measures in Place	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Risk Rating (1-25)
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2	Sharps	Broken light bulbs	Employee/Pupil	Pupils should report any broken light bulbs to staff who should dispose of them in general waste bins. They should be wrapped in sufficient paper to protect cleaning staff from cuts.	1	2	2
3	Sharps	Crocodile clips	Employee/Pupil	Crocodile clips should only be used as intended and not connected to any part of the body.	2	2	4
4	Sharps	Copper electrodes and nails	Employee/Pupil	Electrodes and nails should be used as intended. Staff should highlight to pupils the sharp corners of copper electrodes and instruct them to be cautious.	2	2	4
5	Other (please identify)	Allergies to fruits used	Employee/Pupil	Staff to ensure no pupils or adults in the room have allergies to any of the fruit being used in the experiment. If allergies are present, this fruit should not be used by ANY pupils in the class.	2	5	10
6	Slip/Trip/Fall	Classroom furniture	Employee/Pupil	Ensure pupils have adequate space to carry out the experiement and move about the room without risk of tripping on chairs.	2	2	4
7	Other (please identify)	Pupil additional needs	Employee/Pupil	to be completed by school			0
8	Other (please identify)	pupil behaviour	Employee/Pupil	to be completed by school			0
9							0
10							0
11							0
12							0
13							0
14							0

Forces, Electricity and Waves SCN2-10a

Risk Reduction

Haz No.	Additional Control Measures	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Final Risk Rating (1-25)	Action By (name and target date)	Date Control Implemented	Sign to Confirm
1	As low as reasonably possible			0			
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6	As low as reasonably possible			0			
7	As low as reasonably possible			0			
8	As low as reasonably possible			0			
9				0			
10				0			
11				0			
12				0			
13				0			
14				0			

Assessor(s) Name (print)	Assessment Date	Manager Name (print)

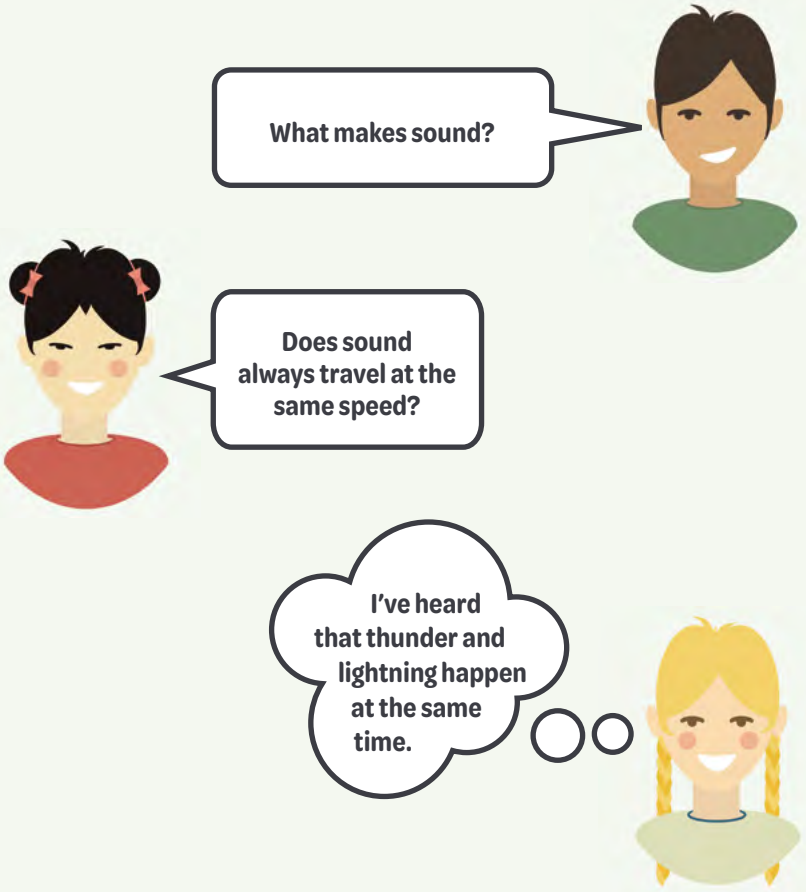
Assessor(s) Signature	Review Date	Manager Signature	Date

Let's Investigate

Sound

Can you design an amplifier for a smart phone?

What do you think?



Let's Investigate

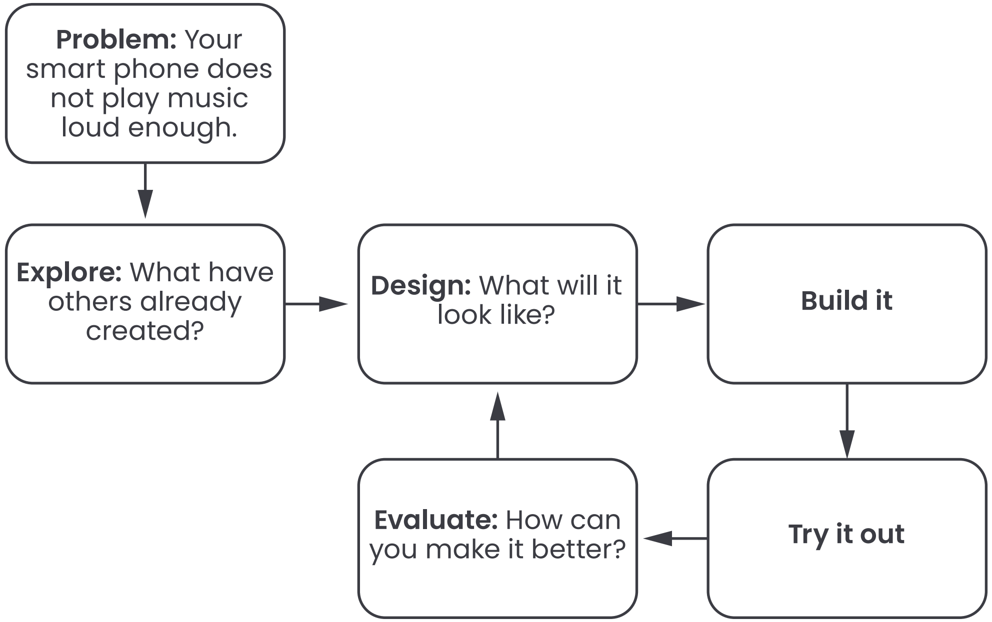
Sound

Task:

Create a device from recycled materials to amplify the sound produced by a smart phone.

Use the Engineering and design process to track your designs and any changes you make as you test your product.

Image: https://learning-resources.sciencemuseum.org.uk/wp-content/uploads/2019/02/SMG-Learning-Activities-Tune-Booster.pdf



Test each amplifier in the classroom. Create a score sheet to record volume and clarity of sound.

- Which one amplifies the volume most?
- Does one produce clearer sound than the others?
- What will you need to control to make this a fair test?

Teacher Guide: Tune Booster

SCN 2-11a

I can explain how sound vibrations are carried by waves through air, water and other media.

I can explain how sound vibrations are carried by waves through air, water and other media.

This task supports the development of the engineering and design process in the context of sound, SCN2-11a. It has been adapted from the 'Tune Booster' activity produced by the Science Museums Group. *https://learning.sciencemuseumgroup.org.uk/learning-resources/*

Key Vocabulary:

Problem: The task or challenge that needs be solved.

Explore: What have other engineers already created? How could they be adapted to suit your problem?

Design: Based on the designs you have seen, what will your design look like? What features will it have? What materials will it be made from?

Create: The construction phase.

Test it out: Does your product work as you intended?

Evaluate: How will you make it better, what will you redesign?

Sound: Sound is produced by vibrations. We hear when vibrations travel through our ear canal and are transferred from the ear drum, through the bones of the inner ear to the cochlea which sends electrical impulses along nerves to the brain.

Amplifier: A device used to increase the volume of sounds.

How to:

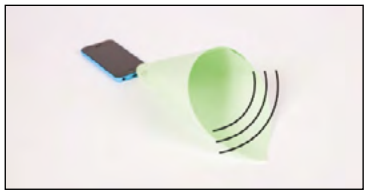
Introduce the challenge, it may be given a context such as the speakers at assembly have stopped working, and pupils need to create an amplifier to play music.

Introduce them to the Engineering and Design process shown on the pupil card, and highlight the cyclical nature of designing, building, testing, evaluating, redesigning.

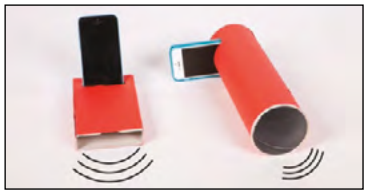
Allow pupils time to research ideas online or show them the examples below.

Allow pupils time to design their own amplifiers before providing the materials to build them.

1. Start playing a song on your phone. Listen and note down how loud it sounds. Put your phone into the different cups and bowls and listen how the sound changes.



2. Try making a horn out of paper and attach it over the speaker of your phone. Does this boost the sound?



3. If you have a card box or tube, cut a hole for your phone to fit inside it. Does it make a good tune booster?

4. Try combining different objects and materials to make something a bit more complex

This activity can remain as a stand-alone engineering task, or the amplifiers can be tested within the class to provide the pupils with the opportunity to design a fair test.

If pupils test their amplifiers the variables are as follows:

Independent Variable (the variable that is changing):

Pupil amplifiers.

Dependent Variable (the variable that is measured):

Volume

Control variables:

The same smart phone, the same volume setting, the same song.

A results table can be created to rate the volume and clarity of each amplifier. These ratings will be subjective and based on pupil opinions.

Materials (per group):

You will need a range of recycled materials for pupils to create their amplifier. Suggested materials include paper cups, bowls, cereal boxes, crisp tubes, tape, milk bottles.

Results:

Results and amplifiers produced will vary depending on resources available and pupil design.

Evaluation:

Pupils will evaluate the effectiveness and of their amplifiers. They can evaluate the activity to suggest alternate materials for construction and alternate scenarios for future classes.

Ask pupils to how this task has an impact on their everyday lives.

- Where in the real world are sounds amplified?
- What are the dangers of being exposed to very loud noises?

A follow up activity is to design a soundproof box for a smartphone, or a pair of ear defenders.

If pupils test the amplifiers, they may suggest more accurate measurements could be achieved by using a sound meter rather than relying on pupil judgements.

Interdisciplinary Learning

Technology:

Digital Literacy	TCH2-02a
Craft, Design, Engineering and Graphics	TCH2-09a, TCH2-10a, TCH2-11a, TCH2-12a

Skill Organiser	Skills	Addressed in Activity
Inquiry and investigative skills	**Plans and designs scientific investigations and enquiries**	
	Formulates questions and predictions (hypotheses), with assistance, based on observations and information	✗
	Identifies the independent, dependent and controlled variables, with assistance.	✓
	Anticipates some risks and hazards.	✓
	Carries out practical activities in a variety of learning environments	
	Applies appropriate safety measures.	✓
	Contributes to carrying out all the procedures.	✓
	Makes observations and collects information and measurements using appropriate devices and units.	✓
	Manages identified controlled variables to ensure validity of results.	✓
	Analyses, interprets and evaluates scientific findings	
	Selects appropriate methods to record data/information.	✓
	Identifies relationships between the independent and dependent variables.	✓
	Makes links to original questions or predictions.	✓
	Relates findings to the wider world.	✓
	Draws basic conclusions consistent with findings.	✗
	Identifies and discusses additional knowledge and understanding gained.	✓
	Recognises anomalous results and suggests possible sources of error.	✗
	Evaluates the investigation and suggests one way of improving it if it was to be repeated.	✓
	Presents scientific findings	
	Presents data/information by choosing from an extended range of tables, charts, diagrams, graphs, including bar graphs and line graphs.	✗
	Reports collaboratively and individually using a range of methods.	✗
	Collates, organises and summarises findings, with assistance, using headings or questions to provide structure for presentations.	✗
	Uses appropriate scientific vocabulary and acknowledges sources, with assistance.	✗

Forces, Electricity and Waves

SCN2-11a

Skill Organiser	Skills	Addressed in Activity
Scientific analytical thinking skills	Applies scientific analytical thinking skills, with assistance, working with less familiar (or familiar but more complex) contexts.	✓
	Applies understanding, and a combination of more than one science concept, to solve problems and provide solutions.	✓
	Demonstrates further development of creative thinking including through the engineering processes of design, construction, testing and modification.	✓
Skills and attributes of scientifically literate citizens	Presents a reasoned argument based on evidence, demonstrating understanding of underlying scientific concepts, and engages with the views of others.	✗
	Demonstrates understanding of the relevance of science to their future lives and the role of science in an increasing range of careers and occupations.	✓
	Demonstrates increased awareness of creativity and inventiveness in science, the use of technologies in the development of sciences and the impact of science on society.	✓
	Expresses informed views about scientific and environmental issues based on evidence.	✗

Risk Assessment

Task/Activity/Process	Tune Booster	**Service**	Communitites
Location	School Name	**Reference**	To be completed by school

Types of Injury/Loss/Ill Health	Minor injuries, cuts, scratches, bruising

For each hazard, please identify the person at risk (direct and indirect)

Consider those especially vulnerable (young or inexperienced workers, members of the public, school pupils, the elderly, residents and contractors)

NOTE: New and expectant mothers require a separate risk assessment

Haz No.	Hazard	Source of Hazard	Persons at Risk	Current Control Measures in Place	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Risk Rating (1-25)
1	Sharps	Scissors	Employee/Pupil	Pupils should only use age appropriate scissors. They should not attempt to cut any materials that are not easily cut by these scissors. Scissors should not be used to pierce holes in materials.	2	2	4
2	Slip/Trip/Fall	Discarded materials	Employee/Pupil	Pupils and staff should take care to maintain a clean working area. Discarded materials can fall to the floor causing a slip and trip hazard.	2	2	4
3	Sharps	Cut and broken materials	Employee/Pupil	Staff and pupils should be aware of sharp edges that may result from cutting or breaking materials.	2	2	4
4	Temperature	Hot glue gun	Employee/Pupil	A separate risk assessment should be completed if hot glue guns are to be used as part of this activity.			
5	Slip/Trip/Fall	Classroom furniture	Employee/Pupil	Ensure pupils have adequate space to carry out the experiment and move about the room without risk of tripping on chairs.	2	2	4
6	Other (please identify)	Pupil additional needs	Employee/Pupil	to be completed by school			0
7	Other (please identify)	pupil behaviour	Employee/Pupil	to be completed by school			0
8							0
9							0
10							0
11							0
12							0
13							0
14							0

Risk Reduction

Haz No.	Additional Control Measures	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Final Risk Rating (1-25)	Action By (name and target date)	Date Control Implemented	Sign to Confirm
1	As low as reasonably possible			0			
2	As low as reasonably possible			0			
3	As low as reasonably possible			0			
4	Separate Risk Assessment required			0			
5	As low as reasonably possible			0			
6	As low as reasonably possible			0			
7	As low as reasonably possible			0			
8				0			
9				0			
10				0			
11				0			
12				0			
13				0			
14				0			

Assessor(s) Name (print)	Assessment Date	Manager Name (print)

Assessor(s) Signature	Review Date	Manager Signature	Date

Let's Investigate

Light

Does light travel in straight or curved lines?

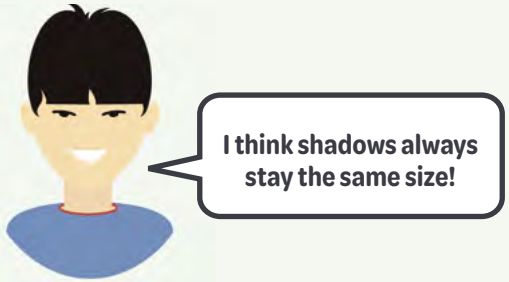
What causes a shadow to form?

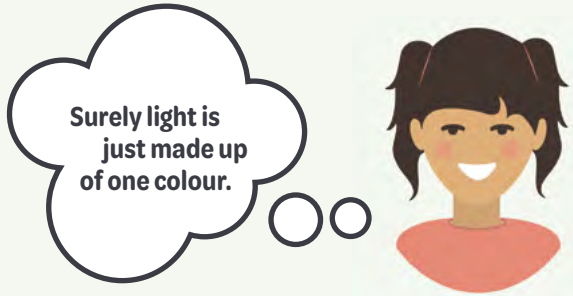
Is light made up of colours or not?

Method:

1. Collect a set of light challenge cards and the equipment needed to complete the challenge.
2. Choose someone from the group to read the question out.
3. Working together discuss how you are going to demonstrate or investigate the challenge.
4. Collect some sticky notes and complete the planning sheets.
5. Complete plenary quiz once all challenges have been completed.

What do you think?





Challenge 1

Does light travel in straight or curved lines?

Equipment:

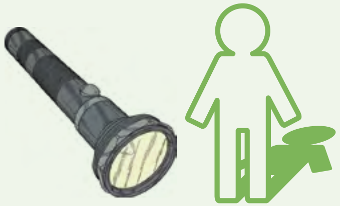
- torch

Extension:

Can you change the direction of a light beam?

Challenge 2

What causes shadows to form?



Equipment:

-torch
-objects to cast a shadow

Extension:

What causes a shadow to become larger or smaller and more or less defined?

Challenge 3

Is light made up of colours?

Equipment:

-torch
-prism
-old CD

Extension:

Why do you think objects appear the colour they do?

Challenge 4

Can you identify natural and artificial sources of light?

Equipment:

- i-pad/laptop
- digital camera

Extension:

Can you draw a diagram to explain why the moon is not a source of light?

Challenge 5

Does light come from our eyes, or a light source that reflects into our eyes?

Equipment:

-viewing box
-objects to place in box

Extension:

Why do you think objects appear the colour they do?

Hints and Tips

Challenge 1:

Have some shiny objects nearby, but not part of the activity, that pupils could naturally find and use to reflect the light. A glass of water with a pencil in it will show light bending and change the shape of objects viewed through the glass.

Challenge 2:

A dark corner of the room will be needed.

Challenge 3:

If a prism is not available, light can be split into the spectrum by reflecting light off the shiny side of an old CD onto a piece of paper or white wall.

Challenge 4:

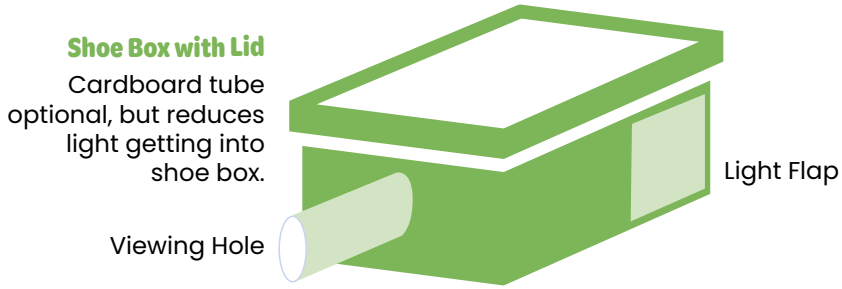
Pupils can use the internet to search for natural and man made sources of light. Students could also find examples of the following:

Chemiluminescence – chemicals that emit light (glow sticks).

Bioluminescence – living organisms that emit light.

Challenge 5:

You will need a shoe box that has a hole for viewing, and a flap that can be lifted to let light in or let down to keep light out. If light came from our eyes we would be able to see the object in a completely dark shoe box.



Teacher Guide: Properties of Light

SCN 2-11b

I can demonstrate and record, through practical activities:

- **that light travels in straight lines**
- **the position, shape and size of a shadow depend on the position of the object in relation to the light source**
- **that we see objects because they give out or reflect light rays that enter our eyes.**
- **that we can recognise the colour of an object due to the reflection and absorption of different parts of the visible spectrum.**

These activities have been adapted from The Hamilton Trust. They form part of a 6 lesson Crime Scene Investigation topic focusing on properties and uses of light. The entire unit can be downloaded for free from:
https://www.hamilton-trust.org.uk/science/year-6-science/crime-lab-investigation/

Key Vocabulary:

Light, light source, names of light sources, dark, reflect, reflective, mirror, shadow, block, absorb, direct/ direction, transparent, opaque, translucent, straight, rainbow, colours.

Aim:

- Plan and complete a series of light investigations, identifying variables and ensuring fair testing.
- Suggest patterns and connections based on observations and measurements.
- Draw conclusions and provide answers based on scientific enquiry.

The Big Questions:

Does light travel in straight or curved lines?

What causes a shadow to form?

Is light made up of colours or not?

Materials (per group):

Light challenges cards and materials

Plenary quiz recording sheet

Properties of light activities:

1. Have the Light Challenge cards (see resource) set up around the room and get children to complete them independently in mixed ability groups (about 12mins per challenge). Included with the Light Challenge cards are some hints and tips to help run the activity.
2. Use questions to support less able learners and encourage more able children to lead the exploration of the extension activities and discussions. Use this as an opportunity to establish current knowledge and any misconceptions. The challenges are also designed to help establish children's approach and ability for working scientifically – encourage children to use the sticky-note approach to investigations (see resources for templates and example of this approach) and look for evidence of effective enquiry questioning, discussion of variables and fair testing, prediction language, accurate observations and use of measuring equipment, recording results and conclusions in a logical manner, and identifying patterns and making connections.
3. At the completion of the investigations pupils can complete the plenary quiz.
4. In a follow up lesson, pupils can create a poster or presentation describing the properties of light:
   - light travels in straight lines
   - light is reflected by smooth shiny surfaces
   - White light is made up of all colours of the visible spectrum (red, orange, yellow, green, blue, indigo, violet)
   - the size of a shadow is dependent on how close the object is to the light source.
   - we see objects because light is reflected from objects into our eyes, or travels directly from a light source to our eyes.

Presenting data:

Sticky notes stuck to blank boxes to show science inquiry skills. This should be done for each challenge card. Answers will vary depending on each child's knowledge of the task. They should be able to use language like variable, fair test and predicting when discussing their answers with their group.

Inquiry Question:	
Variables	
Things I could change/vary	
Things I could observe/measure	

Ensuring my test in fair:		
I will change		
I will observe		
I will keep these things the same		

Predicting:	
When I change	
What will happen to	
I think ...	

Results and Patterns:	
What I changed	What I observed
What happened to	
When I changed	
I discovered	

Misconceptions:

- light travels from our eyes to the object we are viewing
- shiny objects emit light
- a shadow is a form of reflection.

A common misconception that is not covered in this investigation is that yellow is a primary colour. Primary colours of light are green, red, and blue. Yellow is a primary colour in painting when mixing colours and pigments. In physics, yellow is a secondary colour made from the addition of green and red. Coloured filters and paddles can be borrowed from secondary academies or purchased from approved science suppliers to further investigate primary and secondary colours of light.

Interdisciplinary Learning:

Numeracy:

Information handling	MNU 2-20a, MNU 2-20b, MTH 2-21A

Literacy:

Tools for listening and talking	LIT 2-02a
Finding and using information	LIT 2-04a, LIT 2-06a
Understanding, analysing and evaluating	LIT 2-07a
Organising and Using information	LIT 2-26a

Adapted from:

https://www.hamilton-trust.org.uk/science/year-6-science/crime-lab-investigation/

Skill Organiser	Skills	Addressed in Activity
Inquiry and investigative skills	**Plans and designs scientific investigations and enquiries**	
	Formulates questions and predictions (hypotheses), with assistance, based on observations and information	✓
	Identifies the independent, dependent and controlled variables, with assistance.	✓
	Anticipates some risks and hazards.	✓
	Carries out practical activities in a variety of learning environments	
	Applies appropriate safety measures.	✓
	Contributes to carrying out all the procedures.	✓
	Makes observations and collects information and measurements using appropriate devices and units.	✓
	Manages identified controlled variables to ensure validity of results.	✓
	Analyses, interprets and evaluates scientific findings	
	Selects appropriate methods to record data/information.	✓
	Identifies relationships between the independent and dependent variables.	✓
	Makes links to original questions or predictions.	✓
	Relates findings to the wider world.	✓
	Draws basic conclusions consistent with findings.	✓
	Identifies and discusses additional knowledge and understanding gained.	✓
	Recognises anomalous results and suggests possible sources of error.	✓
	Evaluates the investigation and suggests one way of improving it if it was to be repeated.	✓
	Presents scientific findings	
	Presents data/information by choosing from an extended range of tables, charts, diagrams, graphs, including bar graphs and line graphs.	✓
	Reports collaboratively and individually using a range of methods.	✓
	Collates, organises and summarises findings, with assistance, using headings or questions to provide structure for presentations.	✓
	Uses appropriate scientific vocabulary and acknowledges sources, with assistance.	✓

Forces, Electricity and Waves

SCN2-11b

Skill Organiser	Skills	Addressed in Activity
Scientific analytical thinking skills	Applies scientific analytical thinking skills, with assistance, working with less familiar (or familiar but more complex) contexts.	✓
	Applies understanding, and a combination of more than one science concept, to solve problems and provide solutions.	✗
	Demonstrates further development of creative thinking including through the engineering processes of design, construction, testing and modification.	✓
Skills and attributes of scientifically literate citizens	Presents a reasoned argument based on evidence, demonstrating understanding of underlying scientific concepts, and engages with the views of others.	✗
	Demonstrates understanding of the relevance of science to their future lives and the role of science in an increasing range of careers and occupations.	✗
	Demonstrates increased awareness of creativity and inventiveness in science, the use of technologies in the development of sciences and the impact of science on society.	✗
	Expresses informed views about scientific and environmental issues based on evidence.	✗

Risk Assessment

Task/Activity/Process Description	Light Challenges	**Service**	Communitites
Location	School Name	**Reference**	To be completed by school

Types of Injury/Loss/Ill Health	Minor injuries, cuts, scratches, bruising

For each hazard, please identify the person at risk (direct and indirect)

Consider those especially vulnerable (young or inexperienced workers, members of the public, school pupils, the elderly, residents and contractors)

NOTE: New and expectant mothers require a separate risk assessment

Haz No.	Hazard	Source of Hazard	Persons at Risk	Current Control Measures in Place	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Risk Rating (1-25)
1	Tools/Equipment	Inappropriate use of equipment	Employee/Pupil	All equipment in these activities are very low risk and are regularly found in the primary classroom. Pupil behaviour should be managed in accordance with school behaviour policy.	1	2	2
2	Slip/Trip/Fall	Classroom furntiure	Employee/Pupil	Tables and chairs should be kept in a tidy manner to allow pupil movement during this activity.	1	2	2
3	Other (please identify)	Pupil Behaviour	Employee/Pupil	Pupil behaviour should be managed in accordance with school behaviour policy.	1	1	1
4	sharps	broken CD	Employee/Pupil	Broken CDs should not be used. CDs broken during activity should be disposed of by the teacher.	1	1	1
5	Lighting	Torches	Employee/Pupil	Pupils should not be permitted to stare into a torch beam or to shine the torch beam into the eyes of other people.	1	1	1
6							0
7							0
8							0
9							0
10							0
11							0
12							0
13							0
14							0

Risk Reduction

Haz No.	Additional Control Measures	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Final Risk Rating (1-25)	Action By (name and target date)	Date Control Implemented	Sign to Confirm
1	As low as reasonably possible			0			
2	As low as reasonably possible			0			
3	As low as reasonably possible			0			
4	As low as reasonably possible			0			
5	As low as reasonably possible			0			
6				0			
7				0			
8				0			
9				0			
10				0			
11				0			
12				0			
13				0			
14				0			

Assessor(s) Name (print)	Assessment Date	Manager Name (print)

Assessor(s) Signature	Review Date	Manager Signature	Date

Let's Investigate

Digestive System

Can you describe the function of organs in the digestive system?

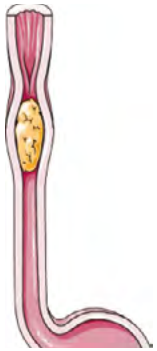
Stomach

Rectum

Small intestine

Liver

Pancreas



Oesophagus

Mouth

Large intestine

What do you think?

Let's Investigate

Digestive System

Activity 1: Drawing the digestive system

Take a large sheet of paper and trace around the head, chest and down to the waist of a person in your group.

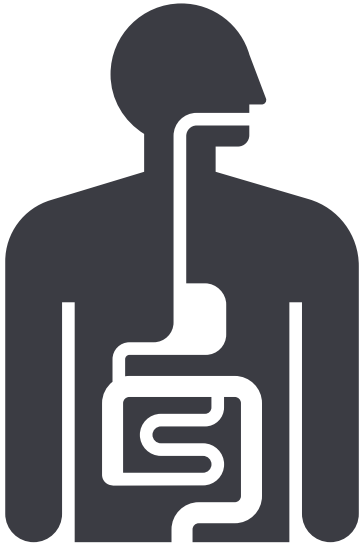
On this outline, draw the organs of the digestive system, in the correct order from the Mouth to the Rectum. Use the images provided to help you with your drawings, can your group figure out where they all go?

Activity 2: Modelling the digestive system

Observe as your teacher demonstrates how each organ of the digestive system works.

Can you describe how each piece of equipment simulates each digestive organ?

Can you find examples of 'mechanical' and 'chemical' digestion?



Let's Investigate

Digestion Dominos

I am the start

Nutrients absorbed here?

Stomach

This is where solid waste leaves the body?

Small Intestine

Where does food get broken up into small pieces?

Anus

What is the solid waste product from our body called?

Mouth

Where would you find strong acid?

Faeces

Which tube does food travel down?

Let's Investigate

Digestion Dominos

Amylase

This is the proper name for liquid waste?

Oesophagus

What is the squeezing motion called in the gut?

Urine

Where all the water is removed.

Peristalsis

We have one large and one small of these in our bodies...

Large intestine

Where most of the heat in your body is produced?

Intestine

Enzyme that breaks down starch

Let's Investigate

Digestion Dominos

Liver

What is the part of your body that connects the large intestine and the anus?

Tongue

The liquid produced in your mouth

Rectum

The part of the body that contains bile

Saliva

Breakdown of large food molecules

Gall bladder

A large muscular organ which moves food about in the mouth

Digestion

I am the finish

Teacher Guide: Gums to Bums

SCN 2-12a

I have investigated the digestive system and can describe its function.

This can be carried out as a demonstration experiment or you can ask pupils to be part of the demonstration while others use i-pads to record. The practical explores the function of different parts of the digestive system including the mouth, oesophagus, stomach, liver, small intestine, large intestine, rectum and anus. It helps to explain the breakdown of food and the absorption of nutrients, minerals and water. This can lead onto discussion and research into the main preventable causes of liver disease such as alcohol and drug misuse.

Key Vocabulary:

Oesophagus: tube leading from the mouth to the stomach

Stomach: muscular bag where food is mixed

Liver: is the largest solid organ in your body. By the time you're grown up, it will be about the size of a football. The liver does many jobs including:

a. It cleans your blood.

b. It produces an important digestive liquid called bile.

c. It stores energy in the form of a sugar called glycogen.

Pancreas: produces enzymes that help digestion and hormones that help regulate blood sugar levels.

Small intestine: long, winding tube where most of the nutrients from your food are absorbed.

Large intestine: responsible for absorbing water from the undigested food.

Rectum: the last straight section of the large intestine which store faeces before it is expelled from the body.

Anus: controls the release of waste from the rectum.

Activity 1: Drawing the Digestive System.

Pupils can work in groups of 3 or 4. Provide each group with a large sheet of paper taken from a roll or flip chart, marker pens and the pupil card for this activity. Ask pupils to trace the outline of a human, from waist to head, on the paper. Pupils then need to draw in what they think is the correct order of the digestive organs.

Extension: Pupils can annotate their diagrams to give a brief description of the function of each organ.

Plenary: At the end of the lesson, pupils can use a different colour pen to add new learning to their annotations and if needed, draw or list the correct order of digestive organs.

Activity 2: Modelling the Digestive System (teacher demonstration).

To investigate the digestive system and its function.

The digital resource found on the NAC STEM hub contains video instructions for this activity.

Materials:

3 salad or mixing bowls

Car sponge

2 buckets – labelled Blood Bucket & Toilet

Bottles each labelled:

Saliva – just water

Enzymes – small drop of washing up liquid and red food colouring

Acid – malt vinegar

Sodium bicarbonate – solution of sodium bicarbonate

Bile salts – washing up liquid

Bile pigments – brown water-based paint or Bisto gravy

2 freezer bags

Scissors

Potato masher

i-pad to record

How to:

Mouth bowl

Add beans, Victoria sponge, frankfurters, chocolate biscuits and discuss mechanically mashing by teeth. Then add the saliva and enzymes to initiate breakdown of food.

Use your hand as the tongue to move food around bowl.

Stomach bag

Using a freezer bag pop the mashed-up mess into the freezer bag discussing how the stomach is a muscular bag. At this point add acid and some more enzymes. Give it a mix about and this can be passed around for pupils to see.

Once the food has been in the stomach it passes through a sphincter into the small intestine bowl – carefully cut a corner of the bag and squeeze contents into bowl.

Small Intestine bowl

Once in the small intestine this mess is now called Chime. Add the sodium bicarbonate to neutralise the acid, then bile salts and more enzymes to break down the food into small molecules.

Use the sponge to absorb the liquid from the mixture and wring out into the 'Blood Bucket'. This process represents villi on the intestinal wall absorbing nutrients into the blood stream. Repeat until all liquid has been transferred to the bucket.

Mix the bile pigment with the digested food, then transfer to the large intestine bowl.

Large intestine bowl

Use the sponge again to remove as much water as possible. Put the remaining solids into a freezer bag. This shows that the rectum is a bag where solid waste is stored until it is removed from the body via the anus.

Cut a corner off the bag and squeeze the poo into a bowl of water – the toilet.

Activity 3 (plenary):

Digestive Dominoes – use the dominoes to consolidate knowledge.

Misconceptions:

1. **Misconception 1:** Digestion starts in the stomach

   Fact: Digestion starts in the mouth where the salivary amylase (enzyme) acts on starch in the food.

2. **Misconception 2:** Digestion ends in the stomach

   Fact: Digestion ends in the small intestine where carbohydrates, protein and fats are digested.

3. **Misconception 3:** The digestive system has 2 outlets, one for faeces and one for urine.

   Fact: Digestive system has one outlet – the anus for undigested waste.

4. **Misconception 4:** Digestion is the process which releases usable energy from food.

   Fact: Digestion is the breakdown of large food molecules into smaller ones. Respiration is the process by which energy is released from food.

5. **Misconception 5:** You cannot swallow food when you are upside down.

   Fact: Regardless of your posture, food will travel in one direction due to peristalsis (muscle contractions) + gravitational force.

Interdisciplinary Learning:

Literacy:

Finding and using information	LIT 2-04a, LIT 2-05a

Skill Organiser	Skills	Addressed in Activity
Inquiry and investigative skills	**Plans and designs scientific investigations and enquiries**	
	Formulates questions and predictions (hypotheses), with assistance, based on observations and information	✓
	Identifies the independent, dependent and controlled variables, with assistance.	✗
	Anticipates some risks and hazards.	✓
	Carries out practical activities in a variety of learning environments	
	Applies appropriate safety measures.	✓
	Contributes to carrying out all the procedures.	✓
	Makes observations and collects information and measurements using appropriate devices and units.	✓
	Manages identified controlled variables to ensure validity of results.	✗
	Analyses, interprets and evaluates scientific findings	
	Selects appropriate methods to record data/information.	✗
	Identifies relationships between the independent and dependent variables.	✗
	Makes links to original questions or predictions.	✗
	Relates findings to the wider world.	✓
	Draws basic conclusions consistent with findings.	✓
	Identifies and discusses additional knowledge and understanding gained.	✗
	Recognises anomalous results and suggests possible sources of error.	✗
	Evaluates the investigation and suggests one way of improving it if it was to be repeated.	✓
	Presents scientific findings	
	Presents data/information by choosing from an extended range of tables, charts, diagrams, graphs, including bar graphs and line graphs.	✗
	Reports collaboratively and individually using a range of methods.	✗
	Collates, organises and summarises findings, with assistance, using headings or questions to provide structure for presentations.	✗
	Uses appropriate scientific vocabulary and acknowledges sources, with assistance.	✗

Biological Systems SCN2-12a

Skill Organiser	Skills	Addressed in Activity
Scientific analytical thinking skills	Applies scientific analytical thinking skills, with assistance, working with less familiar (or familiar but more complex) contexts.	✗
	Applies understanding, and a combination of more than one science concept, to solve problems and provide solutions.	✗
	Demonstrates further development of creative thinking including through the engineering processes of design, construction, testing and modification.	✓
Skills and attributes of scientifically literate citizens	Presents a reasoned argument based on evidence, demonstrating understanding of underlying scientific concepts, and engages with the views of others.	✗
	Demonstrates understanding of the relevance of science to their future lives and the role of science in an increasing range of careers and occupations.	✗
	Demonstrates increased awareness of creativity and inventiveness in science, the use of technologies in the development of sciences and the impact of science on society.	✗
	Expresses informed views about scientific and environmental issues based on evidence.	✗

Risk Assessment

Task/Activity/Process Description	Bums to Gums	**Service**	Communitites
Location	School Name	**Reference**	To be completed by school

Types of Injury/Loss/Ill Health	Slips and trips, skin and eye irritation.

For each hazard, please identify the person at risk (direct and indirect)

Consider those especially vulnerable (young or inexperienced workers, members of the public, school pupils, the elderly, residents and contractors)

NOTE: New and expectant mothers require a separate risk assessment

Haz No.	Hazard	Source of Hazard	Persons at Risk	Current Control Measures in Place	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Risk Rating (1-25)
1	Slip/Trip/Fall	Liquids	Employee/Pupil	This activity uses water, washing up liquid, food dyes, and vinegar. Paper towel should be on hand to clean any spills.	2	2	4
2	Chemicals	Vinegar	Employee/Pupil	Vinegar will cause irritation if it comes into contact with the eyes or broken skin. Rinse with clean running water if this occurs.	2	2	4
3	Slip/Trip/Fall	Classroom furniture	Employee/Pupil	Chairs should be tucked neatly under desks, pupil movement should be managed.	2	2	4
4	Other (please identify)	Pupil behavior		School to complete			
5	Other (please identify)	Pupil additional needs		School to complete			0
6							0
7							0
8							0
9							0
10							0
11							0
12							0
13							0
14							0

Risk Reduction

Haz No.	Additional Control Measures	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Final Risk Rating (1-25)	Action By (name and target date)	Date Control Implemented	Sign to Confirm
1	As low as reasonably possible			0			
2	As low as reasonably possible			0			
3	As low as reasonably possible			0			
4	As low as reasonably possible			0			
5	As low as reasonably possible			0			
6				0			
7				0			
8				0			
9				0			
10				0			
11				0			
12				0			
13				0			
14				0			

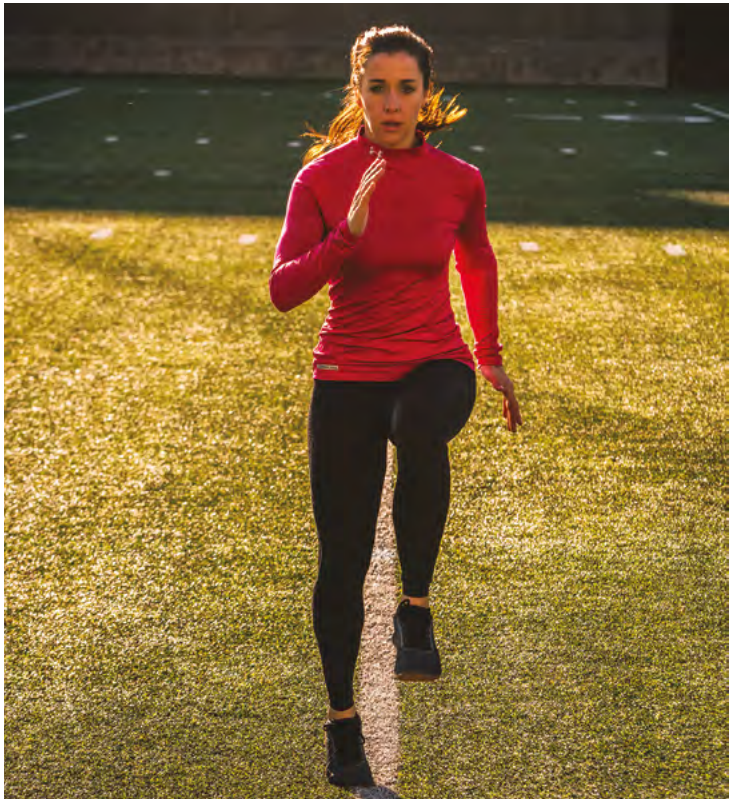
Assessor(s) Name (print)	Assessment Date	Manager Name (print)

Assessor(s) Signature	Review Date	Manager Signature	Date

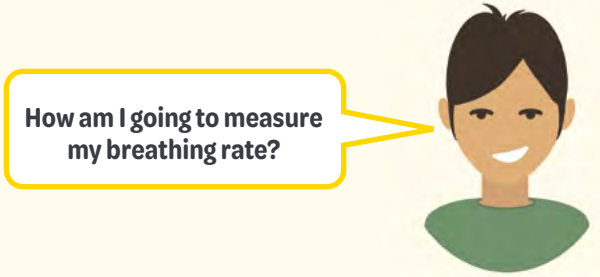
Let's Investigate

How do we Breathe?

What might affect your breathing rate?



What do you think?



Let's Investigate

How do we Breathe?

Method:

1. Sit still on a chair and breathe on to the back of your hand. Count how many breaths you take in 1 minute – this is your resting breathing rate.
2. Perform some exercise for two minutes, e.g. jogging on the spot, or star jumps. Record your breathing rate for one minute immediately after exercise.
3. Continue to record your breathing rate every minute after exercise, until it returns to your resting level.

Results:

Activity	Breathing Rate (breaths/minute)			
	Trial 1	Trial 2	Trial 3	Average
At Rest				
After 1 minute of exercise				
1 minute after exercise				
2 minutes after exercise				
3 minutes after exercise				

Teacher Guide: How Do We Breathe?

SCN 2-12a

I have investigated the respiratory system and can describe its function.

In this experiment, pupils will develop their investigative and inquiry skills through the context of exercise and breathing rate. SCN 2-12a.

Key Vocabulary:

Diaphragm: a muscular wall that separates the lungs from the stomach area and assists in breathing in.

Lungs: bag-like organs used for breathing.

Trachea (windpipe): the tube that carries air to the lungs in humans.

Bronchi: the large air tubes leading from the trachea to the lungs. They carry air to the lungs. The trachea (windpipe) divides to form the right and left main bronchi.

Alveoli: tiny air sacs within the lungs where the exchange of oxygen and carbon dioxide takes place.

Asthma: causes airways (the tubes that carry air into and out of the lungs) to become inflamed, which means that they swell and produce lots of thick mucus.

Bronchitis: is an inflammation of the large breathing tubes (bronchi) in the lungs.

Aim:

How does exercise affect breathing rate?

Independent Variable (the variable that is changing):

Time before and after exercise

Dependent Variable (the variable that is measured):

Breathing rate per minute

Control Variables:

Type of exercise should be kept the same to give valid results (fair test).

Method used to measure breathing rate.

Materials (per group):

Stopwatch

Space to do exercise on the spot.

Method:

1. Sit still on a chair and breathe on to the back of your hand. Count how many breaths you take in 1 minute – this is your resting breathing rate.
2. Perform some exercise for two minutes, e.g. jogging on the spot, or star jumps. Record your breathing rate for one minute immediately after exercise.
3. Continue to record your breathing rate every minute after exercise, until it returns to your resting level.

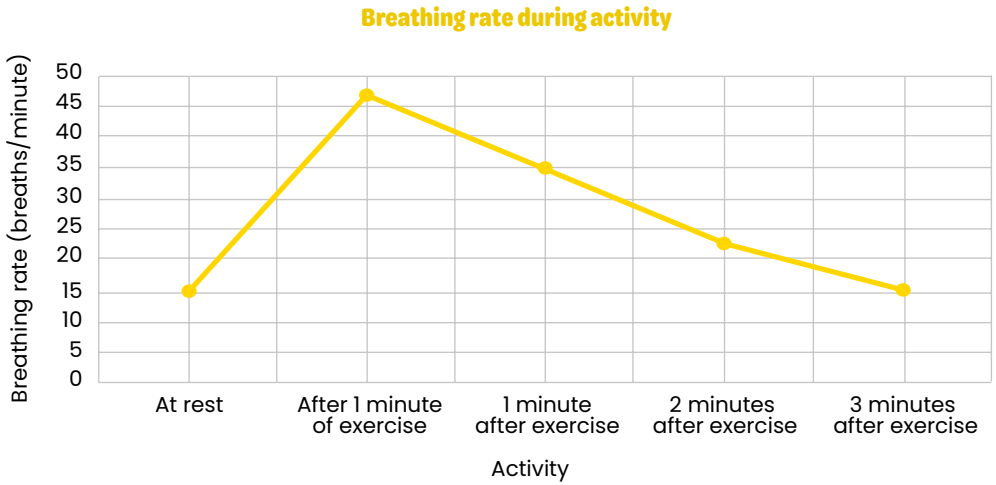
Results:

Results should be recorded in a table similar to the one below. Results will vary between pupils.

Activity (Independent Variable)	Breathing Rate (breaths/minute) (Dependent Variable)			
	Trial 1	Trial 2	Trial 3	Average
At Rest	14	16	14	15
After 1 minute of exercise	45	50	46	47
1 minute after exercise	30	39	35	35
2 minutes after exercise	22	25	22	23
3 minutes after exercise	15	17	14	15

Presenting data:

This investigation produces *continuous data*, it should be presented as a line graph. Values can be rounded to the nearest whole number if required. However for more able pupils the numbers should be plotted to one decimal place.



Conclusion:

Second Level conclusion for expected results:

Breathing rate increases after exercise then starts to decrease.

Second level conclusion for unexpected results:

A statement identifying the time of the highest and lowest breathing rates.

Third level conclusion for unexpected results:

The results do not show a relationship between exercise and breathing rate, no conclusion can be drawn.

Evaluation:

Pupils may suggest using pulsometers to measure heart rate. These give an instant reading and will provide more accurate data.

Misconceptions:

Breathing, or ventilation, is the movement of air into and out of the lungs. Breathing involves the contraction and relaxation of the muscles of the respiratory system, as well as movement of the ribs. When the volume of air inside the lungs changes, so too does the pressure of the air inside the lungs. If the pressure inside the lungs is greater than the pressure outside the lungs, air rushes out of the lungs and vice versa.

Physiological respiration and cellular respiration are not the same. People sometimes use the word "respiration" to refer to the process of cellular respiration, which is a cellular process in which carbohydrates are converted into energy. The two are related processes, but they are not the same.

We do not breathe in *only* oxygen or breathe out *only* carbon dioxide. Often the terms "oxygen" and "air" are used interchangeably. It is true that the air we breathe in has more oxygen than the air we breathe out, and the air we breathe out has more carbon dioxide than the air that we breathe in. However, oxygen is just one of the gases found in the air we breathe. (In fact, the air has more nitrogen than oxygen!)

The respiratory system does not work alone in transporting oxygen through the body. The respiratory system works directly with the circulatory system to provide oxygen to the body. Oxygen taken in from the respiratory system moves into blood vessels that then circulate oxygen-rich blood to tissues and cells.

Risks:

Pupils with breathing difficulties (asthma or other conditions) should take care if participating in the extension activity, or use their partner's results.

Interdisciplinary Learning:

Numeracy:

Data and Analysis	MNU 1-20b, MTH 1-21a, MNU 2-20b, MTH 2-21a

Literacy:

Tools for Writing	LIT 2-23a
Creating texts (writing)	LIT 2-28a

Biological Systems — SCN2-12a

Skill Organiser	Skills	Addressed in Activity
Inquiry and investigative skills	**Plans and designs scientific investigations and enquiries**	
	Formulates questions and predictions (hypotheses), with assistance, based on observations and information	✓
	Identifies the independent, dependent and controlled variables, with assistance.	✓
	Anticipates some risks and hazards.	✓
	Carries out practical activities in a variety of learning environments	
	Applies appropriate safety measures.	✓
	Contributes to carrying out all the procedures.	✓
	Makes observations and collects information and measurements using appropriate devices and units.	✓
	Manages identified controlled variables to ensure validity of results.	✓
	Analyses, interprets and evaluates scientific findings	
	Selects appropriate methods to record data/information.	✓
	Identifies relationships between the independent and dependent variables.	✓
	Makes links to original questions or predictions.	✓
	Relates findings to the wider world.	✓
	Draws basic conclusions consistent with findings.	✓
	Identifies and discusses additional knowledge and understanding gained.	✓
	Recognises anomalous results and suggests possible sources of error.	✓
	Evaluates the investigation and suggests one way of improving it if it was to be repeated.	✓
	Presents scientific findings	
	Presents data/information by choosing from an extended range of tables, charts, diagrams, graphs, including bar graphs and line graphs.	✓
	Reports collaboratively and individually using a range of methods.	✓
	Collates, organises and summarises findings, with assistance, using headings or questions to provide structure for presentations.	✓
	Uses appropriate scientific vocabulary and acknowledges sources, with assistance.	✓

Skill Organiser	Skills	Addressed in Activity
Scientific analytical thinking skills	Applies scientific analytical thinking skills, with assistance, working with less familiar (or familiar but more complex) contexts.	✓
	Applies understanding, and a combination of more than one science concept, to solve problems and provide solutions.	✗
	Demonstrates further development of creative thinking including through the engineering processes of design, construction, testing and modification.	✗
Skills and attributes of scientifically literate citizens	Presents a reasoned argument based on evidence, demonstrating understanding of underlying scientific concepts, and engages with the views of others.	✗
	Demonstrates understanding of the relevance of science to their future lives and the role of science in an increasing range of careers and occupations.	✗
	Demonstrates increased awareness of creativity and inventiveness in science, the use of technologies in the development of sciences and the impact of science on society.	✗
	Expresses informed views about scientific and environmental issues based on evidence.	✗

Risk Assessment

Task/Activity/Process Description	How do we breathe?	**Service**	Communitites
Location	School Name	**Reference**	To be completed by school

Types of Injury/Loss/Ill Health	Minor injuries, cuts, scratches, bruising

For each hazard, please identify the person at risk (direct and indirect)

Consider those especially vulnerable (young or inexperienced workers, members of the public, school pupils, the elderly, residents and contractors)

NOTE: New and expectant mothers require a separate risk assessment

Haz No.	Hazard	Source of Hazard	Persons at Risk	Current Control Measures in Place	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Risk Rating (1-25)
1	Other (please identify)	Physical exersion	Employee/Pupil	Pupils with respiratory conditions (e.g. Asthma) should take care during the physical exertion part of this activity, or alternatively be given a timing role and use their partners results.	1	2	2
2	Slip/Trip/Fall	Classroom furntiure	Employee/Pupil	Tables and chairs should be kept in a tidy manner to allow pupil movement during this activity.	1	2	2
3	Other (please identify)	Pupil Behaviour	Employee/Pupil	Pupil behaviour should be managed in accordance with school behaviour policy.	1	2	2
4	Other (please identify)	Pupil ASN requirements	Employee/Pupil	Schoool to complete			
5							
6							0
7							0
8							0
9							0
10							0
11							0
12							0
13							0
14							0

Risk Reduction

Haz No.	Additional Control Measures	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Final Risk Rating (1-25)	Action By (name and target date)	Date Control Implemented	Sign to Confirm
1	As low as reasonably possible			0			
2	As low as reasonably possible			0			
3	As low as reasonably possible			0			
4	As low as reasonably possible			0			
5				0			
6				0			
7				0			
8				0			
9				0			
10				0			
11				0			
12				0			
13				0			
14				0			

Assessor(s) Name (print)	Assessment Date	Manager Name (print)

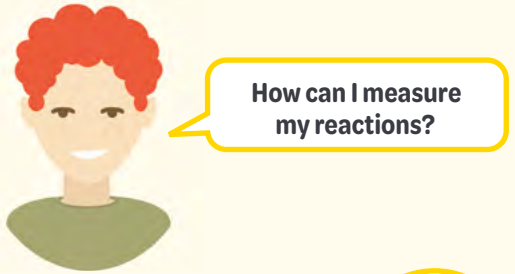
Assessor(s) Signature	Review Date	Manager Signature	Date

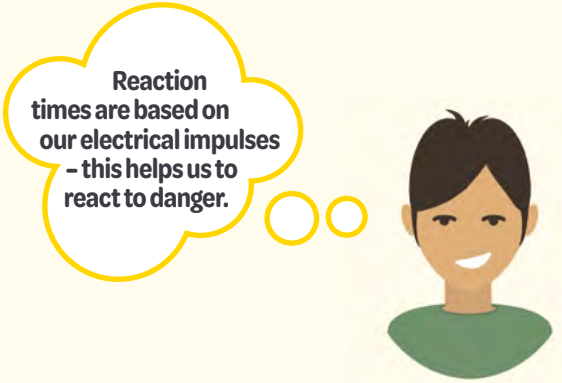
Let's Investigate

Senses

How does background noise affect reaction times?

What do you think?





Let's Investigate

Senses

Method:

1. Working in pairs in a very quiet room, person A holds out their hand with a gap between their thumb and first finger.
2. Person B holds the ruler with the zero at the top of person A's thumb.
3. Person B drops the ruler without telling Person A and they must catch it.
4. The number level with the top of person A's thumb is recorded in the table. Repeat this three times.
5. Repeat steps 1 – 4 this time with high levels of background noise.

Results:

Background noise	Distance ruler travels (cm)			
	Trial 1	Trial 2	Trial 3	Average
No background noise				
Background noise				

Teacher Guide: Background noise and reaction time

SCN 2-12b

I have explored the structure and function of sensory organs to develop my understanding of body actions in response to outside conditions.

This is a simple experiment that can be used to develop science inquiry skills and support the teaching and learning of SCN 2-12b.

Key Vocabulary:

Reaction time: The time taken for to respond to a stimulus.

Stimulus: An event that causes activity. E.g. Touching a hot pan stimulates the reflex to move your hand away.

Aim:

Does background noise affect reaction time?

Independent Variable (the variable that is changing):

Presence or absence of background noise.

Dependent Variable (the variable that is measured):

Distance ruler drops before being caught.

Control Variables:

1. Same ruler.
2. Same start position of ruler.
3. Same catching method.

Materials (per group):

A 30cm ruler.

Optional: Ear defenders.

Method:

1. Pupils should work in pairs with one person dropping the ruler and the other person catching. In the first instance the investigation should be carried out in a very quiet room.
2. The catcher should hold their hand as shown, and the pupil dropping the ruler should hold the ruler so that 0cm is placed in between the thumb and forefinger.
3. The ruler is dropped without warning and the catcher must catch it is quickly as possible.
4. The number level with the top of the thumb is recorded in the table. Repeat this three times and calculate an average.

Repeat steps 1 – 4 this time with high levels of background noise.

Alternative investigations:

Play different types of music/noises. E.g. Lullaby, rock, pop, alarm, siren, crowd noise and investigate if type of sound affects reaction time.

To reduce noise in your classroom you can investigate the reaction time of right hand vs left hand rather than background noise.

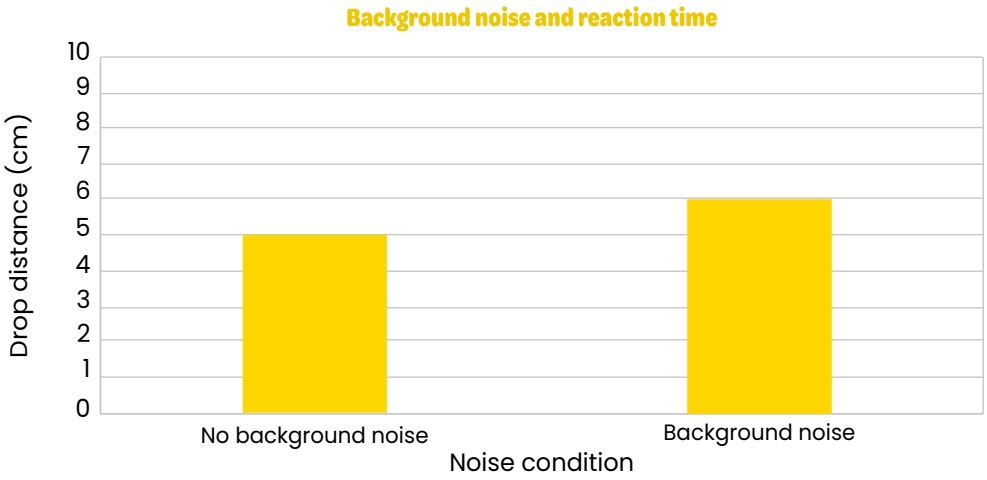
Results:

Individual results will vary. There is opportunity to discuss with the class which pupils had faster reaction times in quiet and noisy environments. Does this match with how easy they find it to concentrate in a noise environment?

Noise conditions	**Drop distance (cm)**			
	Trial 1	**Trial 2**	**Trial 3**	**Average**
No background noise	5	6	5	5
Background noise.	6	6	7	6

Presenting data:

Data should be presented as a bar chart as 'presence or absence of background noise' is *discrete* data.



Conclusion:

A statement of the individual's fastest reaction is all that is required. E.g. The fastest reaction time was for 'No background noise' as the ruler fell the shortest distance.

Evaluation:

Any valid source of error and suggested improvement is acceptable.

Possible suggestions include:

- using time to measure reaction time rather than distance. Included below is a conversion chart that allows pupils to convert the distance the ruler travelled to a reaction time.
- using online reaction timers for more precise and accurate reaction times. A google search for 'BBC Sheep Dash' will provide a pupil friendly reaction time game.

Misconceptions:

'Flinching' is a sign of weakness.

We are all designed to 'flinch' when something fast moving or out of control is headed our way. It is a reflex. Reflexes are automatic reactions of our nervous system designed to protect us. E.g. Ducking a ball moving toward our head, blinking when something passes close to our eyes.

The iris reflex is a very easy reflex to demonstrate to pupils.

In pairs, pupils look into each other's eyes. Turn the lights off and let the pupils vision adjust for 30 seconds. Turn the lights back on and pupils should notice the iris muscles contract causing the pupil to become smaller. When the light is switched off, the iris muscles relax causing the pupil to become larger and let more light in so that we can see better in low light conditions.

Interdisciplinary Learning:

Maths and Numeracy:

Measurement	MNU 1-11a
Data and Analysis	MNU 1-20b, MTH 1-21a, MNU 2-20b, MTH 2-21a

Literacy:

Tools for Writing	LIT 2-23a
Creating texts (writing)	LIT 2-28a

Catch distance	Reaction Time	
Centimetres	Milliseconds	Seconds
0	0	0.000
1	45	0.045
2	64	0.064
3	78	0.078
4	90	0.090
5	101	0.101
6	111	0.111
7	120	0.120
8	128	0.128
9	136	0.136
10	143	0.143
11	150	0.150
12	156	0.156
13	163	0.163
14	169	0.169
15	175	0.175
16	181	0.181
17	186	0.186
18	192	0.192
19	197	0.197
20	202	0.202
21	207	0.207
22	212	0.212
23	217	0.217
24	221	0.221
25	226	0.226
26	230	0.230
27	235	0.235
28	239	0.239
29	243	0.243
30	247	0.247

Biological Systems

SCN2-12b

Skill Organiser	Skills	Addressed in Activity
Inquiry and investigative skills	**Plans and designs scientific investigations and enquiries**	
	Formulates questions and predictions (hypotheses), with assistance, based on observations and information	✓
	Identifies the independent, dependent and controlled variables, with assistance.	✓
	Anticipates some risks and hazards.	✓
	Carries out practical activities in a variety of learning environments	
	Applies appropriate safety measures.	✓
	Contributes to carrying out all the procedures.	✓
	Makes observations and collects information and measurements using appropriate devices and units.	✓
	Manages identified controlled variables to ensure validity of results.	✓
	Analyses, interprets and evaluates scientific findings	
	Selects appropriate methods to record data/information.	✓
	Identifies relationships between the independent and dependent variables.	✓
	Makes links to original questions or predictions.	✓
	Relates findings to the wider world.	✓
	Draws basic conclusions consistent with findings.	✓
	Identifies and discusses additional knowledge and understanding gained.	✓
	Recognises anomalous results and suggests possible sources of error.	✓
	Evaluates the investigation and suggests one way of improving it if it was to be repeated.	✓
	Presents scientific findings	
	Presents data/information by choosing from an extended range of tables, charts, diagrams, graphs, including bar graphs and line graphs.	✓
	Reports collaboratively and individually using a range of methods.	✓
	Collates, organises and summarises findings, with assistance, using headings or questions to provide structure for presentations.	✓
	Uses appropriate scientific vocabulary and acknowledges sources, with assistance.	✓

Skill Organiser	Skills	Addressed in Activity
Scientific analytical thinking skills	Applies scientific analytical thinking skills, with assistance, working with less familiar (or familiar but more complex) contexts.	✓
	Applies understanding, and a combination of more than one science concept, to solve problems and provide solutions.	✗
	Demonstrates further development of creative thinking including through the engineering processes of design, construction, testing and modification.	✗
Skills and attributes of scientifically literate citizens	Presents a reasoned argument based on evidence, demonstrating understanding of underlying scientific concepts, and engages with the views of others.	✗
	Demonstrates understanding of the relevance of science to their future lives and the role of science in an increasing range of careers and occupations.	✗
	Demonstrates increased awareness of creativity and inventiveness in science, the use of technologies in the development of sciences and the impact of science on society.	✗
	Expresses informed views about scientific and environmental issues based on evidence.	✗

Risk Assessment

Task/Activity/Process Description	Ruler drop	**Service**	Communitites
Location	School Name	**Reference**	To be completed by school

Types of Injury/Loss/Ill Health	Minor injuries, cuts, scratches, bruising

For each hazard, please identify the person at risk (direct and indirect)

Consider those especially vulnerable (young or inexperienced workers, members of the public, school pupils, the elderly, residents and contractors)

NOTE: New and expectant mothers require a separate risk assessment

Haz No.	Hazard	Source of Hazard	Persons at Risk	Current Control Measures in Place	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Risk Rating (1-25)
1	Tools/Equipment	Inappropriate use of ruler.	Employee/Pupil	Pupil behaviour should be managed in accordance with school behaviour policy.	1	2	2
2	Slip/Trip/Fall	Classroom furniture	Employee/Pupil	Tables and chairs should be kept in a tidy manner to allow pupil movement during this activity.	1	2	2
3	Other (please identify)	Pupil Behaviour	Employee/Pupil	Pupil behaviour should be managed in accordance with school behaviour policy.	1	2	2
4	Other (please identify)	Pupil ASN requirements	Employee/Pupil	School to complete			
5							
6							0
7							0
8							0
9							0
10							0
11							0
12							0
13							0
14							0

Risk Reduction

Haz No.	Additional Control Measures	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Final Risk Rating (1-25)	Action By (name and target date)	Date Control Implemented	Sign to Confirm
1	As low as reasonably possible			0			
2	As low as reasonably possible			0			
3	As low as reasonably possible			0			
4	As low as reasonably possible			0			
5				0			
6				0			
7				0			
8				0			
9				0			
10				0			
11				0			
12				0			
13				0			
14				0			

Assessor(s) Name (print)	Assessment Date	Manager Name (print)

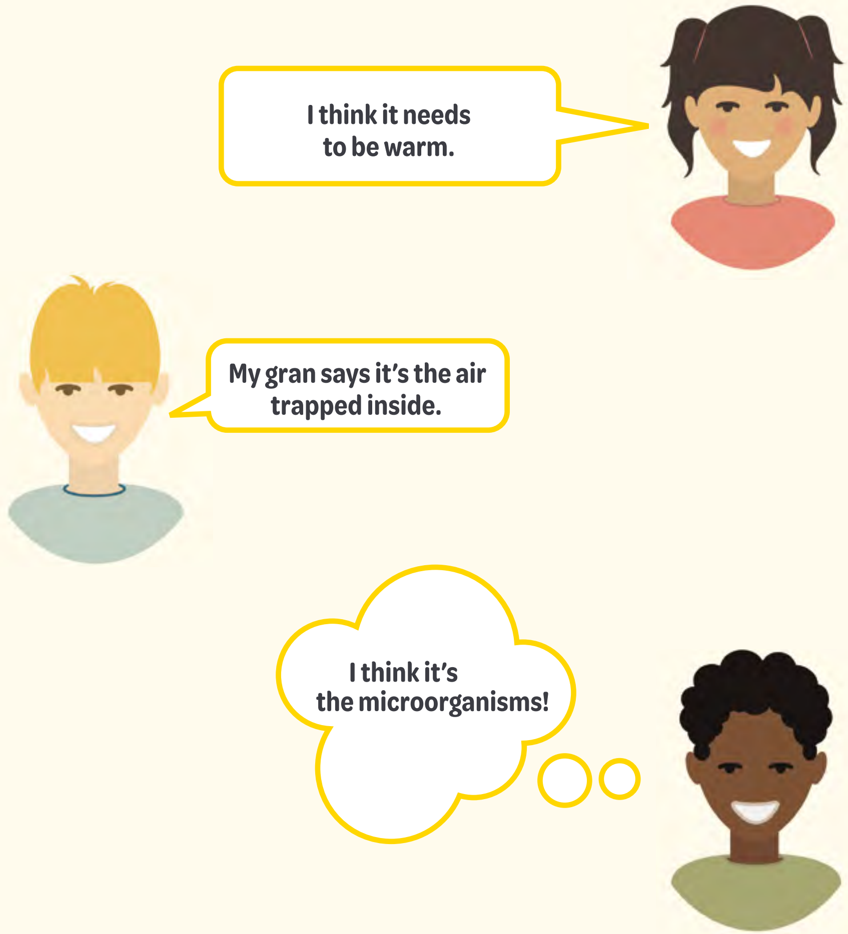
Assessor(s) Signature	Review Date	Manager Signature	Date

Let's Investigate

Making Dough

What is needed to make dough rise?

What do you think?



Let's Investigate

Making Dough

Method:

1. Collect 2 cups and label them A and B.
2. Add 2 heaped dessert spoons of flour and two level teaspoons of sugar to each cup.
3. Add 30ml of fresh yeast to cup A.
4. Add 30ml of water to cup B.
5. Stir each cup well.
6. Measure the height of the mixture.
7. Leave in a warm place for 30 minutes.
8. Record the height of the mixture in each cup and calculate the change in height.

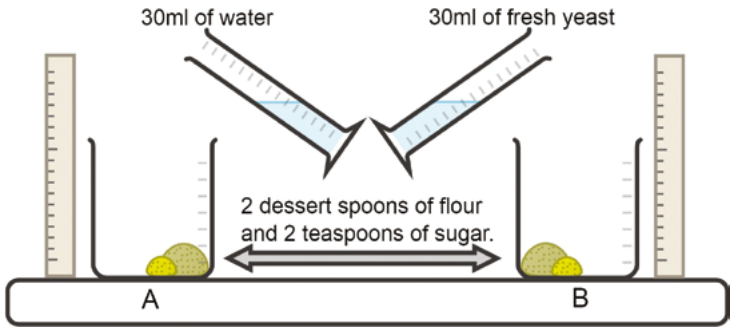


Image courtesy of chemix.org

Results:

Cup	Yeast	Height at start (cm)	Height at end (cm)	Change in height (cm)
A	live			
B	none			

Teacher Guide: Making Dough

SCN 2-13a

I have investigated the role of microorganisms in the production of some materials.

Microbes are found everywhere on planet earth. Microorganisms affect all aspects of our lives. They are a source of food but can also make food spoil. Many benefit humankind, and some provide huge challenges. Brewing and baking are major industries which involve yeast, a group of single celled fungi. These processes have been undertaken for many centuries and both depend on the yeast turning sugar into carbon dioxide, alcohol and heat. The carbon dioxide makes bread rise and beer fizzy. The alcohol evaporates from the bread during baking. This activity develops investigative and inquiry skills through the microorganisms (SCN2-13a) and their role in making dough.

Yeast turning sugar into carbon dioxide and alcohol is a chemical reaction, evidence of this is the holes left by Carbon Dioxide gas in the dough. This activity can be used to support SCN 2-19a – chemical reactions.

Key Vocabulary:

Yeast: single celled organisms.

Microorganism: microscopic living organisms e.g. bacteria, yeast, fungi.

Carbon dioxide: gas given off during respiration.

Microbiology: the scientific study of microbes.

Aim:

To investigate how yeast affects the height that dough rises.

Independent Variable (the variable that is changing):

Yeast

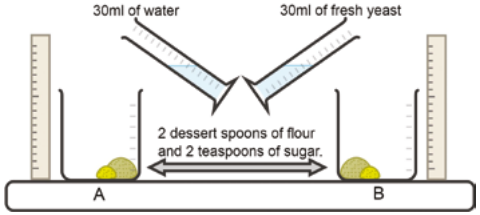
Dependent Variable (the variable that is measured):

Height of dough

Control Variables:

- volume of water
- mass of sugar
- mass and type of flour.

Materials (per group) and method:



1. Collect 2 cups and label A and B.
2. Add 2 heaped dessert spoons of flour and two level teaspoons of sugar to each cup.
3. Add:

   -30ml of water to cup A and stir.
   -30ml of fresh yeast to cup B and stir.
4. Measure the height of the mixture in each cup.
5. Leave in a warm place for 30 minutes.
6. Then record the height of the mixture in each cup.
7. Calculate the change in height.

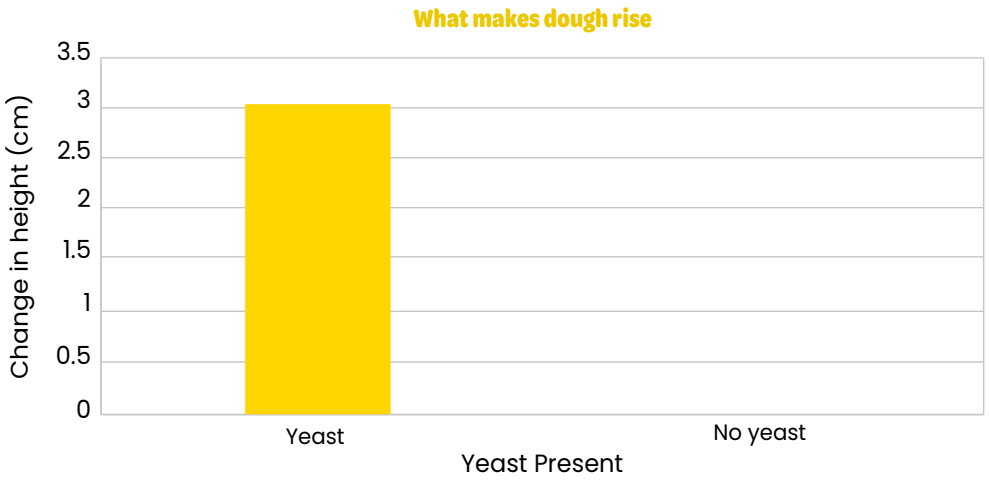
Results:

Cup	Yeast (independent variable)	Height at start (cm)	Height at end (cm)	Change in height (cm) (dependent variable)
A	None	2	2	0
B	Live yeast	2	5	3

Results will vary, the values above have been included as sample values only.

Presenting data:

The presence or absence of yeast is *discrete* data. It should be presented as a bar chart.



Conclusion:

For expected results:
The results show that yeast is required to make dough rise.

For unexpected results a statement of what has been observed is sufficient.

Possible unexpected results include neither recipe rising due to inactive yeast, or the 'water only' recipe rising due to incorrectly labelled cups.

Evaluation:

Are there any common errors that would affect the results?

Are there any alternative methods that would give more accurate results?

Possible sources of errors include difficulty measuring the rise in height of the dough. One possible improvement is to do the experiment in a measuring cylinder rather than a plastic cup and use the graduations on the side of the cylinder to measure the increase in volume.

Pupils may suggest using scales to make accurate measurements rather than using 'heaped dessert spoons' and 'level teaspoons'.

Any valid source of error and a possible improvement is accepted.

Possible variations for complexity:

Compare boiled yeast to live yeast.

Compare different masses of sugar e.g. 2 g, 4 g, 6 g, 8 g and 10 g.

Compare different flour types.

Compare different yeasts.

Interdisciplinary Learning:

Science:

Chemical reactions	SCN2-19a

Numeracy:

Measurement	MNU 1-11a
Data and Analysis	MNU 1-20b, MTH 1-21a, MNU 2-20b, MTH 2-21a

Literacy:

Tools for Writing	LIT 2-23a
Creating texts (writing)	LIT 2-28a

Skill Organiser	Skills	Addressed in Activity
Inquiry and investigative skills	**Plans and designs scientific investigations and enquiries**	
	Formulates questions and predictions (hypotheses), with assistance, based on observations and information	✓
	Identifies the independent, dependent and controlled variables, with assistance.	✓
	Anticipates some risks and hazards.	✓
	Carries out practical activities in a variety of learning environments	
	Applies appropriate safety measures.	✓
	Contributes to carrying out all the procedures.	✓
	Makes observations and collects information and measurements using appropriate devices and units.	✓
	Manages identified controlled variables to ensure validity of results.	✓
	Analyses, interprets and evaluates scientific findings	
	Selects appropriate methods to record data/information.	✓
	Identifies relationships between the independent and dependent variables.	✓
	Makes links to original questions or predictions.	✓
	Relates findings to the wider world.	✓
	Draws basic conclusions consistent with findings.	✓
	Identifies and discusses additional knowledge and understanding gained.	✓
	Recognises anomalous results and suggests possible sources of error.	✓
	Evaluates the investigation and suggests one way of improving it if it was to be repeated.	✓
	Presents scientific findings	
	Presents data/information by choosing from an extended range of tables, charts, diagrams, graphs, including bar graphs and line graphs.	✓
	Reports collaboratively and individually using a range of methods.	✓
	Collates, organises and summarises findings, with assistance, using headings or questions to provide structure for presentations.	✓
	Uses appropriate scientific vocabulary and acknowledges sources, with assistance.	✓

Biological Systems SCN2-13a

Skill Organiser	Skills	Addressed in Activity
Scientific analytical thinking skills	Applies scientific analytical thinking skills, with assistance, working with less familiar (or familiar but more complex) contexts.	✓
	Applies understanding, and a combination of more than one science concept, to solve problems and provide solutions.	✗
	Demonstrates further development of creative thinking including through the engineering processes of design, construction, testing and modification.	✗
Skills and attributes of scientifically literate citizens	Presents a reasoned argument based on evidence, demonstrating understanding of underlying scientific concepts, and engages with the views of others.	✗
	Demonstrates understanding of the relevance of science to their future lives and the role of science in an increasing range of careers and occupations.	✗
	Demonstrates increased awareness of creativity and inventiveness in science, the use of technologies in the development of sciences and the impact of science on society.	✗
	Expresses informed views about scientific and environmental issues based on evidence.	✗

Risk Assessment

Task/Activity/Process Description	Making Dough	**Service**	Communitites
Location	School Name	**Reference**	To be completed by school

Types of Injury/Loss/Ill Health	slips and trips

For each hazard, please identify the person at risk (direct and indirect)

Consider those especially vulnerable (young or inexperienced workers, members of the public, school pupils, the elderly, residents and contractors)

NOTE: New and expectant mothers require a separate risk assessment

Haz No.	Hazard	Source of Hazard	Persons at Risk	Current Control Measures in Place	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Risk Rating (1-25)
1	Chemicals	Water, live yeast and sugar	Employee/Pupil	The suggested chemicals in this experiment are low risk. Any additional liquids used should be risk assessed by staff.	1	1	1
2	Slip/Trip/Fall	Spilled water and granuated sugar	Employee/Pupil	Paper towel available to clean spills. This experiment can be performed in a tote tray to catch any spills.	2	2	4
3	Slip/Trip/Fall	Classroom furniture	Employee/Pupil	Chairs should be tucked neatly under desks, pupil movement should be managed.	1	2	2
4	Tools/Equipment	Beakers and measuring cylinders	Employee/Pupil	Plastic equipment should be used to minimise risks posed by broken glass.	1	1	1
5	Other (please identify)	Pupil behavior	Employee/Pupil	School to complete			0
6	Other (please identify)	Pupil additional needs	Employee/Pupil	School to complete			0
7							0
8							0
9							0
10							0
11							0
12							0
13							0
14							0

Risk Reduction

Haz No.	Additional Control Measures	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Final Risk Rating (1-25)	Action By (name and target date)	Date Control Implemented	Sign to Confirm
1	As low as reasonably possible			0			
2	As low as reasonably possible			0			
3	As low as reasonably possible			0			
4	As low as reasonably possible			0			
5	As low as reasonably possible			0			
6	As low as reasonably possible			0			
7				0			
8				0			
9				0			
10				0			
11				0			
12				0			
13				0			
14				0			

Assessor(s) Name (print)	Assessment Date	Manager Name (print)

Assessor(s) Signature	Review Date	Manager Signature	Date

Let's Investigate

Lifecycles

Exploring:

1. Collect a set of Lifecycle Information Diagrams
2. Read over and discuss the steps in each lifecycle.
3. Your aim is to investigate the similarities and differences in the different lifecycles.

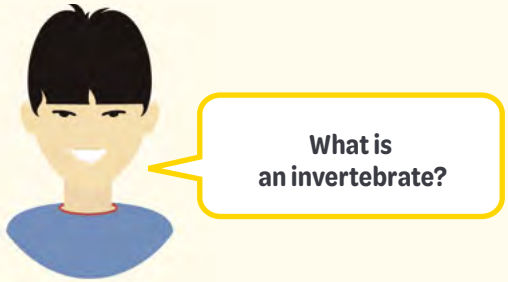
Results:

Create a table to show the results of your investigation, detailing the similarities and differences of the stages of life each creature experiences. Discuss with your group headings for your columns and rows, and how best to organise your data.

Challenge:

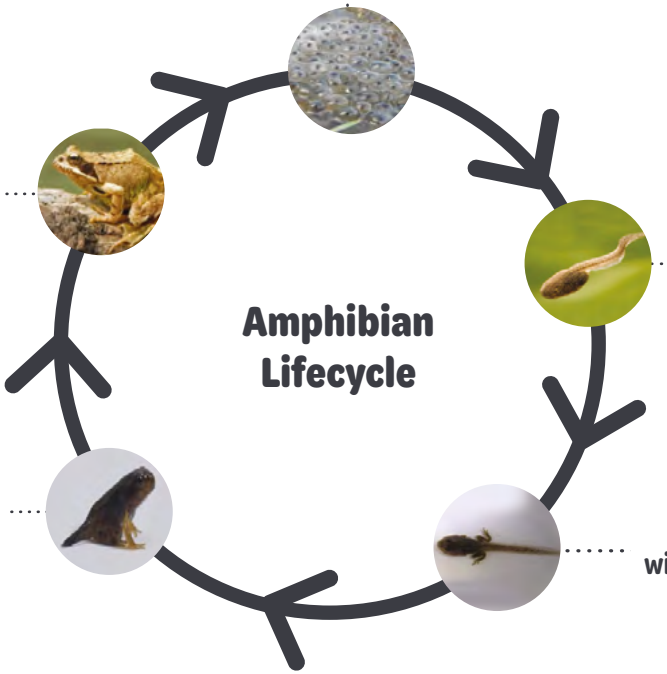
Each lifecycle diagram mentions another creature to investigate. Choose one and research the lifecycle of your chosen creature. How does it compare to the other animals you have investigated?

What do you think?



Lifecycles

Frog



The female lays a mass of eggs which are fertilised by the male.

After 2-25 days the tadpole hatches from the egg. It swims and eats plants. It breathes through gills.

The tadpole grows fins and a stronger tail. Then, it develops lungs and hindlegs.

The tadpole grows front legs and its tail shortens. It uses nutrients in its tail as food. It jumps out of the water on to land.

The tail disappears and it starts to eat insects instead of plants. It takes 2-4 years to become an adult, when it can lay eggs.

Other amphibian lifecycles to explore: toad, newt, salamander.

Lifecycles

Bird

Eggs are laid by the mother and the mother and father care for the egg until it hatches.

Egg

Nesting

Mother and father feed the young bird until it is old enough to fly and find its own food.

Fledgling

The fledgling stage is when birds begin learning to fly. It's common for young robins to end up on the ground because fledglings have sparse feathers.

Juvenile

Juveniles have no red feathers so that adult birds do not attack them in territorial disputes.
The speckled feathers are lost in a partial moult when the bird is about two to three months old.

Adult

Independent adult usually seeks company from the opposite sex and mates.

Other bird lifecycles to explore: chicken, penguin, eagle.

Lifecycles

Butterfly

Eggs are laid by the female.

Egg

Larva

Egg hatches into a larva, known as a caterpillar.

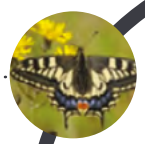
Pupa

The pupa stage is where a hard case forms around the larva.

Metamorphosis

Inside the pupa the caterpillar metamorphoses (changes) into an adult.

Adult



The adult butterfly breaks out of the pupa, matures and (females) lays eggs.

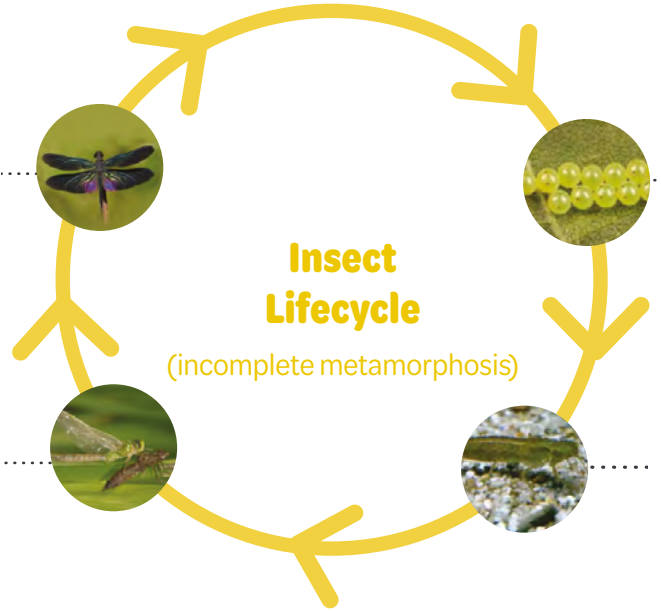
Insect Lifecycle

(complete metamorphosis)

Other complete metamorphosis lifecycles to explore: fly, ladybird, beetle.

Lifecycles

Dragonfly



Adult

The adult can fly. Adult females lay eggs.

Egg

Egg hatches into a nymph. Nymph looks like a small adult.

Larvae (Nymph)

Eggs are laid by the female insect. Sometimes this in the water.

Moult

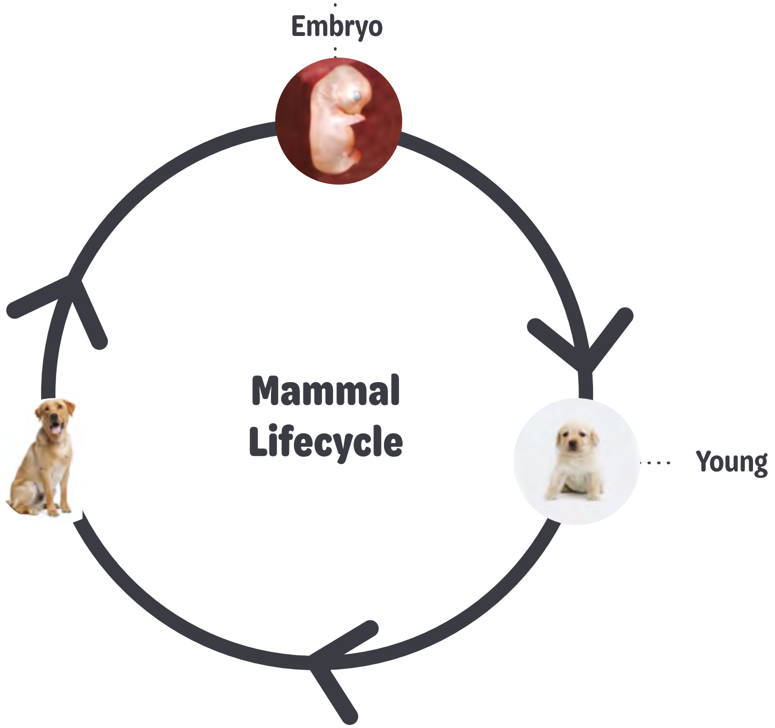
The nymph grows into the adult form, shedding its skin.

Other incomplete metamorphosis lifecycles to explore:
grasshopper, aphid, cockroach.

Lifecycles

Dog

The embryo grows inside the mother. It is completely reliant on the mother for nutrients, oxygen and water.



Independent adults usually seek company from opposite sex and mate. Adult females nurse their young.

Main period of growth and developing independence from parents.

Other mammal lifecycles to explore: dolphin, human, elephant.

Teacher Guide: Lifecycles (of animals)

SCN 2-14a

I can identify and compare different vertebrates
I can research the lifecycles of the five main types of vertebrates

This pack supports exploration of the lifecycles of a variety of plants and animals, investigating the different stages of their development.

Key Vocabulary:

Vertebrate: Animals with a backbone.

Metamorphosis: The process of an animal physically developing after birth or hatching, involves an abrupt change in the animal's body structure through cell growth and differentiation.

Amphibian: A cold-blooded vertebrate animal that is born in water and breathes with gills.

Reptiles: A group of cold-blooded animals which have skins covered with small hard plates called scales and lay eggs, e.g. snakes, lizards and crocodiles.

Aim:

To describe the differences in the life cycles of a mammal, an amphibian, an insect and a bird.

Materials (per group):

Lifecycle diagrams

Results and Presenting data:

Pupils should analyse the lifecycle information sheets and use the information to create a table demonstrating the main similarities and differences in lifecycles.

An example is shown below:

Creature	Hatches from an egg	Mother gives birth to live young	Mother cares for young	Creature undergoes complete metamorphosis	Creature undergoes incomplete metamorphosis
Insect: Butterfly	X			X	
Insect: Dragonfly	X				X
Mammal: Dog		X	X		
Amphibian: Frog	X			X	
Bird: Robin	X		X		

Conclusion:

Mammals are the only creature where the mother gives birth to live young. Both mammals and birds care for their young until they are old enough to find their own food. Insects and amphibians undergo metamorphosis, although this differs by species (butterflies and frogs undergo complete metamorphosis while dragonflies go through an incomplete metamorphosis).

Evaluation:

Pupils should summarise their exploration by discussing the similarities and differences between lifecycles of different species.

Misconceptions:

Some children think of the egg or seed as the first stage of the life cycle. Encourage the idea that life cycles are continuous loops, without a beginning or end. Death is not part of a species' life cycle, but rather the last event in the life of an individual living thing. Children may not appreciate that an egg or seed is a living thing.

Interdisciplinary Learning:

Numeracy:

Data and analysis	MTH 2-21a

Literacy:

Finding and using information	LIT 2-15a
Understanding analysing and Evaluating	LIT 2-16a

Let's Investigate

Inheritance

What characteristics might offspring inherit from a parent?

What do you think?

Let's Investigate

Inheritance

Method:

1. Collect a set of **Inherited Characteristics** Cards.
2. Sort the cards into characteristics that can be inherited from a parent and those that are non-inherited learned behaviours.
3. Collect a **Famous Families** sheet.
4. Choose an individual from Famous Families and try to identify their family members based on their inherited characteristics.
5. Repeat for each family.
6. Draw a table like the one shown to display the results of your investigation.

Results:

Offspring	**Parents**	**Reason (Inherited Characteristic)**
Photo of offspring	Photo of parents	Explanation of inherited characteristic

Inherited or Environmental characteristics?

Cut out the following characteristics and sort them into two groups. Characteristics that are inherited and traits that are environmental or learned characteristics.

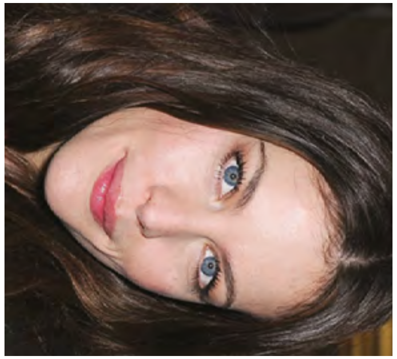
Eye colour	**Skin tan from the sun**	**Natural hair colour**	**Ability to read**
Attached or detached earlobes	**Nose shape**	**Scars**	**Height**
Sporting ability	**Tongue rolling**	**Blood Group**	**Singing ability**
Weight	**Dimples**	**Ability to swim**	**Cleft Chin**

Cut out the following characteristics and sort them into two groups. Characteristics that are inherited and traits that are environmental or learned characteristics.

Eye colour	**Skin tan from sun**	**Natural hair colour**	**Ability to read**
Attached or detached earlobes	**Nose shape**	**Scars**	**Height**
Sporting ability	**Tongue rolling**	**Blood Group**	**Singing ability**
Weight	**Dimples**	**Ability to swim**	**Cleft Chin**

Famous Families












Teacher Guide: Inherited and non-inherited characteristics

SCN 2-14b

I can explore and categorise characteristics into inherited (eye and hair colour) and non-inherited (favourite colour).

This pack supports investigation into the characteristics inherited by offspring when living organisms reproduce and exploration of the difference between inherited and non-inherited characteristics.

Key Vocabulary:

Characteristic: A distinguishing quality, trait or feature of an individual.

Genetics: The study of how inherited characteristics are passed on.

Inherited characteristic: The transmission of parental traits to their offspring.

Non-inherited characteristics:

- learned behaviours such as reading and favourite music genre.
- lifestyle choices such as length of hair, dyed hair and clothing style.
- environmental factors such as accents and skin tan.

Aim:

To investigate the characteristics inherited when living things reproduce, exploring inherited and non-inherited characteristics.

Lessons:

Activity 1: Inherited or Environmental Characteristics card sort

Materials (per group):

Inherited Characteristic Cards (per group of 3)

Results:

Inherited characteristics: tongue rolling, natural hair colour, natural eye colour, chin cleft, dimples, attached or detached earlobes, blood group.

Non-inherited characteristics: Skin tan from the sun, reading, scars, sporting ability, singing, weight, swimming, nose shape*, height*

*Nose shape and height are both inherited, however change during your life as you age or are involved in accidents.

Activity 2: Famous Families

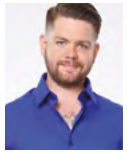
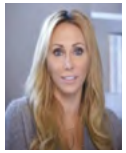
Materials:

Famous families photograph set (per pupil)

Results:

Organisation and classification of families according to inherited characteristics and photograph choices should be accompanied with an explanation of the inherited characteristic.

Activity 2 Presenting data: Explanations may vary, but should follow the following guide.

Offspring	Parent/s	Inherited Characteristic
 		**Smith Family:** Ear shape inherited from dad to son, skin colour from both parents, hair type from both parents, eye colour inherited from both.
 		**Gooding family:** skin colour inherited from dad, chin shape inherited from dad, eye colour inherited from dad.
  		**Osborne family:** Face shape: mum to daughters, hair colour: Dad to son and daughter.
	 	**Cyrus Family:** face shape and hair colour: mum to daughter.
	 	**Tyler family:** eyebrow and face shape: dad to daughter, hair texture: mum to daughter, hair colour: dad to daughter.

Conclusion:

Activity 2 Evaluation:

Summation of characteristics that are inherited from parents and non-inherited learned behaviours.

Interdisciplinary Learning:

Numeracy:

Data and Analysis MTH 2-20b, MTH 2-21a

For reference:

Free earlobe 	Attached earlobe 
Cleft chin 	No cleft 

Skill Organiser	Skills	Addressed in Activity
Inquiry and investigative skills	**Plans and designs scientific investigations and enquiries**	
	Formulates questions and predictions (hypotheses), with assistance, based on observations and information	✗
	Identifies the independent, dependent and controlled variables, with assistance.	✗
	Anticipates some risks and hazards.	✗
	Carries out practical activities in a variety of learning environments	
	Applies appropriate safety measures.	✗
	Contributes to carrying out all the procedures.	✗
	Makes observations and collects information and measurements using appropriate devices and units.	✓
	Manages identified controlled variables to ensure validity of results.	✗
	Analyses, interprets and evaluates scientific findings	
	Selects appropriate methods to record data/information.	✓
	Identifies relationships between the independent and dependent variables.	✗
	Makes links to original questions or predictions.	✓
	Relates findings to the wider world.	✓
	Draws basic conclusions consistent with findings.	✓
	Identifies and discusses additional knowledge and understanding gained.	✓
	Recognises anomalous results and suggests possible sources of error.	✓
	Evaluates the investigation and suggests one way of improving it if it was to be repeated.	✓
	Presents scientific findings	
	Presents data/information by choosing from an extended range of tables, charts, diagrams, graphs, including bar graphs and line graphs.	✓
	Reports collaboratively and individually using a range of methods.	✓
	Collates, organises and summarises findings, with assistance, using headings or questions to provide structure for presentations.	✓
	Uses appropriate scientific vocabulary and acknowledges sources, with assistance.	✗

Biological Systems SCN2-14b

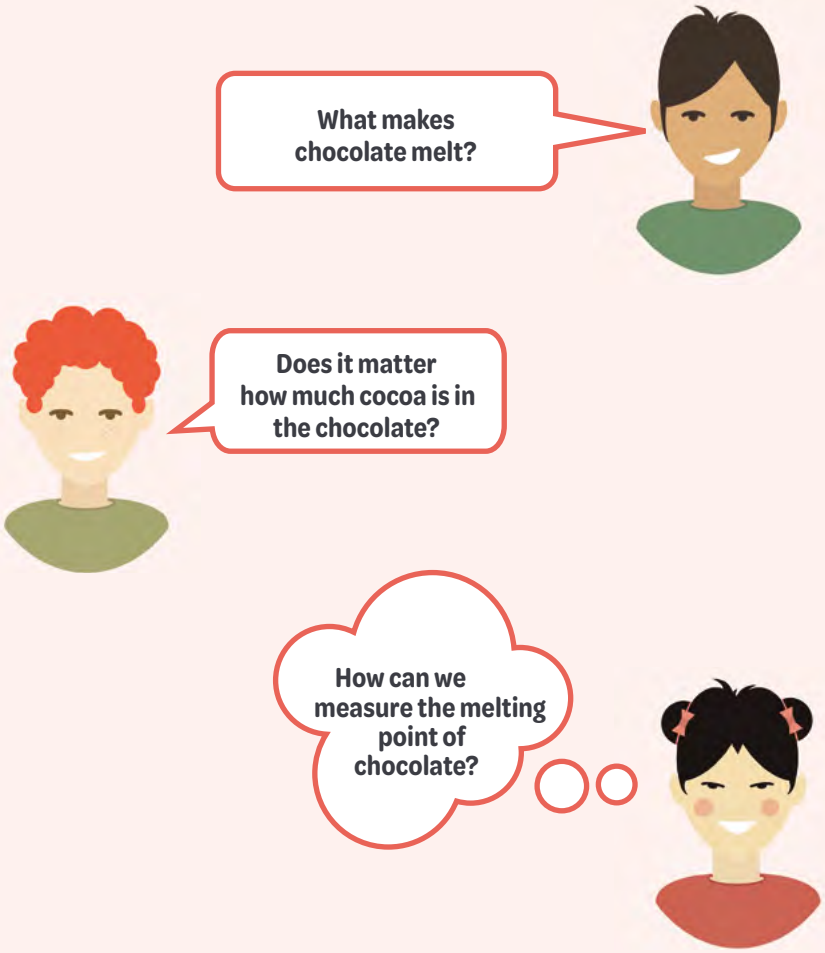
Skill Organiser	Skills	Addressed in Activity
Scientific analytical thinking skills	Applies scientific analytical thinking skills, with assistance, working with less familiar (or familiar but more complex) contexts.	✓
	Applies understanding, and a combination of more than one science concept, to solve problems and provide solutions.	✗
	Demonstrates further development of creative thinking including through the engineering processes of design, construction, testing and modification.	✗
Skills and attributes of scientifically literate citizens	Presents a reasoned argument based on evidence, demonstrating understanding of underlying scientific concepts, and engages with the views of others.	✗
	Demonstrates understanding of the relevance of science to their future lives and the role of science in an increasing range of careers and occupations.	✗
	Demonstrates increased awareness of creativity and inventiveness in science, the use of technologies in the development of sciences and the impact of science on society.	✗
	Expresses informed views about scientific and environmental issues based on evidence.	✗

Let's Investigate

Melting

Do different types of chocolate melt at the same temperature?

What do you think?



Materials SCN2-15a

Let's Investigate

Melting

Method:

1. Use large paperclips to attach 3 pie cases to a plastic takeaway container.
2. Place a different type of chocolate into each of the cases.
3. Ask your teacher to add warm water to your container so that the pie cases are touching the water.
4. Start your stopwatch straight away and record how many seconds it takes for each chocolate to melt.
5. Collect results from 2 other groups and calculate the average melting time for each type of chocolate.

Results:

Type of chocolate	**Time for chocolate to melt (s)**			
	Group 1 results	**Group 2 results**	**Group 3 results**	**Average**
Milk Chocolate				
Dark Chocolate				
White Chocolate				

Teacher Guide: Do different types of chocolate melt at the same temperature?

SCN 2-15a

By contributing to investigations into familiar changes in substances to produce other substances, I can describe how their characteristics have changed.

This resource has been adapted from stem.org.uk. The full resource can be found here: *https://www.stem.org.uk/resources/elibrary/resource/315591/what-temperature-does-chocolate-melt*

This is a comparative test. Pupils will record the time it takes for different types of chocolate to melt. As the heat transfers into the foil pie cases, the chocolate will slowly heat up. The chocolate that melts first has the lowest melting point and the chocolate that melts last has the highest melting point.

Key Vocabulary:

Melting: The change of state that occurs when a solid changes to a liquid.

Evaporation: The change of state that occurs when a liquid changes to a gas.

Condensation: The change of state that occurs when a gas turns to a liquid.

Freezing/solidification: the change of state the occurs when a liquid turns into a solid.

Melting point: the temperature at which a solid turns into a liquid.

Aim:

To find out if different chocolates have different melting points.

Independent Variable (the variable that is changing):

The type of chocolate.

Dependent Variable (the variable that is measured):

The time taken to melt.

Control Variables:

Mass of chocolate. This can be kept the same by breaking approximately equal size pieces of chocolate or using a digital scale to measure each piece (this is very accurate but very time consuming).

Temperature of water. This is controlled as each piece of chocolate is in the same tub of water.

Type of foil pie case. Use the same brand of pie case.

Materials (per group):

1 plastic takeaway container.

1 stopwatch

3 deep foil pie cases

3 different pieces of chocolate. E.g. Milk chocolate, dark chocolate, white chocolate.

3 large paper clips.

Warm water (approximately 40°C)

Wooden stirrer.

How to:

Pupils can prepare their experiment by clipping each pie case to the side of their takeaway container with a large paper clip.

Pupils can then place one piece of chocolate in each pie case.

At this point the teacher can pour the warm water into the takeaway container and pupils can start the stopwatch.

Stirring the chocolate with a wooden stirrer will speed up the melting process.

Pupils then observe and record the time taken for each piece of chocolate to melt.
The stopwatch should only be stopped when the last piece of chocolate has melted.

A water temperature of 40°C is warm enough to carry out this experiment. The warm water should be prepared by the teacher and dispensed to pupils by an adult when they are ready to begin the investigation. A plastic jug can be half filled with water from a recently boiled kettle and topped up with cold tap water to achieve the required temperature. Use a thermometer to check temperature of the water.

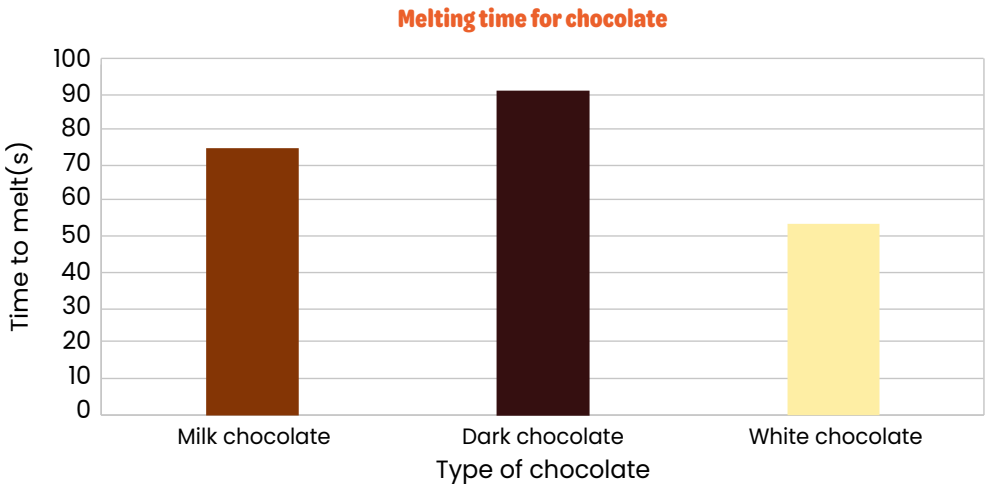
Results:

Data should be recorded in a table similar to the one below. More able pupils can be asked to design their own table. Results will vary, the example below has been produced to show how data can be presented as a bar chart and is not an accurate set of results to compare class results with.

Chocolate	**Time take for chocolate to melt(s)**
Milk Chocolate	75
Dark Chocolate	91
White Chocolate	53

Presenting data:

This data should be presented as a bar chart as it is *'discrete data'*.



Conclusion:

For this experiment a statement of results is sufficient. E.g. White chocolate melted first which means it has the lowest melting point. Dark chocolate took the longest time to melt which means it has the highest melting point.

Please note, results may vary, and pupil conclusions may not match the example above.

Evaluation:

Errors that could occur in this experiment are noting the exact time the chocolate has melted. Pupils may suggest using a thermometer in each piece of chocolate to measure its temperature when it melts as an improvement.

Pupils may come up with other sources of errors, encourage them to suggest methods to improve the experiment to minimise these errors they have identified.

Misconceptions:

Everything melts when you heat it.
– some substances burn when heated. E.g. Paper + wood.

Interdisciplinary Learning:

Maths and Numeracy:

Measurement	MNU 1-11a
Data and Analysis	MNU 1-20b, MTH 1-21a, MNU 2-20b, MTH 2-21a

Literacy:

Tools for Writing	LIT 2-23a
Creating texts (writing)	LIT 2-28a

Materials — SCN2-15a

Skill Organiser	Skills	Addressed in Activity
Inquiry and investigative skills	**Plans and designs scientific investigations and enquiries**	
	Formulates questions and predictions (hypotheses), with assistance, based on observations and information	✓
	Identifies the independent, dependent and controlled variables, with assistance.	✓
	Anticipates some risks and hazards.	✓
	Carries out practical activities in a variety of learning environments	
	Applies appropriate safety measures.	✓
	Contributes to carrying out all the procedures.	✓
	Makes observations and collects information and measurements using appropriate devices and units.	✓
	Manages identified controlled variables to ensure validity of results.	✓
	Analyses, interprets and evaluates scientific findings	
	Selects appropriate methods to record data/information.	✓
	Identifies relationships between the independent and dependent variables.	✓
	Makes links to original questions or predictions.	✓
	Relates findings to the wider world.	✓
	Draws basic conclusions consistent with findings.	✓
	Identifies and discusses additional knowledge and understanding gained.	✓
	Recognises anomalous results and suggests possible sources of error.	✓
	Evaluates the investigation and suggests one way of improving it if it was to be repeated.	✓
	Presents scientific findings	
	Presents data/information by choosing from an extended range of tables, charts, diagrams, graphs, including bar graphs and line graphs.	✓
	Reports collaboratively and individually using a range of methods.	✓
	Collates, organises and summarises findings, with assistance, using headings or questions to provide structure for presentations.	✓
	Uses appropriate scientific vocabulary and acknowledges sources, with assistance.	✓

Skill Organiser	Skills	Addressed in Activity
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	Applies understanding, and a combination of more than one science concept, to solve problems and provide solutions.	✗
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Skills and attributes of scientifically literate citizens	Presents a reasoned argument based on evidence, demonstrating understanding of underlying scientific concepts, and engages with the views of others.	✗
	Demonstrates understanding of the relevance of science to their future lives and the role of science in an increasing range of careers and occupations.	✗
	Demonstrates increased awareness of creativity and inventiveness in science, the use of technologies in the development of sciences and the impact of science on society.	✗
	Expresses informed views about scientific and environmental issues based on evidence.	✗

Materials SCN2-15a

Materials SCN2-15a

Risk Assessment

Task/Activity/Process Description	Melting chocolate investigation	**Service**	Communitites
Location	School Name	**Reference**	To be completed by school

Types of Injury/Loss/Ill Health	slips and trips, scalds

For each hazard, please identify the person at risk (direct and indirect)

Consider those especially vulnerable (young or inexperienced workers, members of the public, school pupils, the elderly, residents and contractors)

NOTE: New and expectant mothers require a separate risk assessment

Haz No.	Hazard	Source of Hazard	Persons at Risk	Current Control Measures in Place	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Risk Rating (1-25)
1	Temperature	Hot water	Employee/Pupil	A water temperature of 40°C is warm enough to carry out this experiment. The warm water should be prepared by the teacher and dispensed to pupils by an adult when they are ready to begin the investigation. A plastic jug can be half filled with water from a recently boiled kettle and topped up with cold tap water to achieve the required temperature. Use a thermometer to check temperature of the water.	1	1	1
2	Slip/Trip/Fall	spilled water	Employee/Pupil	Paper towel available to clean spills. This experiment can be performed in a tote tray to catch any spills.	2	2	4
3	Slip/Trip/Fall	Classroom furniture	Employee/Pupil	Chairs should be tucked neatly under desks, pupil movement should be managed.	1	2	2
4	Other (please identify)	Allergies	Employee/Pupil	This investigation suggests using milk, dark and white chocolate. Avoid using chocolate that contains nuts.			0
5	Biological	Spread of germs and infection	Employee/Pupil	To prevent the spread of infection and to minimise risk of allergic reactions, staff should not allow pupils to eat any of the chocolate that has been used in the experiment.			0
6	Other (please identify)	Pupil behavior	Employee/Pupil	School to complete			0
7	Other (please identify)	Pupil additional needs	Employee/Pupil	School to complete			0
8							0
9							0
10							0
11							0
12							0
13							0
14							0

Risk Reduction

Haz No.	Additional Control Measures	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Final Risk Rating (1-25)	Action By (name and target date)	Date Control Implemented	Sign to Confirm
1	As low as reasonably possible			0			
2	As low as reasonably possible			0			
3	As low as reasonably possible			0			
4	As low as reasonably possible			0			
5	As low as reasonably possible			0			
6				0			
7				0			
8				0			
9				0			
10				0			
11				0			
12				0			
13				0			
14				0			

Assessor(s) Name (print)	Assessment Date	Manager Name (print)

Assessor(s) Signature	Review Date	Manager Signature	Date

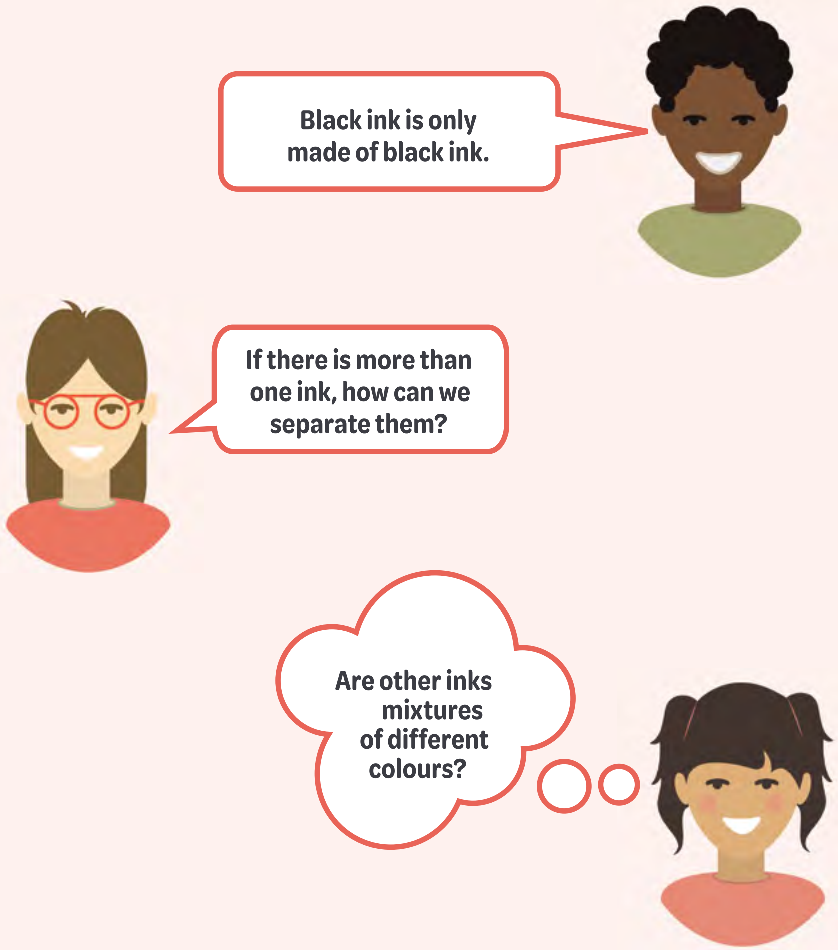
Materials SCN2-15a

Let's Investigate

Separating Mixtures

Are all black felt tip pens made with the same ink?

What do you think?



Let's Investigate

Separating Mixtures

Method:

1. Rule a pencil line 1 cm from the bottom of a piece of filter paper.
2. Place a spot of black ink on the line.
3. Place the filter paper into a beaker with 0.5cm of water in the bottom. Fold the paper over a pencil to stop it falling in.
4. Allow the water to travel up the paper, separating the black ink into different colours.
5. Repeat for each brand of black pen

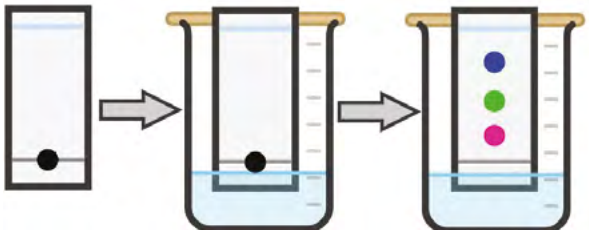


Image courtesy of chemix.org

Results:

Brand of felt tip pen	Colours present in ink

Teacher Guide: Separating Mixtures

SCN 2-16a

I have participated in practical activities to separate simple mixtures of substances and can relate my findings to my everyday experiences.

In this activity, pupils use *chromatography* to separate the mixtures that make black ink. Chromatography separates mixtures based on how soluble each component is in a solvent, usually water or alcohol. The molecules that travel furthest up the chromatography paper are very soluble, the molecules which travel short distances are less soluble. Any inks that do not move are insoluble.

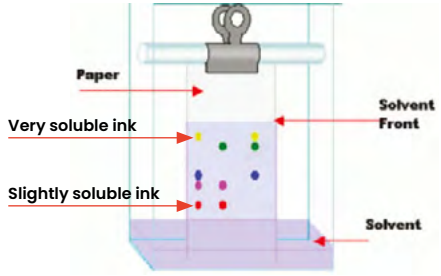


Figure 1. Paper chromatography. Molecules are separated from each other, depending on how fast they move with the solvent up the chromatography paper. (Wikipedia, 2008.)

Key Vocabulary:

Chromatography: a technique for separating a mixture of liquids.

Solution: a liquid mixture in which the solute is uniformly distributed within the solvent.

Solvent: the liquid in which a solute is dissolved to form a solution (water in this experiment).

Solute: the substance dissolving in the solvent (black ink in this experiment).

Aim:

To investigate which colours are in black ink.

Independent Variable (the variable that is changing):

Ink used (type of pen)

Dependent Variable (the variable that is measured):

Number of different inks in black ink mixture

Control Variables:

Size of ink spot, volume of solvent, time experiment is left to run.

Materials (per group):

Chromatography strip (filter paper or coffee filters cut into strips approx. 4cm wide).

Plastic cup or beaker

Water

Mini binder clips (2)

Pencil or lollipop stick.

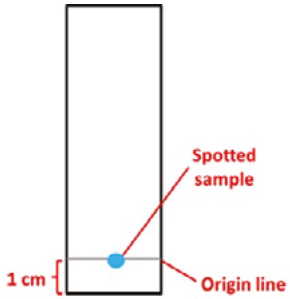
Different black pens and felt tips.

Scissors

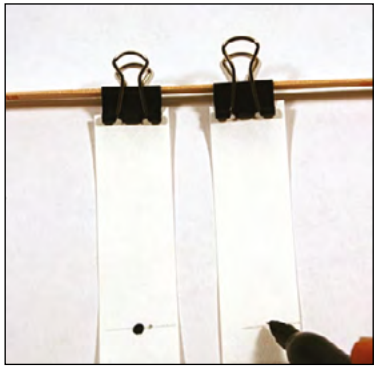
Pencil

Method:

1. Take a chromatography strip and use a ruler and pencil to draw a horizontal line 1cm from the bottom.



2. Using one of the pens/markers, place a small dot of ink at the centre of the line.
3. Use a *pencil* to label which pen/marker you spotted on the chromatography strip. Do not use a pen to label the strips, the ink will run when the water passes through the strips. Repeat steps 1 and 2 for each pen or felt tip you are testing.



4. Add approximately 0.5cm of water to the bottom of a beaker.
5. Clip two of the prepared chromatography strips to a pencil or lollipop stick. Make sure the two strips do not touch each other and the bottoms align. Rest the pencil/lollipop stick on top of the beaker so that the strips hang into the beaker and just touch the water. The water should be below the ink dots.

6. Let the water rise up the strip until it is about 0.5 cm from the top, then remove the strip from the solvent. Keep a close eye on your chromatography strip and the water front – if you let it run too long the dye may run off the paper and become distorted.
7. Record how many different colours of ink are present in the black in mixture.

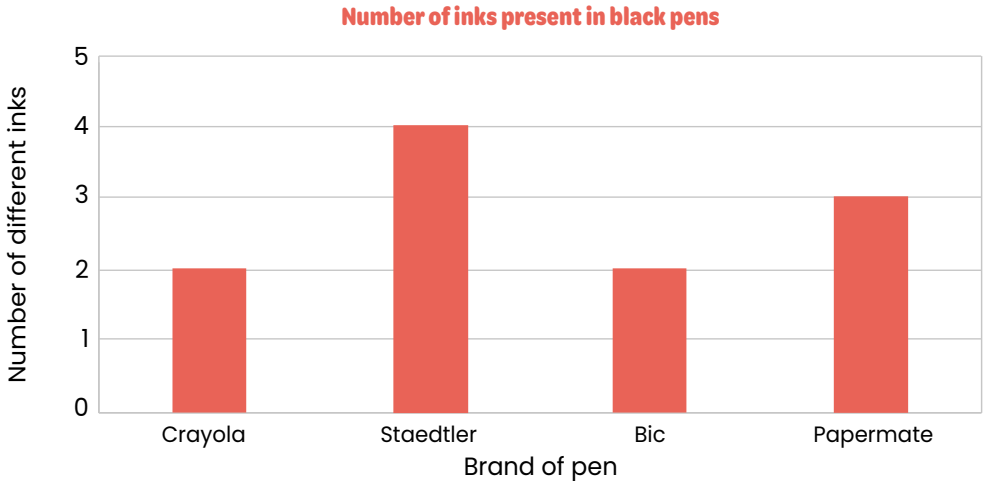
Results:

Create a data table to record the different colours present in each black pen or felt tip.

Brand of pen/felt tip	Colours present in black ink

Presenting data:

The data collected in this experiment is discrete data. It should be presented as a bar chart with number of ink colours on the Y axis and brand of pen on the X axis. It should look similar to the graph shown below.



Conclusion:

This is a comparative test. A statement of the colours found in black ink is all that is needed. Pupils may include were common across all pen types, which colours were present in the greatest volume, or which colours were most or least soluble.

Evaluation:

Pupils may suggest the following for improvements to the investigation:

- expand the investigation to find out which other colours are mixtures of different inks.
- longer test strips to allow the test to run longer. This may give greater separation of colours.
- any other valid improvement.

Interdisciplinary Learning:

Maths and Numeracy:

Data Analysis	2-20a, 2-20b, 2-21a
Number and Number Processes	2-03a

Literacy:

Tools for writing	LIT 2-23a
Creating texts	LIT 2-28a

More information for this experiment can be found at the sciencebuddies.org website.
Link: https://www.sciencebuddies.org/science-fair-projects/project-ideas/Chem_p008/chemistry/paper-chromatography#summary

Skill Organiser	Skills	Addressed in Activity
Inquiry and investigative skills	**Plans and designs scientific investigations and enquiries**	
	Formulates questions and predictions (hypotheses), with assistance, based on observations and information	✓
	Identifies the independent, dependent and controlled variables, with assistance.	✓
	Anticipates some risks and hazards.	✓
	Carries out practical activities in a variety of learning environments	
	Applies appropriate safety measures.	✓
	Contributes to carrying out all the procedures.	✓
	Makes observations and collects information and measurements using appropriate devices and units.	✓
	Manages identified controlled variables to ensure validity of results.	✓
	Analyses, interprets and evaluates scientific findings	
	Selects appropriate methods to record data/information.	✓
	Identifies relationships between the independent and dependent variables.	✓
	Makes links to original questions or predictions.	✓
	Relates findings to the wider world.	✓
	Draws basic conclusions consistent with findings.	✓
	Identifies and discusses additional knowledge and understanding gained.	✓
	Recognises anomalous results and suggests possible sources of error.	✓
	Evaluates the investigation and suggests one way of improving it if it was to be repeated.	✓
	Presents scientific findings	
	Presents data/information by choosing from an extended range of tables, charts, diagrams, graphs, including bar graphs and line graphs.	✓
	Reports collaboratively and individually using a range of methods.	✓
	Collates, organises and summarises findings, with assistance, using headings or questions to provide structure for presentations.	✓
	Uses appropriate scientific vocabulary and acknowledges sources, with assistance.	✓

Materials SCN2-16a

Materials

SCN2-16a

Skill Organiser	Skills	Addressed in Activity
Scientific analytical thinking skills	Applies scientific analytical thinking skills, with assistance, working with less familiar (or familiar but more complex) contexts.	✓
	Applies understanding, and a combination of more than one science concept, to solve problems and provide solutions.	✗
	Demonstrates further development of creative thinking including through the engineering processes of design, construction, testing and modification.	✗
Skills and attributes of scientifically literate citizens	Presents a reasoned argument based on evidence, demonstrating understanding of underlying scientific concepts, and engages with the views of others.	✗
	Demonstrates understanding of the relevance of science to their future lives and the role of science in an increasing range of careers and occupations.	✗
	Demonstrates increased awareness of creativity and inventiveness in science, the use of technologies in the development of sciences and the impact of science on society.	✗
	Expresses informed views about scientific and environmental issues based on evidence.	✗

Risk Assessment

Task/Activity/Process Description	Chromatography of black ink	**Service**	Communitites
Location	School Name	**Reference**	To be completed by school

Types of Injury/Loss/Ill Health	slips and trips, cuts from broken glass, scalding

For each hazard, please identify the person at risk (direct and indirect)

Consider those especially vulnerable (young or inexperienced workers, members of the public, school pupils, the elderly, residents and contractors)

NOTE: New and expectant mothers require a separate risk assessment

Haz No.	Hazard	Source of Hazard	Persons at Risk	Current Control Measures in Place	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Risk Rating (1-25)
1	Slip/Trip/Fall	spilled water	Employee/Pupil	Paper towel available to clean spills. This experiment could be performed in a tote tray to catch any spills.	1	1	1
2	Sharps	broken glassware	Employee/Pupil	Plastic beakers should be used where possible. Staff will clear away any broken glassware including thermometers. Pupils will be instructed not to handle any broken glass.	2	2	4
3	Slip/Trip/Fall	Classroom furniture	Employee/Pupil	Chairs should be tucked neatly under desks, pupil movement should be managed.	1	2	2
4	Other	Pupil behaviour	Employee/Pupil	School to complete	2	2	4
5	Other	Pupil additional needs		School to complete	2	2	4
6							0
7							0
8							0
9							0
10							0
11							0
12							0
13							0
14							0

Materials SCN2-16a

Risk Reduction

Haz No.	Additional Control Measures	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Final Risk Rating (1-25)	Action By (name and target date)	Date Control Implemented	Sign to Confirm
1	As low as reasonably possible			0			
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4	As low as reasonably possible			0			
5	As low as reasonably possible			0			
6				0			
7				0			
8				0			
9				0			
10				0			
11				0			
12				0			
13				0			
14				0			

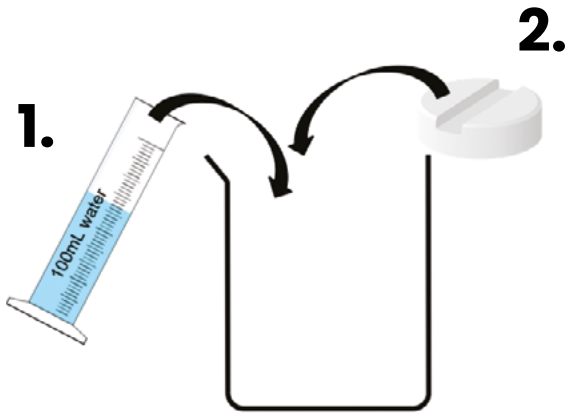
Assessor(s) Name (print)	Assessment Date	Manager Name (print)

Assessor(s) Signature	Review Date	Manager Signature	Date

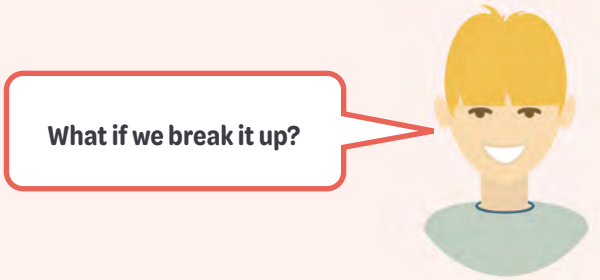
Let's Investigate

Dissolving time

How can you speed up the time it takes for a tablet to dissolve?



What do you think?



Materials

SCN2-16b

Let's Investigate

Dissolving time

Method:

1. Use the measuring cylinder to add 100mL of water to the beaker.
2. Add a whole Vitamin C tablet and start the stopwatch.
3. Record how long it takes for the tablet to completely dissolve.
4. Repeat for a tablet that has been broken in half.
5. Repeat for a tablet that has been broken into quarters.

Results:

Tablet	Time to dissolve (seconds)			
	Group 1 results	Group 2 results	Group 3 results	Average
Whole 				
Halved 				
Quartered 				

Teacher Guide: Particle size and dissolving time

SCN 2-16b

I can investigate conditions that will increase the speed of dissolving.

This experiment can be used to investigate how particle size affects time to dissolve and can be adapted to investigate how temperature affects time to dissolve. It can be bundled with SCN 2-19a as pupils are able to identify 'fizzing' as sign of a chemical reaction.

Key Vocabulary:

Solute: The substance that is dissolving.

Solvent: The liquid that has dissolved a substance.

Solution: A liquid that has a substance dissolved in it.

Aim:

To investigate how particle size affects time taken for a vitamin c tablet to dissolve.

Independent Variable (the variable that is changing):

Particle size of tablet

Dependent Variable (the variable that is measured):

Time taken for tablet to dissolve

Control Variables:

Volume of water

Temperature of water

Type of tablet

Whole tablet used each time (1 whole tablet, 2x1/2 tablets, 4x1/4 tablets)

End point – How will pupils know when the tablet has dissolved?

Materials (per group):

3 x dissolvable vitamin C tablets. (available from Aldi and Lidl, cheaper non-branded varieties work well)

1 Plastic Beaker (a clear plastic cup can be used)

1 stopwatch/timer

1 measuring cylinder

Access to water.

How to:

- Use the measuring cylinder to add 100mL of water to the beaker.
- Place a whole table in the water and start the timer.
- When the tablet has completely dissolved stop the timer and record the time taken to dissolve.
- Repeat for a tablet that has been broken in half.
- Repeat for a table that has been broken into quarters.
- To help you break the tablet into halves, use a butter knife to score a line across the middle of the tablet, then break the tablet along this line.

Results:

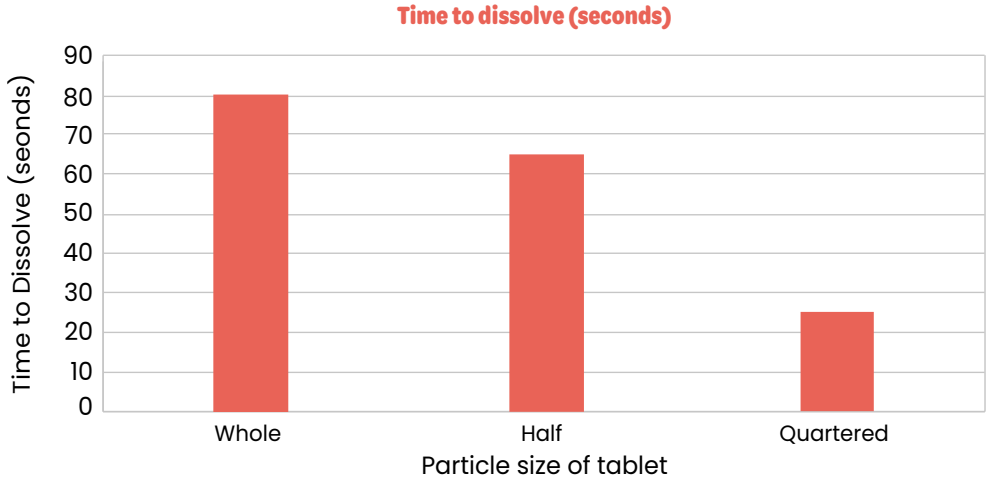
It is expected that the smallest particle size (quartered tablet) will dissolve fastest and the largest particle size (whole tablet) will dissolve the slowest. There is often variation in the class as pupils can find it difficult to accurately identify the end point. Class discussion around variables and fair testing should lead to pupils deciding the end point is when they can no longer see the tablet.

Pupils could be asked to predict how fast a crushed whole tablet would take to dissolve.

Volume of water	Tablet	Time to dissolve (seconds)
100mL		Slowest
100mL		
100mL		Fastest

Presenting data:

This data should be presented as a bar chart as particle size labels 'whole', 'half' and 'quartered' is discrete data.

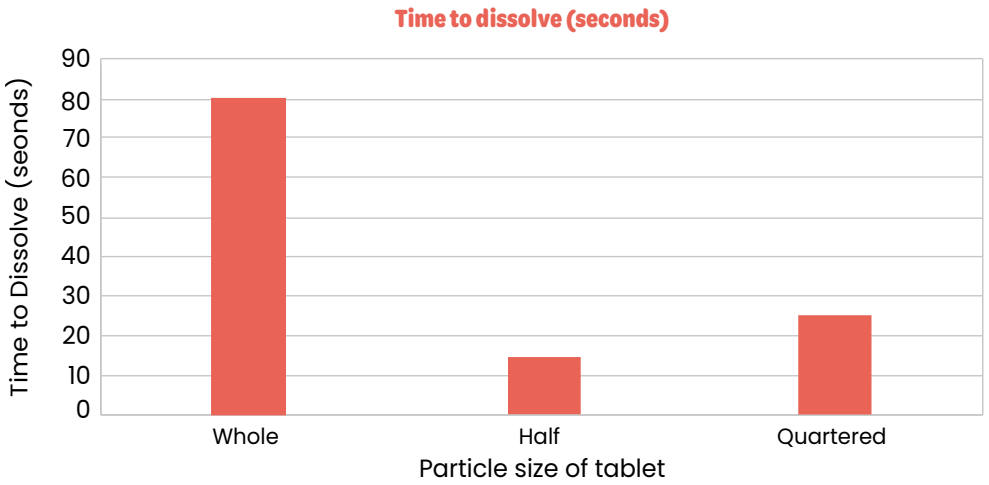


Expected results would look like the graph above.

Conclusion:

For expected results:
The conclusion should state the trend shown in the results. E.g. *The results show that the smaller the particle size, the faster the tablet dissolves.*

Conclusions for unexpected results:



At level 2, if there is no trend, an answer to the aim is sufficient. For the unexpected results shown about an example conclusion could be written as follows: *'Our results show that the halved tablet dissolved fastest.'*

At level 3 and above, a conclusion should state that no trend has been shown. E.g. The results do not show a trend with particle size and time to dissolve.

Evaluation:

An evaluation is a discussion around how this experiment could be more accurate.
Pupils might raise the following issues:

- inaccuracy of timing/difficulty using stop watches
- knowing when to start and stop the timer.
- some of the tablet is lost when it is broken into smaller pieces

For each cause of possible inaccuracies, pupils should try to think of a method that would minimise these errors.

Misconceptions:

4 signs of a chemical reaction are:

- colour change
- fizzing
- change in temperature
- new substance produced.

The apparent colour change in this experiment is due to the coloured tablet dissolving in the water, not a chemical reaction (similar to diluting juice in water). The chemical reaction is between the vitamin C (acid) and Sodium Hydrogen Carbonate (base) when they dissolve in water. They release carbon dioxide gas which causes the fizzing.

Staff could measure the temperature of the water before and during the reaction to show a change in temperature. A small decrease in temperature is expected.

Interdisciplinary Learning:

Numeracy:

Measurement	MNU 1-11a
Time	MNU 2-10b
Data and Analysis	MNU1-20b, MTH 1-21a, MNU 2-20b, MTH 2-21a

Literacy:

Tools for Writing	LIT 2-23a
Creating texts (writing)	LIT 2-28a

Materials

SCN2-16b

Skill Organiser	Skills	Addressed in Activity
Inquiry and investigative skills	**Plans and designs scientific investigations and enquiries**	
	Formulates questions and predictions (hypotheses), with assistance, based on observations and information	✓
	Identifies the independent, dependent and controlled variables, with assistance.	✓
	Anticipates some risks and hazards.	✓
	Carries out practical activities in a variety of learning environments	
	Applies appropriate safety measures.	✓
	Contributes to carrying out all the procedures.	✓
	Makes observations and collects information and measurements using appropriate devices and units.	✓
	Manages identified controlled variables to ensure validity of results.	✓
	Analyses, interprets and evaluates scientific findings	
	Selects appropriate methods to record data/information.	✓
	Identifies relationships between the independent and dependent variables.	✓
	Makes links to original questions or predictions.	✓
	Relates findings to the wider world.	✓
	Draws basic conclusions consistent with findings.	✓
	Identifies and discusses additional knowledge and understanding gained.	✓
	Recognises anomalous results and suggests possible sources of error.	✓
	Evaluates the investigation and suggests one way of improving it if it was to be repeated.	✓
	Presents scientific findings	
	Presents data/information by choosing from an extended range of tables, charts, diagrams, graphs, including bar graphs and line graphs.	✓
	Reports collaboratively and individually using a range of methods.	✓
	Collates, organises and summarises findings, with assistance, using headings or questions to provide structure for presentations.	✓
	Uses appropriate scientific vocabulary and acknowledges sources, with assistance.	✓

Skill Organiser	Skills	Addressed in Activity
Scientific analytical thinking skills	Applies scientific analytical thinking skills, with assistance, working with less familiar (or familiar but more complex) contexts.	✓
	Applies understanding, and a combination of more than one science concept, to solve problems and provide solutions.	✓
	Demonstrates further development of creative thinking including through the engineering processes of design, construction, testing and modification.	✗
Skills and attributes of scientifically literate citizens	Presents a reasoned argument based on evidence, demonstrating understanding of underlying scientific concepts, and engages with the views of others.	✗
	Demonstrates understanding of the relevance of science to their future lives and the role of science in an increasing range of careers and occupations.	✗
	Demonstrates increased awareness of creativity and inventiveness in science, the use of technologies in the development of sciences and the impact of science on society.	✗
	Expresses informed views about scientific and environmental issues based on evidence.	✗

Materials SCN2-16b

Risk Assessment

Task/Activity/Process Description	Reaction Time with Vitamin C tablets – Class activity	**Service**	Communitites
Location	School Name	**Reference**	To be completed by school

Types of Injury/Loss/Ill Health	possible skin irritation, slips and trips, cuts from broken glass, scalding

For each hazard, please identify the person at risk (direct and indirect)

Consider those especially vulnerable (young or inexperienced workers, members of the public, school pupils, the elderly, residents and contractors)

NOTE: New and expectant mothers require a separate risk assessment

Haz No.	Hazard	Source of Hazard	Persons at Risk	Current Control Measures in Place	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Risk Rating (1-25)
1	Chemicals	Skin irritation form vitamin C tablet	Employee/Pupil	Water available to rinse affected area. Pupils should be instructed not to eat the tablets.	1	1	1
2	Slip/Trip/Fall	spilled water	Employee/Pupil	Paper towel available to clean spills. This experiment can be performed in a tote tray to catch any spills.	2	2	4
3	Slip/Trip/Fall	Classroom furniture	Employee/Pupil	Chairs should be tucked neatly under desks, pupil movement should be managed.	1	2	2
4	Temperature	Scalds from hot water	Employee/Pupil	Warm tap water is sufficient to observe affect of temperature on reaction rate. Staff should check temperature of water from the hot tap to ensure it will not cause scalds. Staff could supply warm water of a safe temperature in a plastic jug to pupils.	2	2	4
5	Sharps	broken glassware	Employee/Pupil	Plastic beakers should be used where possible. Staff will clear away any broken glassware including thermometers. Pupils will be instructed not to handle any broken glass.	2	2	4
6	Other (please identify)	Pupil behavior		School to complete			0
7	Other (please identify)	Pupil additional needs		School to complete			0
8							0
9							0
10							0
11							0
12							0
13							0
14							0

Risk Reduction

Haz No.	Additional Control Measures	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Final Risk Rating (1-25)	Action By (name and target date)	Date Control Implemented	Sign to Confirm
1	As low as reasonably possible			0			
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5	As low as reasonably possible			0			
6				0			
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8				0			
9				0			
10				0			
11				0			
12				0			
13				0			
14				0			

Assessor(s) Name (print)	Assessment Date	Manager Name (print)

Assessor(s) Signature	Review Date	Manager Signature	Date

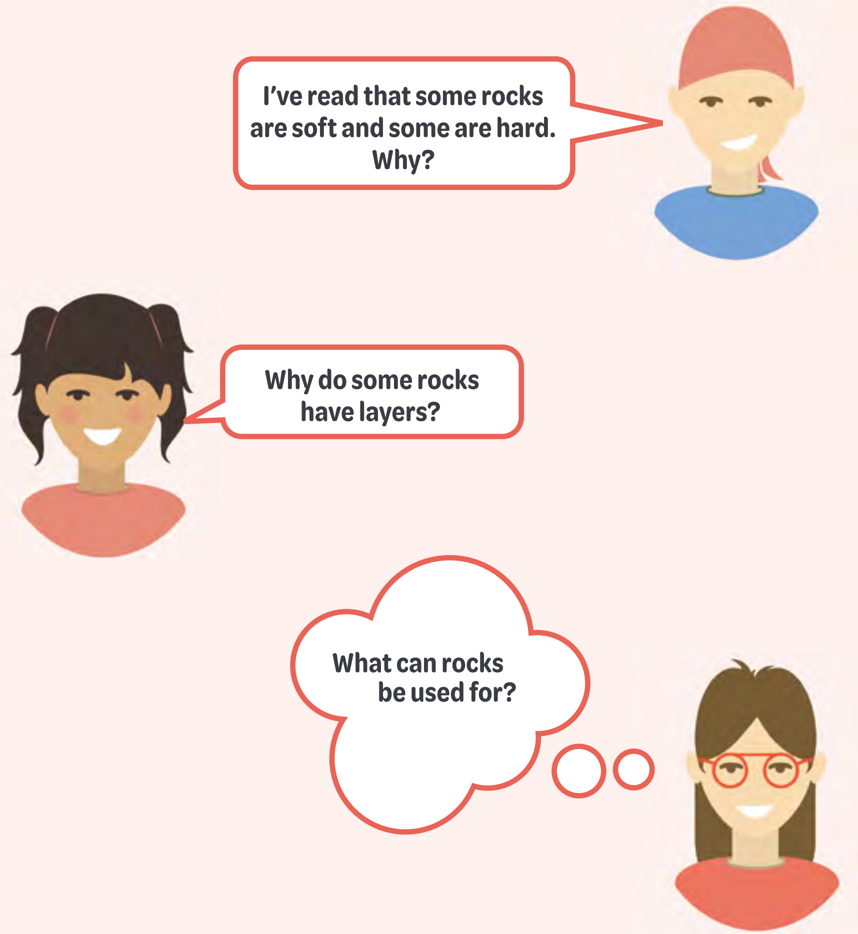
Materials SCN2-16b

Let's Investigate

Rock Formation and their Uses

How is a rock made? What do we use rocks for?

What do you think?



Let's Investigate

Activity 1: Sorting rocks

Natural or Man-made Rocks

Natural

Man-made

Igneous

Sedimentary

Metamorphic

Materials

SCN2-17a

Let's Investigate

Activity 2: Igneous rock formation

Materials:

1. Tin foil
2. Chocolate (shavings or small pieces)
3. Medium hot water
4. Bowl to keep hot water

Method:

1. Take a square of silver foil.
2. Fold up the edges so that it is like a bowl shape.
3. Gently pour in a small amount of chocolate shavings, and close up the foil so no chocolate can escape.
4. Place this carefully on top of the hot water to allow it to melt.
5. Remove chocolate from heat and leave chocolate lava to cool into an igneous rock.

Results /Observations:

Let's Investigate

Activity 3: Sedimentary rock formation

Materials:

1. Tin foil (2x small squares)
2. White chocolate (shavings)
3. Milk/Dark chocolate (shavings)

Method Take 2 squares of silver foil:

1. Take a small handful of broken milk/dark chocolate rocks. Press them down into the bottom of the foil.
2. Take a small handful of white chocolate rocks. Press them down on top of the first layer.
3. Repeat 2 more times and then cover over with another square of foil. Observe how the layers are building up.

Results /Observations:

Rock identification sheet

Igneous Rock

Metamorphic Rocks

Sedimentary Rocks

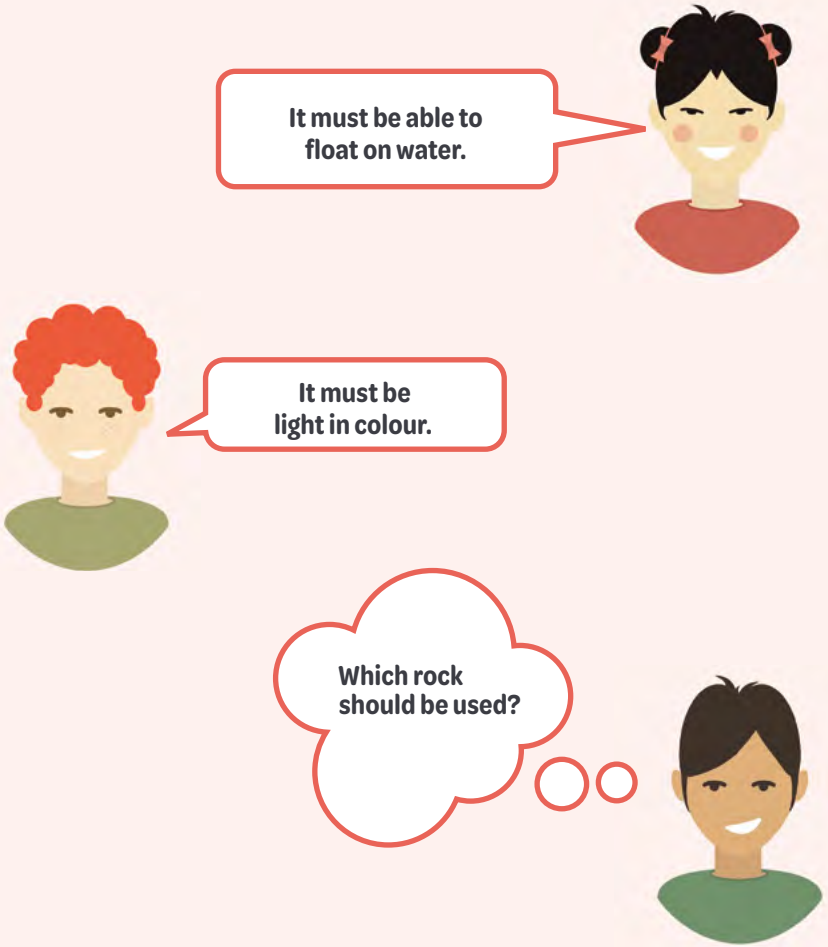
Igneous Rock		Metamorphic Rocks		Sedimentary Rocks	
Pumice	- Light in colour - Lots of holes, will float in water - Very light weight due to air spaces - Bubbly, spongey texture	**Marble**	- Usually white, can have different coloured veins visible - Can be polished to look smooth - Very durable – but can be dissolved by lemon juice!	**Sandstone**	- Red, brown, grey or white - Round, medium grains - Sometimes has layers - Returns to sand when damaged - Hard and durable, but easy enough to work with
Granite	- Hard - Large crystals - Usually red, pink, grey or white with dark mineral grains - Usually very rough but can be polished. - Very common	**Quartzite**	- Usually white, although sometimes has a yellow or red tint - Sand-sized grains - Very strong and thick - Typically found in mountains and hillside	**Chalk**	- Very soft and crumbly - White - Light weight - Very fine grain - Type of limestone
Basalt	- Dark-coloured - Grains are too small to see - Very hard	**Slate**	- Very fine grain - Grey or dark grey in colour - Has thin smooth, layers - Splits into flat pieces	**Limestone**	- White, grey or yellow - Contains fossils as made from animal shells - Produces stalactites and stalagmites in caves

Let's Investigate

Activity 4: Rocks and their uses

An artist would like to make a sculpture, using a type of rock.

What do you think?



Materials

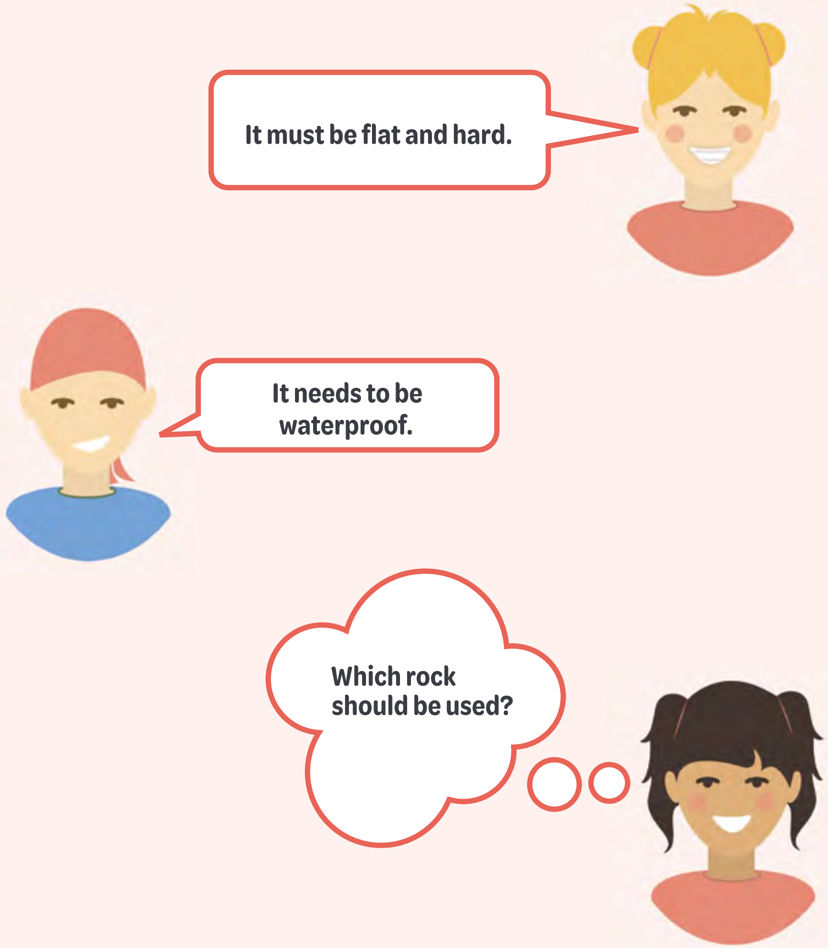
SCN2-17a

Let's Investigate

Activity 4: Rocks and their uses

A builder must decide which tile would be best to use for a house roof.

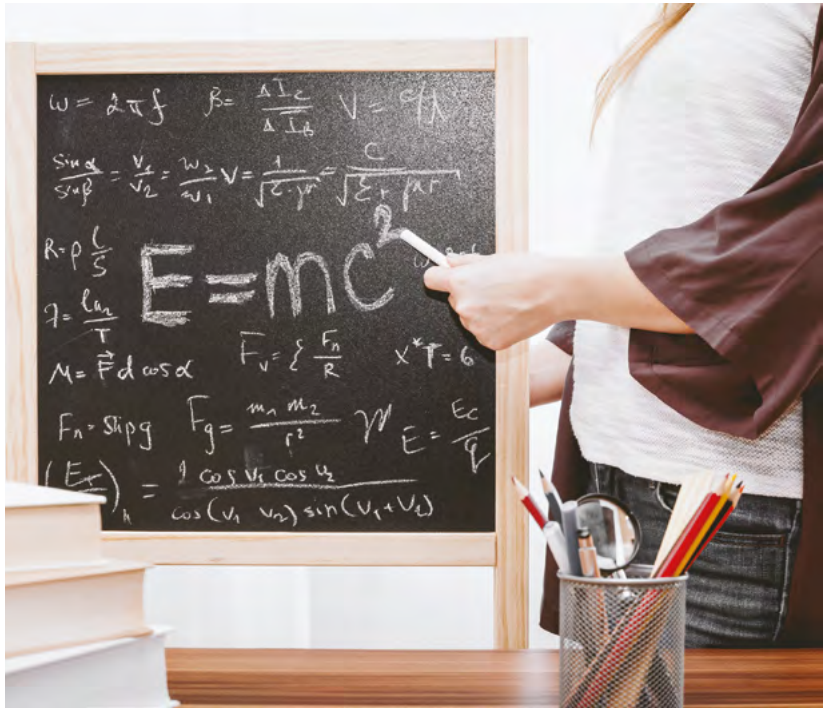
What do you think?



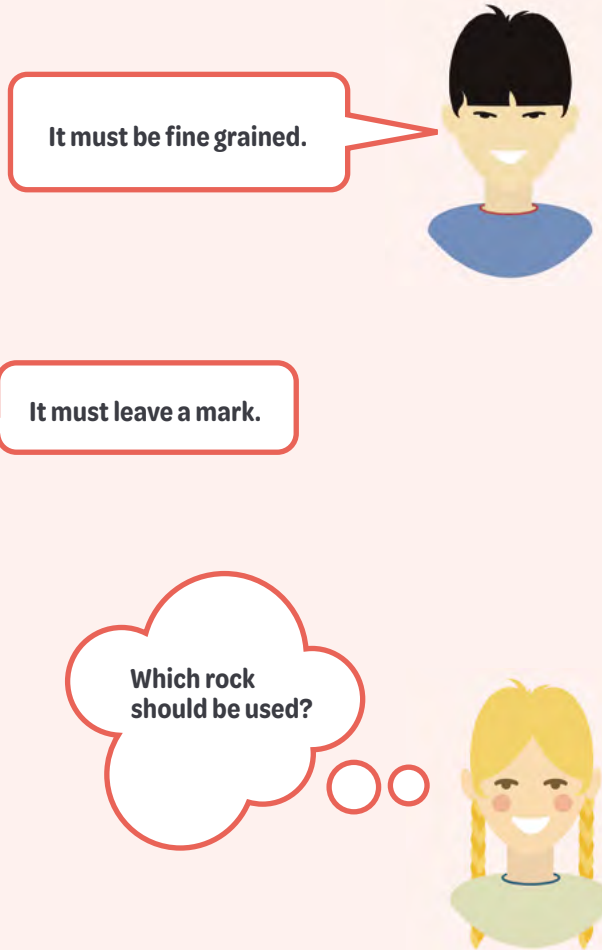
Let's Investigate

Activity 4: Rocks and their uses

A teacher must find the best writing tool for the board.



What do you think?



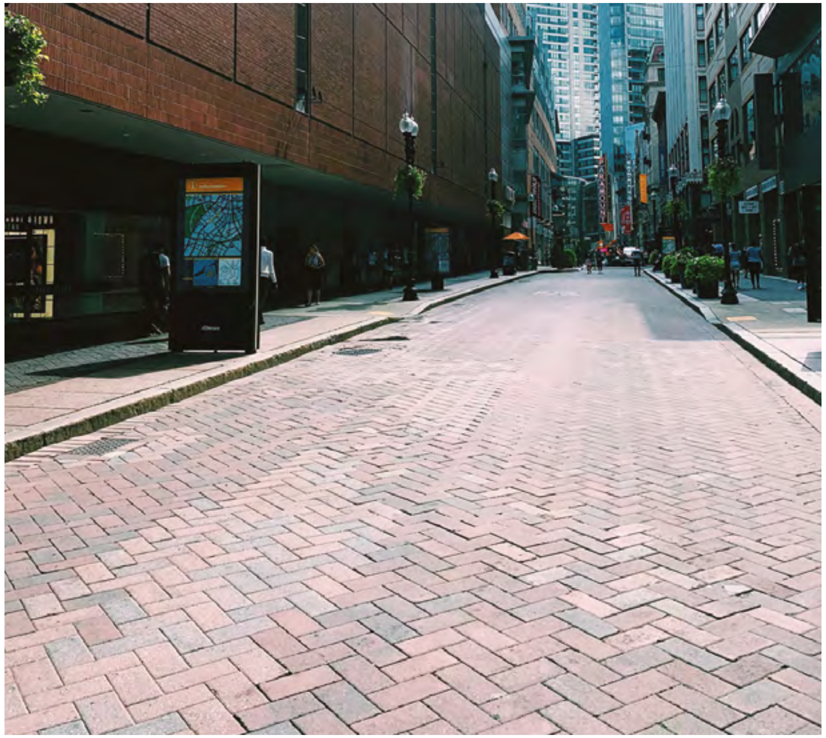
Materials

SCN2-17a

Let's Investigate

Activity 4: Rocks and their uses

A landscaper must find the best type of rock to lay a pavement.



What do you think?

Teacher Guide: Formation and Uses of Rock

SCN 2-17a

Having explored the substances that make up the Earth's surface, I can compare some of their characteristics and uses.

Key Vocabulary:

- Sandstone
- Granite
- Slate
- Quartz
- Igneous
- Sedimentary
- Metamorphic

Aim:

To explore the formation of rocks and their uses in everyday life.

The Big Questions:

How are different types of rock formed? What uses do rocks have?

Materials (per group):

Pupil card – Rock Formation and their uses.

Lesson:

Introduction (background):

There are many kinds of rock. They are all formed in different ways, giving them different names – igneous, sedimentary and metamorphic.

Igneous rocks are formed when magma or lava from volcanoes cools down and hardens (solidifies). Magma is formed because the temperature under the ground is so hot it turns rock to liquid. There are two types of igneous rocks – intrusive and extrusive. Intrusive igneous rocks remain under the ground and hardens as it reaches closer to the surface. Extrusive igneous rocks are made when the magma comes out of the ground, turns into lava and hardens and cools becoming hard rock. Examples: granite, pumice and basalt.

Sedimentary rocks are formed when old rocks at the bottom of lakes or seas, break down in sediment (like sand) due to erosion and hardens again creating a layer (strata). Over time, more sands and rock sediments continue to build on top of the old layers (compaction). Over many years, lots of layers are formed and stick to each other, through a process called cementation. Sometimes fossils can be found in sedimentary rocks due to the length of time they take to form. Examples: chalk, limestone and sandstone.

Metamorphic rocks are originally igneous or sedimentary rocks, that are buried deep within the Earth's crust or located close to magma, which causes the rocks to be heated and/or squeezed under the pressure of the Earth's surface, making the minerals in the rocks change chemically. Collision of tectonic plates can also cause the formation of metamorphic rocks. Examples: marble, slate and quartzite.

Some rocks are also man-made. These are called anthropic rocks. This means they have been made, modified or moved by humans. Examples: Concrete, mock rock (pulhamite and coade stone) and bricks.

Presenting data, activity 1:

Sorting activity – Metamorphic, sedimentary, igneous and man-made.

Learners must sort out various types of rock and place them in the correct type of rock formation. If needed rock samples can be borrowed from secondary academies.

Geology.com is a good source of rock images and information.

Learners should have the opportunity to carry out research into the various types of rock and explore more in-depth about the formation of rocks. This can be presented in any way the learner wishes, allowing for personalisation and choice. This also gives the learner the opportunity to explore how best to present findings, ensuring that it is not misleading. Appropriate success criteria set by adult.

Presenting data, activity 2:

Igneous rock formation. Pupils should observe rocks (chocolate) melting and then solidifying when cooled.

Materials (per group):

Tin foil

Chocolate (shavings or small pieces)

Medium hot water

Bowl to keep hot water

Method:

1. Take a square of silver foil.
2. Fold up the edges so that it is like a bowl shape.
3. Gently pour in a small amount of chocolate shavings, and close up the foil so no chocolate can escape.
4. Place this carefully on top of the hot water to allow it to melt.
5. Remove chocolate from heat and leave chocolate lava to cool into an igneous rock.

Presenting data, activity 3:

Sedimentary rock formation. Pupils should observe layers of different rock types (chocolate types) building up over time.

Materials:

White chocolate (shavings)

Milk/Dark chocolate (shavings)

Tin Foil

Method:

1. Take 2 squares of silver foil.
2. Take a small handful of broken milk/dark chocolate rocks. Press them down into the bottom of the foil.
3. Take a small handful of white chocolate rocks. Press them down on top of the first layer.
4. Repeat 2 more times and then cover over with another square of foil. Observe how the layers are building up.

Presenting data, activity 4:

Rock identification sheet – to see how each named rock can be used. Match rocks from the identification sheet to the scenarios on the 'rocks and their uses' cards.

A selection of rocks should be placed out to allow learners to explore, touch and feel to investigate the properties of the rock. Secondary Academies should have rock kits you can borrow if you don't have any in your school.

Challenge cards could be used to present learners with opportunity to decide uses for each type of rock e.g. "this rock is soft, and so cannot be used the build a house" etc.

Learners should have the opportunity to carry out further, in-depth research into the use of various rocks and how the rock in the local area is utilised. This can be presented in any way the learner wishes, allowing for personalisation and choice. This also gives the learner the opportunity to explore how best to present findings, ensuring that sources of information are reliable and referenced in their work. Appropriate success criteria set by adult.

If rock samples are not available, rock fact sheets should be given to learners.

Plenary:

Who Am I?

Twinkl PowerPoint: Year 3 Comparing and Grouping Rocks PowerPoint and Activity Pack.
If no access to PowerPoint, the clues can be read out for the learners from below

Who Am I? 1

I can be sliced into thin, flat pieces.

I am black or dark grey.

I am waterproof.

Slate

Who Am I? 2

I am white

I am soft

I easily rub off on surfaces

Chalk

Who Am I? 3

I am light in colour

I am very light in weight

I am full of holes.

Pumice

Challenge: Learners could make their own Who Am I? Challenge cards, including a use and two other properties.

Interdisciplinary Learning:

Social Studies:

People, Place and Environment	SOC 2-13a.

Numeracy:

Data and Analysis	MNU 2-20a, MNU 2-20b.

Literacy:

Finding and using information	LIT 2-14a, LIT 2-15a.
Organising and Using information	LIT 2-26a
Creating Texts	LIT 2-28a

Digital Literacy:

Using digital products and services...	TCH 2-01a
Searching, processing and managing information...	TCH 2-02a

Materials SCN2-17a

Materials

SCN2-17a

Skill Organiser	Skills	Addressed in Activity
Inquiry and investigative skills	**Plans and designs scientific investigations and enquiries**	
	Formulates questions and predictions (hypotheses), with assistance, based on observations and information	✗
	Identifies the independent, dependent and controlled variables, with assistance.	✗
	Anticipates some risks and hazards.	✓
	Carries out practical activities in a variety of learning environments	
	Applies appropriate safety measures.	✓
	Contributes to carrying out all the procedures.	✓
	Makes observations and collects information and measurements using appropriate devices and units.	✓
	Manages identified controlled variables to ensure validity of results.	✗
	Analyses, interprets and evaluates scientific findings	
	Selects appropriate methods to record data/information.	✗
	Identifies relationships between the independent and dependent variables.	✗
	Makes links to original questions or predictions.	✗
	Relates findings to the wider world.	✓
	Draws basic conclusions consistent with findings.	✗
	Identifies and discusses additional knowledge and understanding gained.	✓
	Recognises anomalous results and suggests possible sources of error.	✗
	Evaluates the investigation and suggests one way of improving it if it was to be repeated.	✗
	Presents scientific findings	
	Presents data/information by choosing from an extended range of tables, charts, diagrams, graphs, including bar graphs and line graphs.	✗
	Reports collaboratively and individually using a range of methods.	✓
	Collates, organises and summarises findings, with assistance, using headings or questions to provide structure for presentations.	✓
	Uses appropriate scientific vocabulary and acknowledges sources, with assistance.	✓

Skill Organiser	Skills	Addressed in Activity
Scientific analytical thinking skills	Applies scientific analytical thinking skills, with assistance, working with less familiar (or familiar but more complex) contexts.	✗
	Applies understanding, and a combination of more than one science concept, to solve problems and provide solutions.	✗
	Demonstrates further development of creative thinking including through the engineering processes of design, construction, testing and modification.	✓
Skills and attributes of scientifically literate citizens	Presents a reasoned argument based on evidence, demonstrating understanding of underlying scientific concepts, and engages with the views of others.	✓
	Demonstrates understanding of the relevance of science to their future lives and the role of science in an increasing range of careers and occupations.	✗
	Demonstrates increased awareness of creativity and inventiveness in science, the use of technologies in the development of sciences and the impact of science on society.	✗
	Expresses informed views about scientific and environmental issues based on evidence.	✗

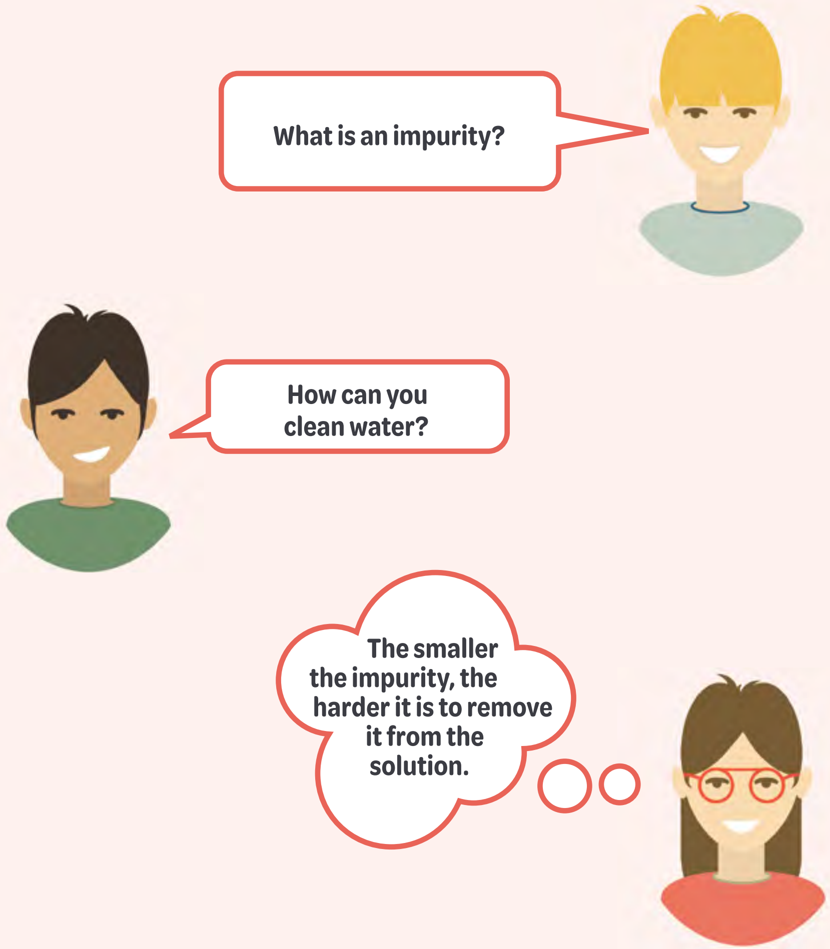
Materials SCN2-17a

Let's Investigate

Purification of Water

Can you build a filter to purify different liquids?

What do you think?



Let's Investigate

Purification of Water

Method:

1. Carefully cut the bottom off an old 2L plastic bottle.
2. Place the bottle upside down into the bottom piece you have just cut off.
3. Look at the materials you have available to filter your mixture. How will you layer these materials to filter your mixture? Draw a labelled diagram of your design.
4. Build the water filter you have designed.
5. Collect 200mL of contaminated water from your teacher. Rate the dirtiness of the water.
6. Pour the water through the filter and rate the dirtiness of the water that passes through the filter.
7. How could you improve the design of your water filter to get even cleaner water?

Results:

1. Rate the dirtiness of the water before passing through the filter:

Very Clean	1	2	3	4	5	6	7	8	9	10	Very dirty

2. Rate the dirtiness of the water after passing through the filter:

Very Clean	1	2	3	4	5	6	7	8	9	10	Very dirty

3. Describe how you would improve your water filter.

Teacher Guide: Purification of Water

SCN 2-18a

I have investigated different water samples from the environment and explored methods that can be used to clean and conserve water and I am aware of the properties and uses of water.

This activity has been adapted from the Engineers without Borders movement. The full lesson including support and presentation materials can be found at *https://www.ewb-uk.org/group/water-for-everyone-everywhere/*

The activity has links to Learning for Sustainability and the Rights Respecting Schools Award.

https://www.globalgoals.org/ Goal 6: Clean water and sanitation. Rights respecting schools. Article 24: Children have the right to the best health care possible, clean water to drink, healthy food and a clean and safe environment to live in.

Key Vocabulary:

Contamination: the action of being made impure by polluting.

Filter: a porous device for removing impurities or solid particles from a liquid or gas passed through it.

Impurity: a constituent which impairs the purity of something.

Absorption: the process by which a solid holds molecules of a gas or liquid or solute as a thin film.

Clarity: the quality of transparency or purity.

Murky: (of liquid) dark and dirty; not clear.

Aim:

To build a water filter to purify a sample of water contaminated with different sized soil and rock particles.

Materials (per group):

2L Plastic bottle

Gravel or small stones

Coarse Sand

Fine Sand

Cotton wool balls

Coffee filters or blue kitchen cloth (sometimes called J cloth)

Water

Rubber band

Scissors

How to:

A contaminated sample of water should be made in advance. It should contain fine soil particles, sand, small stones and pieces of twigs and leaves.

Pupils should view the materials they have to build their filter. What order will they layer them inside their bottle, or will they mix them all up?

An effective filter should have the finest materials at the bottom (cotton wool balls) and increase in size to having gravel or stones at the top. The coffee filters or blue kitchen cloth should be placed around the opening of the bottle and held in place with a rubber band.

Method:

1. Carefully cut the bottom off an old 2L plastic bottle.
2. Place the bottle upside down into the bottom piece you have just cut off.
3. Look at the materials you have available to filter your mixture. How will you layer these materials to filter your mixture? Draw a labelled diagram of your design.
4. Build the water filter you have designed.
5. Collect 100mL of contaminated water from your teacher. Rank the dirtiness of the water.

6. Pour the water through the filter and rank the dirtiness of the water that passes through the filter.
7. Pupils evaluate the effectiveness of their water filter and suggest improvements.

Results:

This is a comparative activity. Filtered water samples can be compared and class results can be ranked in order of clarity. Pupils can discuss what were the design features of filters that produced the cleanest water.

Conclusion:

As no pattern or trend is being measured, a conclusion is not required for this activity.

Evaluation:

Evaluation is an important part of the engineering and design process. Pupils should identify flaws in their design and suggest alternative methods, designs or materials to improve the effectiveness of their filter.

***materials note:**

Sand is used in the filter to remove small objects from the mixture. Sand collected from the beach or garden will contain very small sediment particles and will need to be rinsed thoroughly before use. There is also a risk of collecting sharp objects and biological material if collecting sand from the beach.

If possible, Silver Sand should be used. This is clean and free from contamination. It can be purchased from Scientific and Chemical at a cost of approximately £1/Kg. At the time of writing Scientific and Chemical are an approved NAC supplier.
https://education.scichem.com/Site/Home

Interdisciplinary Learning:

Technology

Design and construct models/products	TCH 2-09a
Exploring uses of materials	TCH 2-10a
Application of Engineering	TCH 2-12a

Materials SCN2-18a

Skill Organiser	Skills	Addressed in Activity
Inquiry and investigative skills	**Plans and designs scientific investigations and enquiries**	
	Formulates questions and predictions (hypotheses), with assistance, based on observations and information	✗
	Identifies the independent, dependent and controlled variables, with assistance.	✗
	Anticipates some risks and hazards.	✓
	Carries out practical activities in a variety of learning environments	
	Applies appropriate safety measures.	✓
	Contributes to carrying out all the procedures.	✓
	Makes observations and collects information and measurements using appropriate devices and units.	✓
	Manages identified controlled variables to ensure validity of results.	✗
	Analyses, interprets and evaluates scientific findings	
	Selects appropriate methods to record data/information.	✓
	Identifies relationships between the independent and dependent variables.	✗
	Makes links to original questions or predictions.	✗
	Relates findings to the wider world.	✓
	Draws basic conclusions consistent with findings.	✗
	Identifies and discusses additional knowledge and understanding gained.	✓
	Recognises anomalous results and suggests possible sources of error.	✗
	Evaluates the investigation and suggests one way of improving it if it was to be repeated.	✓
	Presents scientific findings	
	Presents data/information by choosing from an extended range of tables, charts, diagrams, graphs, including bar graphs and line graphs.	✗
	Reports collaboratively and individually using a range of methods.	✗
	Collates, organises and summarises findings, with assistance, using headings or questions to provide structure for presentations.	✗
	Uses appropriate scientific vocabulary and acknowledges sources, with assistance.	✗

Skill Organiser	Skills	Addressed in Activity
Scientific analytical thinking skills	Applies scientific analytical thinking skills, with assistance, working with less familiar (or familiar but more complex) contexts.	✓
	Applies understanding, and a combination of more than one science concept, to solve problems and provide solutions.	✓
	Demonstrates further development of creative thinking including through the engineering processes of design, construction, testing and modification.	✓
Skills and attributes of scientifically literate citizens	Presents a reasoned argument based on evidence, demonstrating understanding of underlying scientific concepts, and engages with the views of others.	✗
	Demonstrates understanding of the relevance of science to their future lives and the role of science in an increasing range of careers and occupations.	✓
	Demonstrates increased awareness of creativity and inventiveness in science, the use of technologies in the development of sciences and the impact of science on society.	✓
	Expresses informed views about scientific and environmental issues based on evidence.	✗

Materials SCN2-18a

Risk Assessment

Task/Activity/Process Description	Purification of water	**Service**	Communitites
Location	School Name	**Reference**	To be completed by school

Types of Injury/Loss/Ill Health	possible skin irritation, slips and trips, cuts from broken glass, scalding

For each hazard, please identify the person at risk (direct and indirect)

Consider those especially vulnerable (young or inexperienced workers, members of the public, school pupils, the elderly, residents and contractors)

NOTE: New and expectant mothers require a separate risk assessment

Haz No.	Hazard	Source of Hazard	Persons at Risk	Current Control Measures in Place	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Risk Rating (1-25)
1	Sharps	Cut edge of plastic bottle	Employee/Pupil	Pupils will be made aware that cutting a plastic bottle may result in a sharp point being produced. Pupils will be instructed to cut in smooth straight lines.	1	1	1
2	Slip/Trip/Fall	spilled water	Employee/Pupil	Paper towel available to clean spills. This experiment can be performed in a tote tray to catch any spills.	2	2	4
3	Slip/Trip/Fall	Classroom furniture	Employee/Pupil	Chairs should be tucked neatly under desks, pupil movement should be managed.	1	2	2
4	Slip/Trip/Fall	Spilled sand	Employee/Pupil	a brush and pan should be on hand to clean any spills immeadiately.	2	2	4
5	Sharps	Cuts from collected sand	Employee/Pupil	Sand collected from a local beach should be done with caution, using a bucket and spade. It should be rinsed thoroughly before use. It is preferrable to use Silver Sand purchased from an approved chemical supplier.	1	2	2
6	Other (please identify)	Pupil behavior		School to complete			0
7	Other (please identify)	Pupil additional needs		School to complete			0
8							0
9							0
10							0
11							0
12							0
13							0
14							0

Risk Reduction

Haz No.	Additional Control Measures	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Final Risk Rating (1-25)	Action By (name and target date)	Date Control Implemented	Sign to Confirm
1	As low as reasonably possible			0			
2	As low as reasonably possible			0			
3	As low as reasonably possible			0			
4	As low as reasonably possible			0			
5	As low as reasonably possible			0			
6	As low as reasonably possible			0			
7	As low as reasonably possible			0			
8				0			
9				0			
10				0			
11				0			
12				0			
13				0			
14				0			

Assessor(s) Name (print)	Assessment Date	Manager Name (print)

Assessor(s) Signature	Review Date	Manager Signature	Date

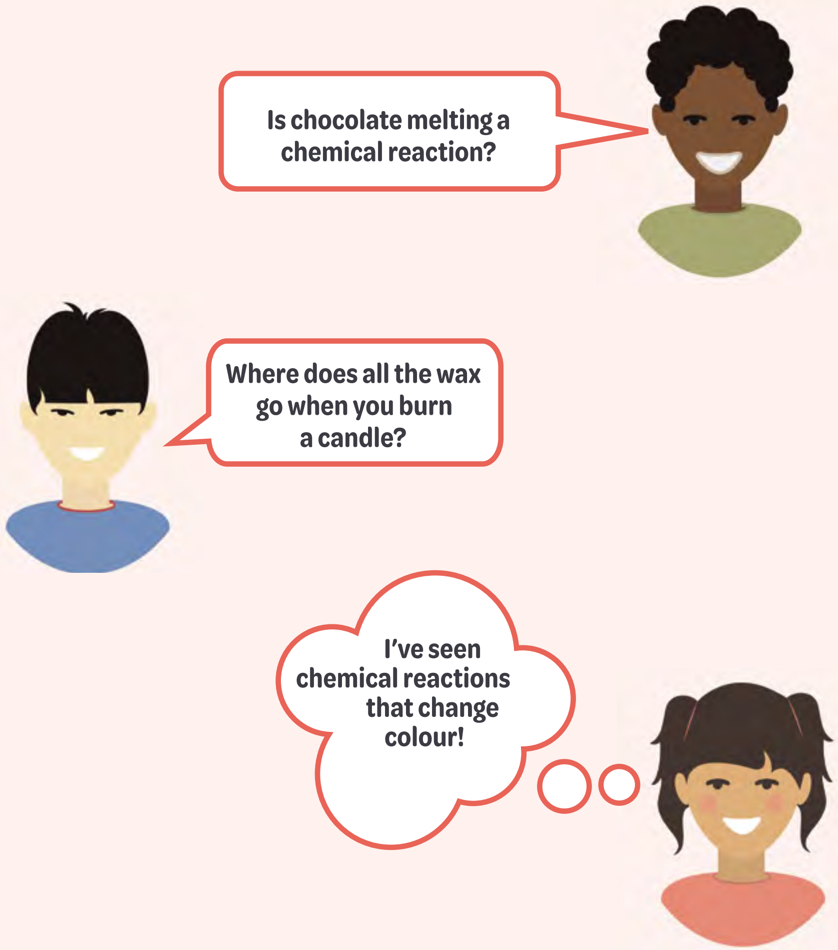
Materials SCN2-18a

Let’s Investigate

Chemical reactions

What are the signs of a chemical reaction?

What do you think?



Let's Investigate

Chemical reactions

Activity 1:

Part 1.

1. Add a small amount of water and 5 drops of red cabbage water to a beaker. Leave this to one side as a control colour.
2. Add a small volume of vinegar to a beaker and then add 5 drops of red cabbage water. Observe the colour change.
3. Add half a teaspoon of bicarbonate soda to a beaker and add enough red cabbage water to make a runny mixture. Observe the colour change.

Part 2.

1. Use a thermometer to measure the temperature of your vinegar and red cabbage water.
2. Pour in the mixture of red cabbage water and bicarbonate soda. Observe the reaction and record the change in temperature.

Activity 2:

Observe your teacher burning a candle. Record your observations.

Results:

Draw a table with the following headings:

Activity	Observations	Signs of a Chemical reaction

Teacher Guide: Chemical reactions

SCN 2-19a

I have collaborated in activities which safely demonstrate simple chemical reactions using everyday chemicals.
I can show an appreciation of a chemical reaction as being a change in which different materials are made.

In this activity pupils will take part in a range of activities to identify the signs of a chemical reaction.

The for signs of a chemical reaction are:

Colour change, release of gas (fizzing), change in temperature, formation of new substance.

In a chemical reaction, a new substance is always formed. A colour change, gas release and a noticeable change in temperature do not occur in every chemical reaction.

Key Vocabulary:

Physical Change: A change in state of matter. Easily reversible, e.g. melting and freezing of water. No new substance has formed, just liquid and solid forms of water.

Chemical Change: The formation of a new substance from a chemical reaction. E.g. vinegar and bicarbonate soda react to make water and carbon dioxide.

Activity 1 – Red cabbage indicator (colour change and temperature change)

Materials (per group):

Red cabbage water (approx. 50mL)

Vinegar

Bicarbonate soda

3 x plastic cups or beakers

Pipette

Thermometer

How to:

Part 1

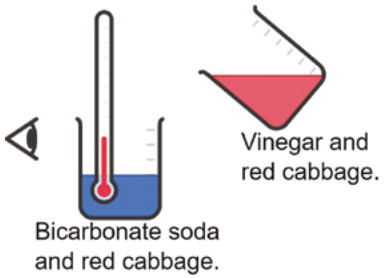
Red cabbage water is made by dicing red cabbage and letting it soak in hot water for a few minutes. Filter the mixture of cabbage and water, discard the cabbage and keep the purple coloured cabbage water. This can be done by pupils or prepared in advance by the teacher.

Add a small volume of water to a beaker, add 4 or 5 drops of red cabbage water to the water. This will be the control colour that other solutions will be compared to.

Add a small volume of vinegar to a second beaker and add 4 or 5 drops of red cabbage indicator. There should be an instant colour change to red/pink.

In a third beaker, add half a teaspoon of bicarbonate soda and enough red cabbage water to make a pourable solution. There should be an instant colour change to teal.

Part 2:



Use a thermometer to measure the temperature of the bicarbonate soda and red cabbage water. Let the thermometer sit in the solution for 30 seconds before recording the temperature.

Pour the vinegar and red cabbage water into the beaker containing bicarbonate soda and observe the reaction. Record the final temperature. This should result in a temperature drop of 2 or 3 degrees Celsius. As it is only a small drop in temperature, some pupils will not observe a change, or record an increase in temperature if they have misread the thermometer.

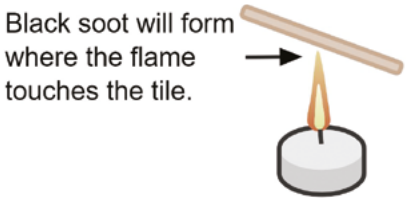
Activity 2 – Formation of soot (new substance forming)

Materials (per group):

Staff may prefer to perform this as a demonstration.

1 x tea light

1 x white tile, coffee mug with white bottom or aluminium can.



How to:

Light the tea light and ask pupils to explain the chemical reaction taking place. They might identify heat and light being released as a sign of a chemical change, and wax melting as a physical change.

Ask them to predict what will happen when you hold the white tile close over the tea light. Hold it close enough so the top of the flame is touching the tile/coffee mug/aluminium can.

Black soot will form where the flame meets the tile/mug/can. When burning a candle paraffin wax reacts with oxygen in the air. The new substances formed are Water vapour, carbon dioxide and soot (pure carbon).

Optional Activity – Fizzing

Pupils will observe fizzing in activity 1. A complete investigation into dissolving time using fizzing to measure speed of dissolving can also be found in SCN 2-16b of this resource.

Results:

The table below can be used to record observations and signs of a chemical reaction. More able and older pupils should be encouraged to design and draw their own table.

Activity	Observations	Signs of a chemical reaction
Red cabbage water + Vinegar		
Red cabbage water + Bicarbonate Soda		
Vinegar + Bicarbonate soda		
Burning tea light		

Misconceptions:

4 signs of a chemical reaction are:

- Colour change
- fizzing
- change in temperature
- New substance produced.

A colour change and fizzing are not always observed in a chemical reaction. A new substance is always formed and there is always a change in temperature, however it is not always easily observed. Other changes may occur as well including light, sound and kinetic energy (e.g. burning and explosions). Level 2 pupils do not need to be able identify these additional energy changes.

Interdisciplinary Learning: (Including outcomes for SCN2-16b)

Numeracy:

Measurement	MNU 1-11a
Time	MNU 2-10b
Data and Analysis	MNU 2-20b, MTH 2-21a

Literacy:

Tools for Writing	LIT 2-23a
Creating texts (writing)	LIT 2-28a

Risk Assessment

Task/Activity/Process Description	Cabbage water and tea light experiments	**Service**	Communitites
Location	School Name	**Reference**	To be completed by school

Types of Injury/Loss/Ill Health	slips and trips, cuts from broken glass, scalding, burns

For each hazard, please identify the person at risk (direct and indirect)

Consider those especially vulnerable (young or inexperienced workers, members of the public, school pupils, the elderly, residents and contractors)

NOTE: New and expectant mothers require a separate risk assessment

Haz No.	Hazard	Source of Hazard	Persons at Risk	Current Control Measures in Place	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Risk Rating (1-25)
1	Chemicals	bicarbonate soda	Employee/Pupil	low risk	1	1	1
2	Slip/Trip/Fall	spilled water	Employee/Pupil	Paper towel available to clean spills. This experiment can be performed in a tote tray to catch any spills.	2	2	4
3	Slip/Trip/Fall	Classroom furniture	Employee/Pupil	Chairs should be tucked neatly under desks, pupil movement should be managed.	1	2	2
4	Temperature	Scalds from hot water	Employee/Pupil	Warm water from a recently boiled kettle is enough to remove the purple pigment from red cabbage. If pupils are completing this part of the experiment staff should ensure the water has cooled enough that it will not cause scalds if spilled.	2	2	4
5	Sharps	broken glassware	Employee/Pupil	Plastic beakers should be used where possible. Staff will clear away any broken glassware including thermometers. Pupils will be instructed not to handle any broken glass including thermometers.	2	2	4
6	Fire	Tea light	Employee/Pupil	Light the candle on a table clear of combustible materials and flammable liquids. Extinguish safely by placing an upturned mug over the candle.	2	2	4
7	Temperature	Heated tile/mug/can	Employee/Pupil	Take care not too heat the tile/mug/can for extended periods as it can become hot and cause burns.	2	2	4

Materials SCN2-19a

Materials SCN2-19a

Risk Reduction

Haz No.	Additional Control Measures	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Final Risk Rating (1-25)	Action By (name and target date)	Date Control Implemented	Sign to Confirm
1	As low as reasonably possible			0			
2	As low as reasonably possible			0			
3	As low as reasonably possible			0			
4	As low as reasonably possible			0			
5	As low as reasonably possible			0			
6	As low as reasonably possible			0			
7	As low as reasonably possible			0			
8				0			
9				0			
10				0			
11				0			
12				0			
13				0			
14				0			

Assessor(s) Name (print)	Assessment Date	Manager Name (print)

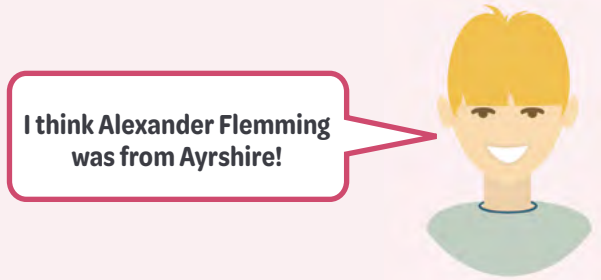
Assessor(s) Signature	Review Date	Manager Signature	Date

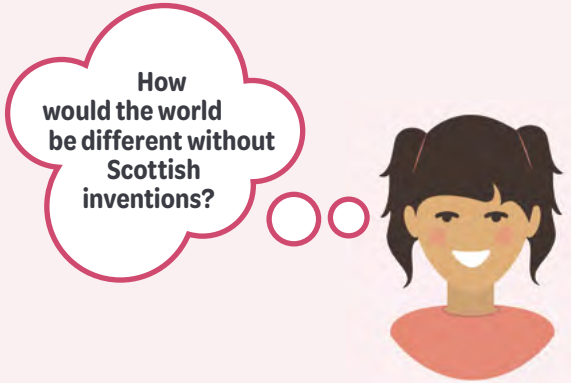
Let's Investigate

Scottish Scientists

What impact have Scottish Scientists had on society?

What do you think?





Let's Investigate

Scottish Scientists

You are going to Research the life and work of a Scottish scientist. You can choose a scientist from the list below or choose one of your own:

Alexander Bain	John Logie Baird	Alexander Graham Bell	James W Black	Joseph Black
Elizabeth Blackwell	David Brewster	Robert Brown	Alexander Crum Brown	James Dewar
Victoria Drummond	John Boyd Dunlop	Alexander Fleming	Williamina Fleming	Maria Gordon
Thomas Graham	James Gregory	Peter Higgs	James Hutton	Charles MacIntosh
John Mallard	James Clark Maxwell	William Murdoch	John Napier	James Nasmyth
William Ramsay	Robert Angus Smith	Mary Somerville	William Symington	William Thomson
Robert Watson-Watt	James Watt	Charles Thomson Rees Wilson		

You will need to research the scientist's life, their work and describe the impact their work has had on society. You can use the following questions to guide your research:

Where was your scientist born?	Where did they work/study?
What area of science/technology did they work in?	Describe the work/invention they are best known for.
How has their work changed the way we live?	Did they research or invent anything else?

You should create a PowerPoint presentation or a poster to use in a 2 – 3 minute talk to the class. Your PowerPoint or poster should be a visual aid to support your class talk and not contain to much text. Make sure you include references to the websites and books you used to find your information.

Presentation Success Criteria:

 Excellent
 Good
 Satisfactory
 Unsatisfactory

Date:	**Name(s):**	**Scientist:**
	Rating Scale	**Comment**
Style Was the presentation fit for purpose?		
Was it visually appealing?		
Did it include a range of visuals (Photos/Diagrams/Headings)?		
Content Was there a clear structure (start, middle, conclusion)?		
Did the content describe the life and work of the scientist?		
Did the content describe the impact the Scientist has had on our lives?		
Was subject specific vocabulary used?		
Were the references to the sources of information (websites/book titles)		

Topical Science SCN2-20a

Presentation Success Criteria:

Excellent | Good | Satisfactory | Unsatisfactory

Date:	Name(s):	Scientist:
	Rating Scale	**Comment**
Delivery Was the presenter positioned appropriately (e.g. not in the way of the presentation)?		
Was the tone and pitch of the presenter's voice clear?		
Did they make eye contact with a number of pupils?		
Did they speak to the audience during the presentation rather than just read notes?		
Group Presentation: Were all members of the group actively involved?		
Peer Review Comments		
Teacher Review Comments		
Targets	1. 2.	
Final Reflections (Self)		

Teacher Guide: Scottish Scientists

SCN 2-20a

'Through research and discussion, I have an appreciation of the contribution that individuals are making to scientific discovery and invention and the impact this has made on society'.

Lesson:

This activity provides the opportunity for pupils to research and recognise the contribution Scottish Scientists have made to the modern way of life. The pupil card contains 6 images which can be used to generate discussion around Scottish scientists/inventors and how their work has influenced our way of life.

Wifi symbol: *James Clark Maxwell* was a great physicist to rival Newton and Einstein. His many achievements included producing the first colour photograph and correctly predicting Saturn's rings were made of countless orbiting particles. He is most well known for are his investigations into light as an electromagnetic wave and predicting the existence of other electromagnetic waves. In later years scientists would confirm the existence of Radio waves, Infrared, Ultraviolet, X-rays and Gamma rays. Radio waves led to global communication and are used to transmit data over Wi-Fi.

Microscope: *Robert Brown* was a botanist who first used a microscope to observe the nucleus of a cell in 1831. This was the first step in a greater understanding of cellular structure and microbiology.

Vintage Telephone: The telephone was invented by *Alexander Graham Bell*, the first working telephone was demonstrated in 1876. It was the first technology that allowed people to communicate instantly over long distances.

Penicillin: *Alexander Fleming* is an Ayrshire born scientist who discovered the antibiotic effects of penicillin, publishing his findings in 1929. His discovery has saved millions of people from dying of bacterial infection. Staff may like to discuss the implications of overuse of antibiotics and antibiotic resistant bacteria.

Steam Engine: *James Watt* improved an existing design of a steam engine to make it more efficient. He patented his improved design in 1769. The steam engine led to the development of trains and fast, reliable transport of goods and passengers over long distances.

Television: *John Logie Baird* demonstrated a working television in 1926 and the first transatlantic transmission in 1928.

Research and Presentation:

Pupils can choose, or be assigned, a scientist to research. Female scientists are underlined on the pupil card.

They should research the life and work of the scientist and create a visual display in the form of a PowerPoint or poster to use in an oral presentation to the class. The Visual Display should include headings, images and references to websites or book titles only. The focus of this activity should be on oral presentation skills.

A success criteria for the presentation is included as a separate document, or alternatively the class can create their own success criteria.

Evaluation:

Pupils can use the success criteria to self or peer assess their work, and identify areas for improvement.

Additional Material:

The Royal Society of Edinburgh have produced a showcase of contemporary female scientists in Scotland. It can be found here: *http://www.rse.org.uk/wp-content/uploads/2019/05/7249-RSE-Women-in-Science-A5-Guide_Sign-off-002.pdf*

The Primary Science Teaching Trust has published 'Standing on the Shoulders of Giants'. The resource links the work of 10 famous historic scientists to the work of contemporary scientists, giving children an appreciation of how wider scientific understanding develops over time. The resources includes a hands on practical activity to support the understanding of the work of each scientist. ISBN: 978-0-9954811-8-3

Interdisciplinary Learning:

Literacy

Tools for listening and talking	LIT 2-03a
Creating texts (listening and talking)	LIT 2-09a, LIT 2-10a
Finding and Using Information (reading)	LIT 2-14a, LIT 2-15a
Understanding, Analysing and Evaluating	LIT 2-18a
Tools for writing	LIT 2-23a, LIT 2-24a
Organising and Using Information	LIT 2-25a, LIT 2-26a
Creating Texts (writing)	LIT 2-28a

Social Studies

People, Past Events and Societies	SOC 2-01a, SOC 2-03a

Skill Organiser	Skills	Addressed in Activity
Inquiry and investigative skills	**Plans and designs scientific investigations and enquiries**	
	Formulates questions and predictions (hypotheses), with assistance, based on observations and information	✗
	Identifies the independent, dependent and controlled variables, with assistance.	✗
	Anticipates some risks and hazards.	✗
	Carries out practical activities in a variety of learning environments	
	Applies appropriate safety measures.	✗
	Contributes to carrying out all the procedures.	✗
	Makes observations and collects information and measurements using appropriate devices and units.	✗
	Manages identified controlled variables to ensure validity of results.	✗
	Analyses, interprets and evaluates scientific findings	
	Selects appropriate methods to record data/information.	✗
	Identifies relationships between the independent and dependent variables.	✗
	Makes links to original questions or predictions.	✗
	Relates findings to the wider world.	✓
	Draws basic conclusions consistent with findings.	✗
	Identifies and discusses additional knowledge and understanding gained.	✓
	Recognises anomalous results and suggests possible sources of error.	✗
	Evaluates the investigation and suggests one way of improving it if it was to be repeated.	✗
	Presents scientific findings	
	Presents data/information by choosing from an extended range of tables, charts, diagrams, graphs, including bar graphs and line graphs.	✓
	Reports collaboratively and individually using a range of methods.	✓
	Collates, organises and summarises findings, with assistance, using headings or questions to provide structure for presentations.	✓
	Uses appropriate scientific vocabulary and acknowledges sources, with assistance.	✓

Topical Science

SCN2-20a

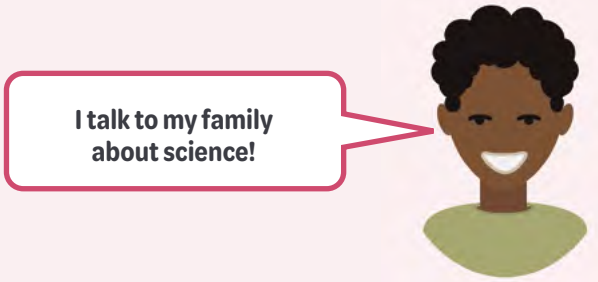
Skill Organiser	Skills	Addressed in Activity
Scientific analytical thinking skills	Applies scientific analytical thinking skills, with assistance, working with less familiar (or familiar but more complex) contexts.	✗
	Applies understanding, and a combination of more than one science concept, to solve problems and provide solutions.	✗
	Demonstrates further development of creative thinking including through the engineering processes of design, construction, testing and modification.	✗
Skills and attributes of scientifically literate citizens	Presents a reasoned argument based on evidence, demonstrating understanding of underlying scientific concepts, and engages with the views of others.	✓
	Demonstrates understanding of the relevance of science to their future lives and the role of science in an increasing range of careers and occupations.	✓
	Demonstrates increased awareness of creativity and inventiveness in science, the use of technologies in the development of sciences and the impact of science on society.	✓
	Expresses informed views about scientific and environmental issues based on evidence.	✓

Let's Investigate

Science in the News

What science events and ideas are in the news this week?

What do you think?



Let's Investigate

Science in the News

Title:

Published on:

Type of publication:

Area of Science discussed in the article:

Credibility of the source:

Main points:

Current or future impacts of the science:

Questions and opinions you have of the article:

Teacher Guide: Scottish Scientists

SCN 2-20b

I can report and comment on current scientific news items to develop my knowledge and understanding of topical science.

Key Vocabulary:

Credible: A source of information that is unbiased and backed up with evidence.

Aim:

The aim of this activity is to engage pupils with topical and current scientific developments. By definition this Experience and Outcome should not be prescriptive and should be experienced by pupils in response to interest or current events.

When viewing news articles, pupils should be encouraged to assess the credibility of the source and form and share their own opinions of the article. They should discuss the opinions of others and be encouraged to respectfully debate opposing views.

Materials:

Included in this pack is a template that pupils can use to respond to a news article.

Useful Websites:

https://newsforkids.net/category/all_news/science/

https://www.bbc.co.uk/newsround

https://sciencejournalforkids.org/

https://www.reachoutreporter.com/

Interdisciplinary Learning:

Literacy:

Listening and Talking:

Tools for listening and talking	LIT 2-02a,
Finding and Using Information	LIT 2-04a, LIT 2-05a, LIT 2-06a
Understanding, Analysing and Evaluating	LIT 2-07a, 2-08a
Creating Texts	LIT 2-09a

Reading:

Finding and Using Information:	LIT 2-15a
Understanding Analysing and Evaluating	LIT 2-18a

Topical Science SCN2-20b

Skill Organiser	Skills	Addressed in Activity
Inquiry and investigative skills	**Plans and designs scientific investigations and enquiries**	
	Formulates questions and predictions (hypotheses), with assistance, based on observations and information	✗
	Identifies the independent, dependent and controlled variables, with assistance.	✗
	Anticipates some risks and hazards.	✗
	Carries out practical activities in a variety of learning environments	
	Applies appropriate safety measures.	✗
	Contributes to carrying out all the procedures.	✗
	Makes observations and collects information and measurements using appropriate devices and units.	✗
	Manages identified controlled variables to ensure validity of results.	✗
	Analyses, interprets and evaluates scientific findings	
	Selects appropriate methods to record data/information.	✗
	Identifies relationships between the independent and dependent variables.	✗
	Makes links to original questions or predictions.	✗
	Relates findings to the wider world.	✓
	Draws basic conclusions consistent with findings.	✗
	Identifies and discusses additional knowledge and understanding gained.	✓
	Recognises anomalous results and suggests possible sources of error.	✗
	Evaluates the investigation and suggests one way of improving it if it was to be repeated.	✗
	Presents scientific findings	
	Presents data/information by choosing from an extended range of tables, charts, diagrams, graphs, including bar graphs and line graphs.	✗
	Reports collaboratively and individually using a range of methods.	✓
	Collates, organises and summarises findings, with assistance, using headings or questions to provide structure for presentations.	✓
	Uses appropriate scientific vocabulary and acknowledges sources, with assistance.	✓

Skill Organiser	Skills	Addressed in Activity
Scientific analytical thinking skills	Applies scientific analytical thinking skills, with assistance, working with less familiar (or familiar but more complex) contexts.	✗
	Applies understanding, and a combination of more than one science concept, to solve problems and provide solutions.	✗
	Demonstrates further development of creative thinking including through the engineering processes of design, construction, testing and modification.	✗
Skills and attributes of scientifically literate citizens	Presents a reasoned argument based on evidence, demonstrating understanding of underlying scientific concepts, and engages with the views of others.	✓
	Demonstrates understanding of the relevance of science to their future lives and the role of science in an increasing range of careers and occupations.	✓
	Demonstrates increased awareness of creativity and inventiveness in science, the use of technologies in the development of sciences and the impact of science on society.	✓
	Expresses informed views about scientific and environmental issues based on evidence.	✓

Risk Assessment

Task/Activity/Process Description		Service	
Location		Reference	

Types of Injury/Loss/Ill Health	

For each hazard, please identify the person at risk (direct and indirect)

Consider those especially vulnerable (young or inexperienced workers, members of the public, school pupils, the elderly, residents and contractors)

NOTE: New and expectant mothers require a separate risk assessment

Haz No.	Hazard	Source of Hazard	Persons at Risk	Current Control Measures in Place	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Risk Rating (1-25)
1	Please select						0
2							0
3							0
4							0
5							0
6							0
7							0
8							0
9							0
10							0
11							0
12							0
13							0
14							0

Risk Reduction

Haz No.	Additional Control Measures	Likeli-hood Rating (1-5)	Severity Rating (1-5)	Final Risk Rating (1-25)	Action By (name and target date)	Date Control Implemented	Sign to Confirm
1				0			
2				0			
3				0			
4				0			
5				0			
6				0			
7				0			
8				0			
9				0			
10				0			
11				0			
12				0			
13				0			
14				0			

Assessor(s) Name (print)	Assessment Date	Manager Name (print)

Assessor(s) Signature	Review Date	Manager Signature	Date

Appendices SCN2-Appendix 01

Risk Matrix

Likelihood

When considering the likelihood of occurrence, the risk assessor's judgement must be based on the prevalence of the event/circumstance and outcome, backed up by experience and data such as relevant incidents/events, complaints and/or claims.

1 Will only occur in exceptional circumstances

2 Unlikely to occur but potential exists

3 Reasonable chance of occurring – has happened before on occasions

4 Likely to occur – strong possibility

5 The event will occur in most circumstances

Severity

When considering the consequences of a potential risk, all scenarios must be considered with scoring based on the most likely outcome. It may be appropriate to consider the worst case scenario, however, those undertaking the risk analysis must be able to provide a robust rationale and have evidence to support their selection. For example, if 'death' could be the ultimate potential severity in relation to a specific problem, the risk assessors must have knowledge that this outcome has occurred in the past either internal or external to North Ayrshire Council.

1 Adverse event leading to minor injury not requiring first aid

2 Minor injury or illness, first aid required; no employee absence expected

3 Significant injury requiring medical treatment and/or counselling

4 Major injuries or long term incapacity requiring medical treatment and/or counselling

5 Incident leading to death or major permanent incapacity

Evaluation

As shown in the matrix below, Likelihood x Severity produces an evaluation of the significance of risk, described as 'Low', 'Moderate', 'High' or 'Very High'.

		Severity				
		1	2	3	4	5
Likelihood		Insignificant	Minor	Moderate	Major	Extreme
5	Almost Certain	5	10	15	20	25
4	Likely	4	8	12	16	20
3	Possible	3	6	9	12	15
2	Unlikely	2	4	6	8	10
1	Remote	1	2	3	4	5

1 to 3	Low Risk	No further action, but ensure controls are maintained and reviewed
4 to 9	Moderate Risk	Implement additional control measures where practicable whilst ensuring existing controls are maintained
10 to 16	High Risk	Take immediate action – implement additional control measures to reduce the risk rating
20 to 25	Very High Risk	Unacceptable- The work activity cannot commence until the risk is reduced to at least a High Risk (10-16)

Source Examples

Source	Example of Source
Access & Egress	Temporary work carried out on final exit doors of school
Aggression & Violence	Employees visit members of public in their homes and carry out personal interviews
Asbestos	Tradesperson can be exposed when fitting new bathroom/kitchen units in clients' homes
Biological	Body fluids, vermin, fleas, pigeons (droppings), spores, dust etc
Bullying	Senior management/colleagues possibly unaware of bullying styles
Chemicals	Employees use cleaning agents to wash down road signs
Computers	Employees use DSE including laptops for several hours per day – eye strain, musculoskeletal problems
Confined Spaces	Employees/inspectors work in small loft spaces
Drugs & Alcohol	Hazardous where employees are classified in high risk driving jobs such as cleansing, care in the community
Electricity	Building Services operatives potentially working with live electricity
Fire	Waste materials stored at rear of premises – trespassers could potentially ignite the combustible materials
Heights	Employees/maintenance companies have to access roof to carry out repairs/visual inspections
Housekeeping	Deliveries arrive daily to rear of building and are stored in corridor until suitable space is available
Lighting	Roads Services carry out late night and early morning emergency repairs
Manual Handling	Employees have to physically transport bags of cement from vehicle to work area
Moving and Handling	Employees have to move and handle service user from bed to wheelchair/toilet/bath etc
Noise	Employees entering workshop when drilling and lathe machines in operation
Radiation	Grounds Maintenance employees work outside in direct sunlight
Sharps	Employees have to clear rubbish and debris from hedges/bushes etc
Slip/Trip/Fall	Risk of slipping on uneven paths and walkways or tripping over tools and equipment
Stress	H&SCP employees deal with vulnerable adults and children on a daily basis with increased workload
Temperature	Catering employees have to access walk-in cold storage unit where temp is -20^{o}C
Tools/Equipment	Employees using chisels, hammers and general hand held tools
Vehicle/Transport	Employees have to cross busy car park used by service vehicles
Vibration	Use of hand held power drill when fitting kitchen unit
Water	Employees working beside fast flowing waterway

Risk Assessment

Haz No.	Additional Control Measures Recommended by Risk Assessor(s)	Rationale for not Implementing Control Measures and/or not Achieving Target Date	Rationale for Alternative Control Measures
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			

Inquiry skills assessment grid

Name: _____ **Class:** _____ **Date:** _____

Science Skills	I can statements:	☺	😐	☹	Pupil/teacher comments
Inquiry and Investigative Skills	I am beginning to formulate my own scientific questions based on observations and predictions.				
	I can understand fair testing and can identify Independent, Dependent and Control variables.				
	I can investigate potential dangers in an experiment.				
	I can apply safety measures before carrying out a practical activity.				
	I can contribute to all aspects of a procedure.				
	I can make observations, collect information and measurements using appropriate devices.				
	I can present data in a range of ways (tables/charts/diagrams/graphs).				
	I can identify relationships between variables.				
	I can make links with the aim and draw conclusions from the results.				
	I can recognise unexpected results and suggest why these occurred.				
Scientific and analytical thinking skills.	I can link my findings to my own experiences and discuss additional knowledge.				
	I can contribute to reporting on an experiment using a variety of media, using appropriate scientific vocabulary and acknowledge sources.				
	I can sort and summarise what I have found out.				
	I can write a structured science report using appropriate headings.				
	I can apply what I have learnt in new contexts.				
Skills and attributes of scientifically literate citizens.	I can think of, and test, creative ways to solve problems in science.				
	I can talk and write about science subjects that I have researched.				
	I can present a reasoned argument based on scientific research.				
	I can discuss the relevance of science in careers and my own future.				
	I can demonstrate awareness of how inventions and creativity in science impacts on society.				

Investigation report

Name: **Class:** **Date:**

Experiment Title:

Aim:

Hypothesis:
(what you think will happen)

Variables:
(what you will keep the same, what you will change, what will you measure?)

Materials:
(draw the equipment you will use)

Investigation report

Name: _____ **Class:** _____ **Date:** _____

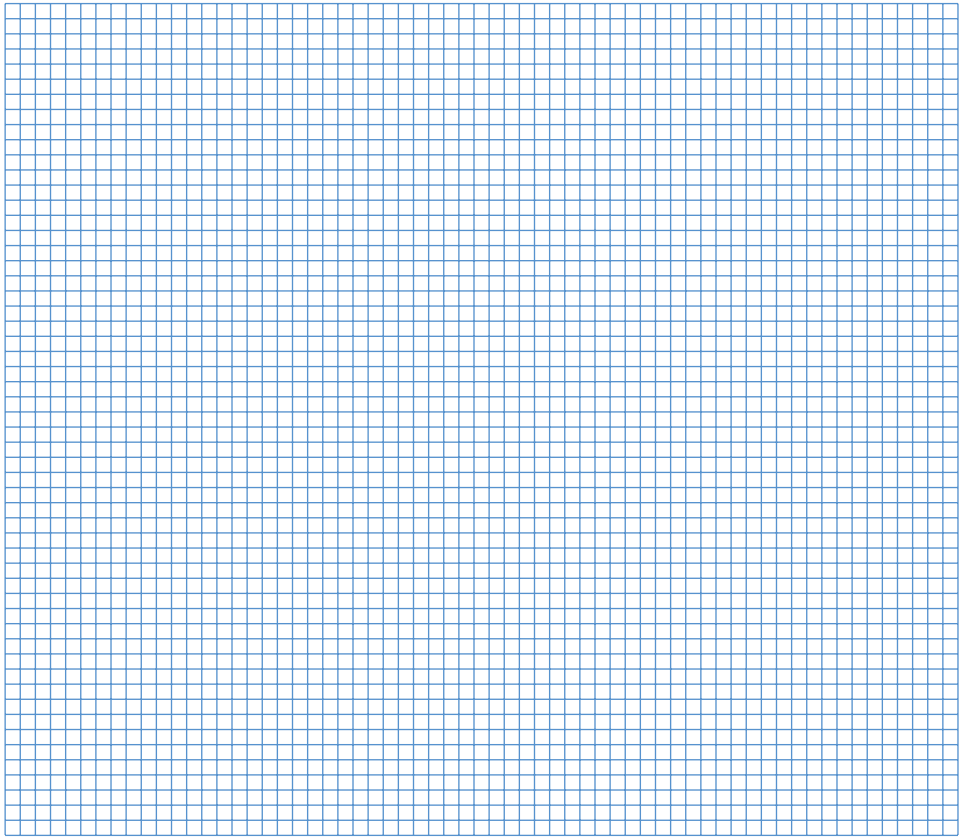
Method:
(the steps you will follow)

Results:
(a table of what you measured)

Investigation report

Name: _____ **Class:** _____ **Date:** _____

Graph:
(a bar or line graph of your results)



Conclusion:
(what your results tell you)

Evaluation:
(what would make the results better)

RAiSE

Raising Aspirations in Science Education

North Ayrshire Council

Comhairle Siorrachd Àir a Tuath