ChrisQuigley
Education

Greater Depth in Science

Planning for Fundamental Foundations to Greater Depth

By Chris Quigley

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Contents

Introduction

Greater Depth in Science is a resource designed to:

- enable teachers to understand the concept of greater depth in science
- help teachers to plan activities that will lead to progression from fundamental foundations to greater depth
- provide examples of pupils' work that show progression
- help teachers to assess progress.

In addition, the book and accompanying CD provide professional development in the nature of the science curriculum and aims to develop the subject knowledge of teachers so that the purpose and aims of teaching science are brought out in the delivery of the science curriculum.

The resource is structured as follows:

Section 1: Understanding greater depth

This section:

- explains the nature of a 'mastery curriculum'
- defines 'greater depth'
- explains the stages of development from fundamental foundations to greater depth
- sets time-scales for when greater depth might be reasonably expected
- explains how greater depth fits within the wider purpose and aims of the science curriculum.

Section 2: Curriculum design

This section provides the following for each milestone:

- curriculum content for gaining knowledge and skill through a 'working scientifically' approach
- conscious connections between science topics and other subjects
- continuous provision to create a science-rich classroom environment and secure greater depth
- continuous provision activity ideas.

Section 3: Planning for and assessing progress

This section provides the following for each milestone:

- Proof of Progress (PoP) tasks that show teachers how to explicitly plan for and assess progress from fundamental foundations to greater depth
- deep activity examples of pupils' work that give a fantastic visual depiction of completed PoP tasks that may be used by teachers to plan how pupils may record their work and for leaders to use moderate teachers' assessment judgements.

This section uses every statement from Chris Quigley's Essential Curriculum and provides a comprehensive progression document. This is useful for helping teachers to plan and assess and for helping leaders to set tangible expectations for progress.

On the CD

The CD includes all sections of the resource in an electronic format for use within an individual school to aid professional development.

Section 1:
Understanding greater depth

‘Greater depth’ and a ‘mastery’ curriculum

The term ‘greater depth’ is best understood by exploring why the old system of levels was abandoned. One of the main reasons for moving away from levels was that the expectation of rapid progress through the levels was stopping pupils from gaining the depth of understanding necessary to prepare them for future stages of education. Instead of a ‘levels’ curriculum we now have a ‘mastery’ curriculum. The main differences between the two types of curricula are shown below:

A ‘levels’ curriculum

Two aspects to the curriculum: content and levels.

Aim of the curriculum: cover the content.

Method: use level descriptors to figure out the standard at which pupils are working.

Expected rate of progress: at least one level every two years.

A ‘mastery’ curriculum

One aspect to the curriculum: content.

Aim of the curriculum: understand the content.

Method**: Repeat** the content as many times as necessary to ensure pupils are fluent in everything by the end of the key stage.

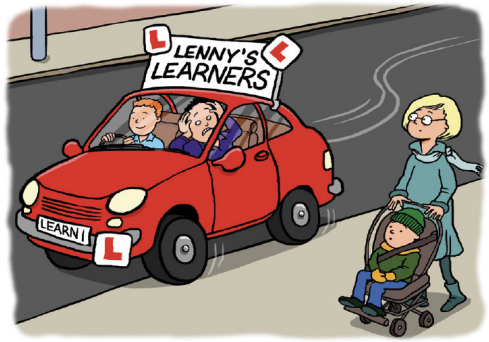
Expected rate of progress: none. As long as pupils are fluent in everything by the end of the key stage they are meeting expectations. If they get there early, stick with the same content and secure a **greater depth** of understanding. The extent to which teachers repeat and deepen content is a **professional decision**.

What is greater depth?

Greater depth is a way of describing the degree of understanding pupils have of the **entire content** of the curriculum - for the purposes of this book, the science curriculum. It is a term used to assess pupils' understanding at the end of a key stage rather than within it.

Pupils with a greater depth of understanding will have the same knowledge and skills as pupils reaching the expected standard but they will show greater understanding through their inventive application of their knowledge and skills. It is important that greater depth is **not** seen as pupils making rapid progress through content or pupils having a greater quantity of knowledge than their peers. For example, 'I can' statements are of little use in defining greater depth because they don't tell us to what degree a pupil understands an aspect of the curriculum.

Look at the example below. The statement '**I can** drive a car.' gives us no information about how well the car can be driven. Instead, it is better to ask: '**to which degree** can you drive the car?'.



I can drive to a **BASIC** degree. I'm learning the **fundamental foundations** of driving.

I can drive to an **ADVANCING** degree. I'm applying the **fundamental foundations** of driving in a range of different situations, making decisions for myself along the way.

I can drive to a **DEEP** degree. I'm inventively applying the **fundamental foundations** of driving in a range of non-standard, non-routine situations, reasoning and justifying as I go.

Notice that the content stays the same - in this case cars - and that fundamental foundations are common to all stages of understanding and should therefore not be rushed. Without the fundamental foundations of driving it would be impossible to pass one's driving test or to progress to greater depth in driving - in this example, managing to negotiate Paris!

Cognitive domains

The three car pictures focus on the same content: driving a car. The nature of thinking and the way in which it is used and applied changes from one picture to the next. In this way, they are cognitive domains that demonstrate a **basic**, **advancing** and **deep** degree of understanding.

Low level cognitive demand. Involves acquisition of **fundamental foundations**.

Higher level cognitive demand beyond recall. Requires application involving some degree of decision making in how to **apply fundamental foundations**.

Cognitive demand involves non-standard, non-routine, inter-connected, multi-step thinking in problems with more than one possible solution. Requires reasoning and justification for the **inventive application of fundamental foundations**.

From fundamental foundations to greater depth

To secure greater depth, it is important that teachers change the nature of tasks and questions as pupils move through the three cognitive domains. This table shows how the nature of tasks and questions should change in each domain:

Cognitive domain	Types of thinking	Nature of tasks and questions	Types of tasks and questions
Basic	Low level cognitive demand. Involves following instructions.	Building knowledge of fundamental foundations	Name, describe, follow instructions or methods, complete tasks, recall information, ask basic questions, observe, use, match, report, measure, list, illustrate, label, recognise, tell, repeat, arrange, define, memorise, calculate, recite, draw, recall.
Advancing	Higher level cognitive demand beyond recall. Requires application involving some degree of decision making.	Applying fundamental foundations	Apply skills to solve problems, explain methods, classify, infer, categorise, identify patterns, organise, modify, predict, interpret, summarise, estimate, compare, experiment, demonstrate, practise, show, arrange, point out, graph, separate.
Deep	High level cognitive demand that involves non-standard, non-routine, inter-connected, multi-step thinking in problems with more than one possible solution. Requires reasoning and justification.	Inventively applying fundamental foundations	Solve non-routine problems, appraise, explain concepts, hypothesise, investigate, cite evidence, design, create, prove, judge, recommend, justify, generalise, propose, discover, arrange, rate, evaluate, revise, conclude, formulate, construct, develop, connect, prioritise.

Proof of Progress (PoP) tasks

To plan for progress, different types of tasks may be created that prove to the teacher that pupils are gaining a deeper understanding of the same content.

The example below shows how pupils working in Milestone 1 may progress from a BASIC to an ADVANCING and then DEEP understanding of an aspect of the science curriculum by completing the PoP tasks:

Identify and name a variety of common plants, including garden plants, wild plants and trees and those classified as deciduous and evergreen.

Basic	Advancing	Deep
What are the **names** of common wild plants?	What are the **similarities and differences** between deciduous and evergreen trees?	Could you **suggest** a garden **design** for someone who likes privacy and bright autumn colours?
What are the **names** of some common garden plants?	Think of some ways to **categorise** plants.	
What are the **names** of common trees?		
Which trees are evergreen and which are deciduous? **(name)**		

Notice the importance of fundamental foundations in each task: it would be impossible to complete the advancing and deep tasks without the fundamental foundations of the basic tasks. It is, therefore, important not to rush through the cognitive domains. The wider a pupil's fundamental foundations, the more chance there is of securing greater depth at a later stage.

Working scientifically

All of the PoP tasks in Section 3: Planning for and assessing progress involve one or more of the 'working scientifically' objectives of the National Curriculum. As a reminder, the 'working scientifically' milestone standards are:

Milestone 1 Years 1 and 2	Milestone 2 Years 3 and 4	Milestone 3 Years 5 and 6
Ask simple questions.	Ask relevant questions.	Plan enquiries, including recognising and controlling variables where necessary.
Observe closely, using simple equipment.	Set up simple practical enquiries, comparative and fair tests.	Take measurements, using a range of scientific equipment, with increasing accuracy and precision.
Perform simple tests.	Make accurate measurements using standard units, using a range of equipment, for example thermometers and data loggers.	Record data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, bar and line graphs, and models.
Identify and classify.	Gather, record, classify and present data in a variety of ways to help in answering questions.	Report findings from enquiries, including oral and written explanations of results, explanations involving causal relationships, and conclusions.
Use observations and ideas to suggest answers to questions.	Record findings using simple scientific language, drawings, labelled diagrams, bar charts, and tables.	Present findings in written form, displays and other presentations.
Gather and record data to help in answering questions.	Report on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions.	Use test results to make predictions to set up further comparative and fair tests.
	Use results to draw simple conclusions and suggest improvements, new questions and predictions for setting up further tests.	Use simple models to describe scientific ideas identifying scientific evidence that has been used to support or refute ideas or arguments.
	Identify differences, similarities or changes related to simple scientific ideas and processes.	
	Use straightforward scientific evidence to answer questions or to support their findings.	

Some of the higher order 'working scientifically' objectives are embedded in the advancing and deep tasks which are suggested for the second phase of each milestone.

Section 2:
Curriculum design

Milestone 1

Curriculum content in Key Stage 1

Across all year groups, pupils should gain the knowledge and skills within each area of science through a predominantly 'working scientifically' approach.

Biology

Plants
- Identify, classify and describe their basic structure.
- Observe and describe growth and conditions for growth.

Habitats
- Look at the suitability of environments and at food chains.

Animals and humans
- Identify, classify and observe.
- Look at growth, basic needs, exercise, food and hygiene.

Living things*
- Investigate differences.

Chemistry

Materials
- Identify, name, describe, classify and compare properties and changes.
- Look at the practical uses of everyday materials.

Physics

Light*
- Look at sources and reflections.

Sound*
- Look at sources.

Electricity*
- Look at appliances and circuits.

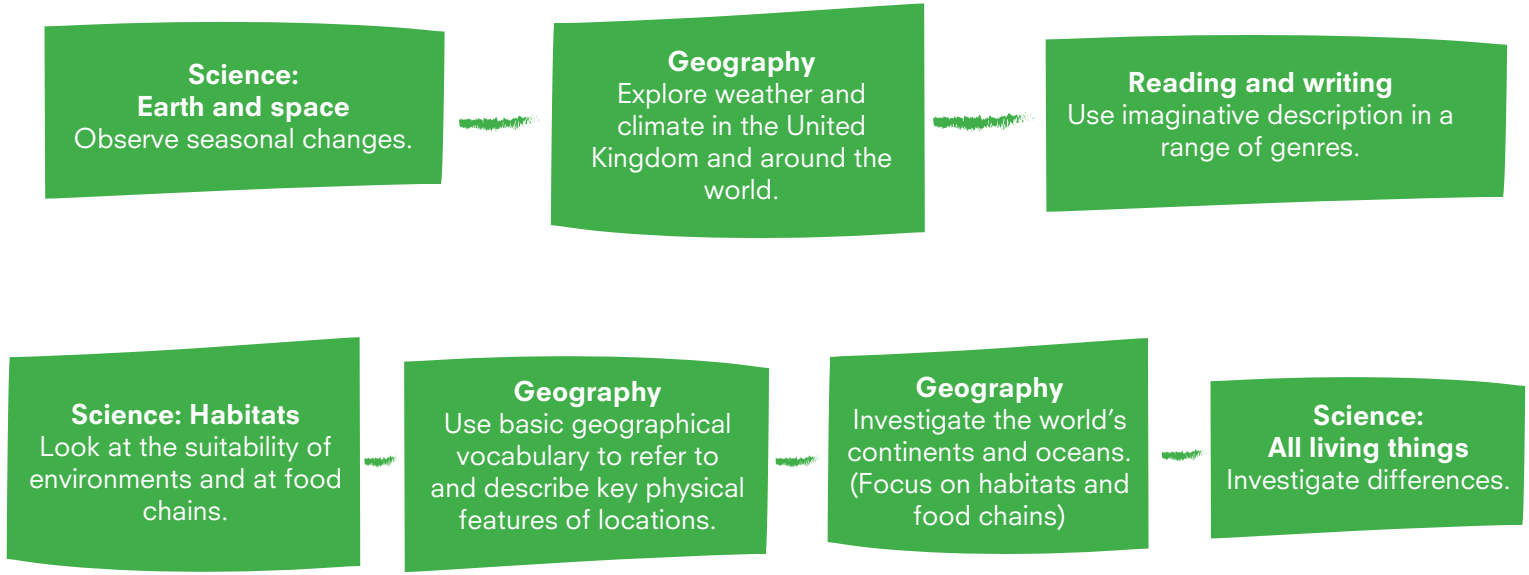
Forces
- Describe basic movements.

Earth and space
- Observe seasonal changes.

* These items are not statutory in the National Curriculum but form part of the progression in understanding in the Chris Quigley Essentials Curriculum.

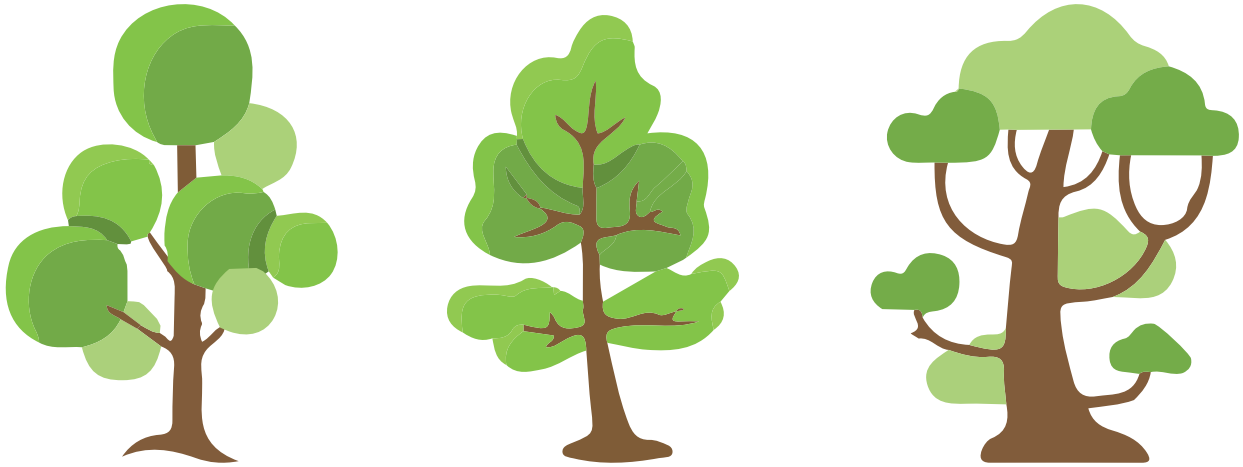
Conscious connections

Making connections between science and other subject areas means that pupils can benefit from a more connected learning experience and a large amount of curriculum time is saved. Here are six ideas that show how conscious connections may be made between science topics and other subjects:



Continuous provision activity ideas

Name that tree



In this ongoing challenge, pupils match the names of common trees to their picture or to their leaf shape.

As time goes on, introduce trees found on other continents. Pupils should classify the tree as deciduous or evergreen.

As an extension to the activity, pupils could create a game 'Which tree am I thinking of?' They play in pairs. Pupils think of a tree and their opponent asks ten questions to try to guess the type of tree.

Learning Objective(s):

- To work scientifically
- To understand plants

Milestone standard(s):

- Ask simple questions.
- Observe closely, using simple equipment.
- Identify and classify.
- Identify and name a variety of common plants.

How to organise this activity

- During **unstructured time** when pupils select an activity of their choice.
- **Homework**.

Milestone 2

Curriculum content in Key Stage 2

This content should be divided between Years 3 and 4 and Years 5 and 6.

The areas we recommend you cover in Years 3 and 4 are highlighted.

Plants

- Look at the function of parts of flowering plants, requirements of growth, water transportation in plants, life cycles and seed dispersal.

Evolution and inheritance

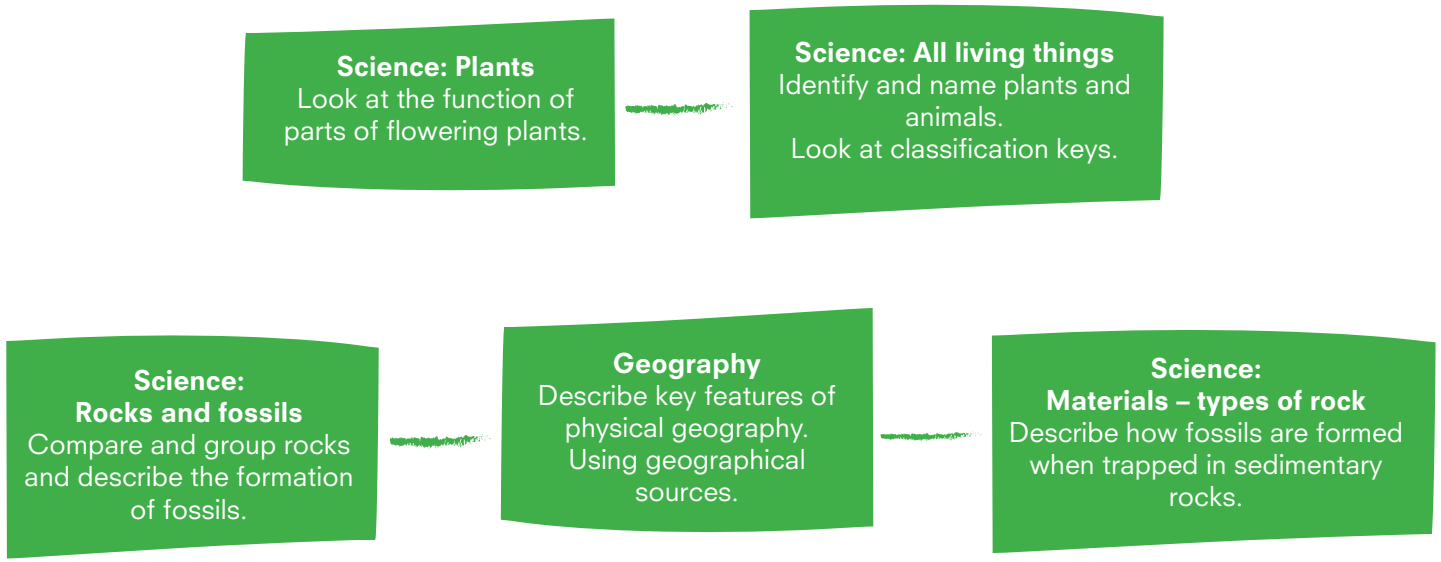
- Look at resemblance in offspring.
- Look at changes in animals over time.
- Look at adaptation to environments.
- Look at differences in offspring.
- Look at adaptation and evolution.
- Look at changes to the human skeleton over time.

Animals and humans

- Look at nutrition, transportation of water and nutrients in the body, and the muscle and skeleton system of humans and animals.
- Look at the digestive system in humans.
- Look at teeth.
- Look at the human circulatory system.

Conscious connections

Making connections between science and other subject areas means that pupils can benefit from a more connected learning experience and a large amount of curriculum time is saved. Here are eight ideas that show how conscious connections may be made between science topics and other subjects:



Continuous provision activity ideas

Plant doctor

In this ongoing challenge, pupils keep a selection of plants to look after.

They explore the requirements of plants for life and growth and how these vary from plant to plant. They make observations and engage in discussions about conditions for growth. They also seek to solve any problems with plant growth.

Milestone 3

Curriculum content in Key Stage 2

This content should be divided between Years 3 and 4 and Years 5 and 6.

The areas we recommend you cover in Years 5 and 6 are highlighted.

Plants

- Look at the function of parts of flowering plants, requirements of growth, water transportation in plants, life cycles and seed dispersal.

Evolution and inheritance

- Look at resemblance in offspring.
- Look at changes in animals over time.
- Look at adaptation to environments.
- Look at differences in offspring.
- Look at adaptation and evolution.
- Look at changes to the human skeleton over time.

Animals and humans

- Look at nutrition, transportation of water and nutrients in the body, and the muscle and skeleton system of humans and animals.
- Look at the digestive system in humans.
- Look at teeth.
- Look at the human circulatory system.

Science:
Animals and humans
Look at the human circulatory system.

Physical education
Participate and compete to lead a healthy lifestyle.

Working scientifically
Analyse data

Mathematics
Statistics

Science:
Forces and magnets
Look at the transference of forces in gears, pulleys, levers and springs.

Design and technology
Understand and use mechanical systems in products, such as gears, pulleys, cams, levers and linkages.

Science:
States of matter
Look at solids, liquids and gases, changes of state, evaporation, condensation and the water cycle.

Geography
Describe key aspects of physical geography, including the water cycle.

Continuous provision activity ideas

Potions

In this ongoing challenge, pupils investigate a range of ‘potions’ that are made from salt, sand and gravel, and are asked to find ways to separate them.

Section 3:
Planning for,
and assessing progress

Milestone 1

Milestone 1 – Biology
To understand plants

Identify and name a variety of common plants, including garden plants, wild plants and trees and those classified as deciduous and evergreen.

Basic

What are the **names** of some common wild plants?

What are the **names** of some common garden plants?

What are the **names** of some common trees?

Which trees are evergreen and which are deciduous? **(name)**

Advancing

What are the **similarities and differences** between deciduous and evergreen trees?

Think of some ways to **categorise** plants.

Deep

Suggest a garden **design** for someone who likes privacy and bright autumn colours?

See an example on page 103

Milestone 1 – Biology
To understand plants

Find out and describe how plants need water, light and a suitable temperature to grow and stay healthy.

Basic

What do plants need to stay healthy? (**describe, list**)

Advancing

How could you try to revive these plants? (**apply**) (Give pupils a dried out plant, one that's been in a fridge, one that's been kept in the dark etc?)

Deep

Devise a way of **proving** that plants need certain conditions for growth.

See an example on page 106

Milestone 1 – Biology

To understand animals and humans

Investigate and describe the basic needs of animals, including humans, for survival (water, food and air).

Basic

List the basic needs of animals, including humans, for survival.

Advancing

Compare the types of food that different animals require.

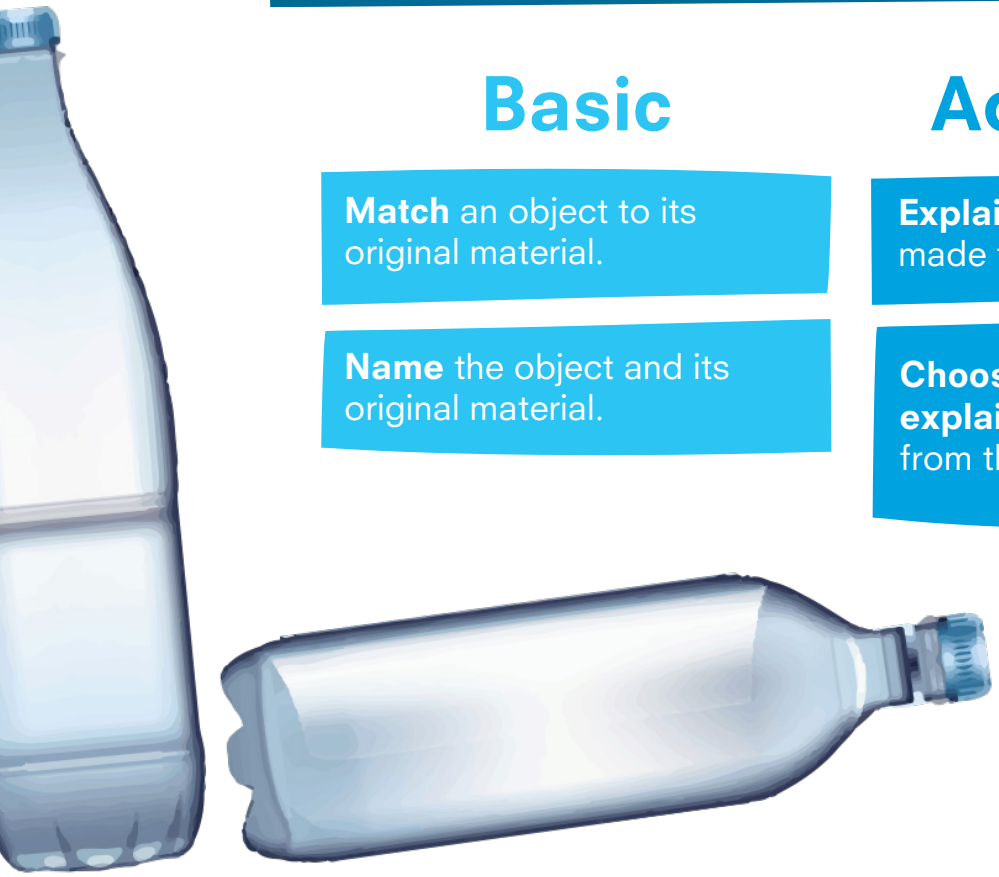
Deep

Explain the concept of humans' need for clean water and why this is not so important for other animals.

See an example on page 112

Milestone 1 – Chemistry
To investigate materials

Distinguish between an object and the material from which it is made.



Basic

Match an object to its original material.

Name the object and its original material.

Advancing

Explain how a bottle is made from sand.

Choose some objects and **explain** how they were made from their original material.

Deep

True or false? Some fleece jackets start as plastic bottles.

See an example on page 119

Describe the simple physical properties of a variety of everyday materials.

Basic

Observe and **name** the properties of everyday materials.

Complete tables that describe the properties of materials.

Advancing

Explain why the properties of materials are useful for deciding which materials to use for an object. Give **examples**.

Deep

Design an item of clothing to keep the wearer dry.

See an example on page 121

Milestone 1 – Physics

To understand movement, forces and magnets

Compare how different things move.

Basic

Observe and **describe** the movement of a range of things including things that move with magnets.

Advancing

Compare the movement of remote control cars and a helicopter drone. **Explain** the differences in movement.

Deep

Do heavy and light things move differently? Is there a **pattern**?

See an example on page 122

Milestone 1 – Physics

To understand the Earth's movement in space

Observe changes across the four seasons.

Basic

Name the four seasons.

Notice and name the key features of each season.

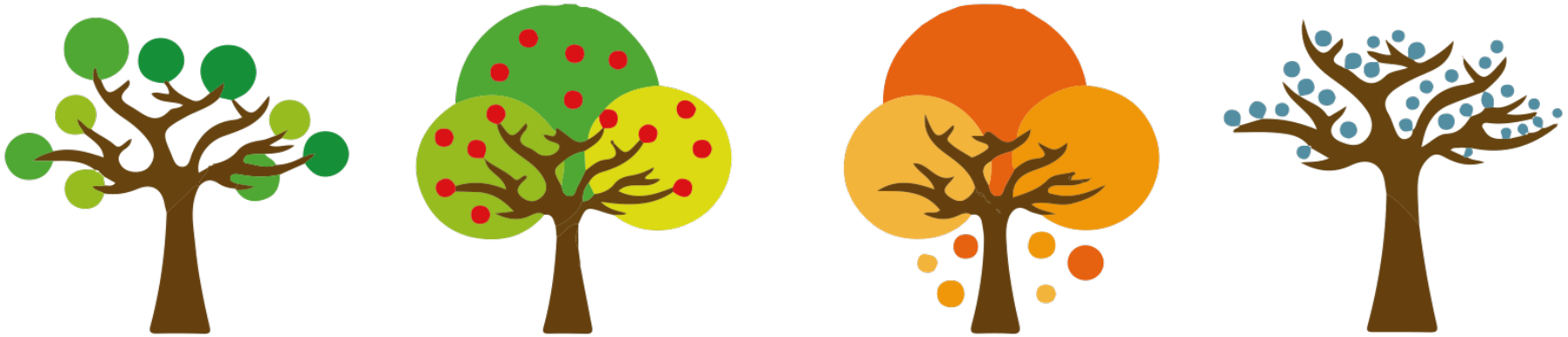
Advancing

Organise images or objects from each season into categories. **Explain** your categories.

Deep

Always, sometimes or never? It is warm and dry during summer.

See an example on page 127



Observe and describe weather associated with the seasons and how day length varies.

Basic

Observe and **record** weather over four seasons.

Describe weather in a named season.

Describe how day length varies in each season.

Advancing

Compare and **contrast** weather and day length across the four seasons.

Identify patterns in day length across the four seasons.

Deep

Plan some activities that would be suited to each season.

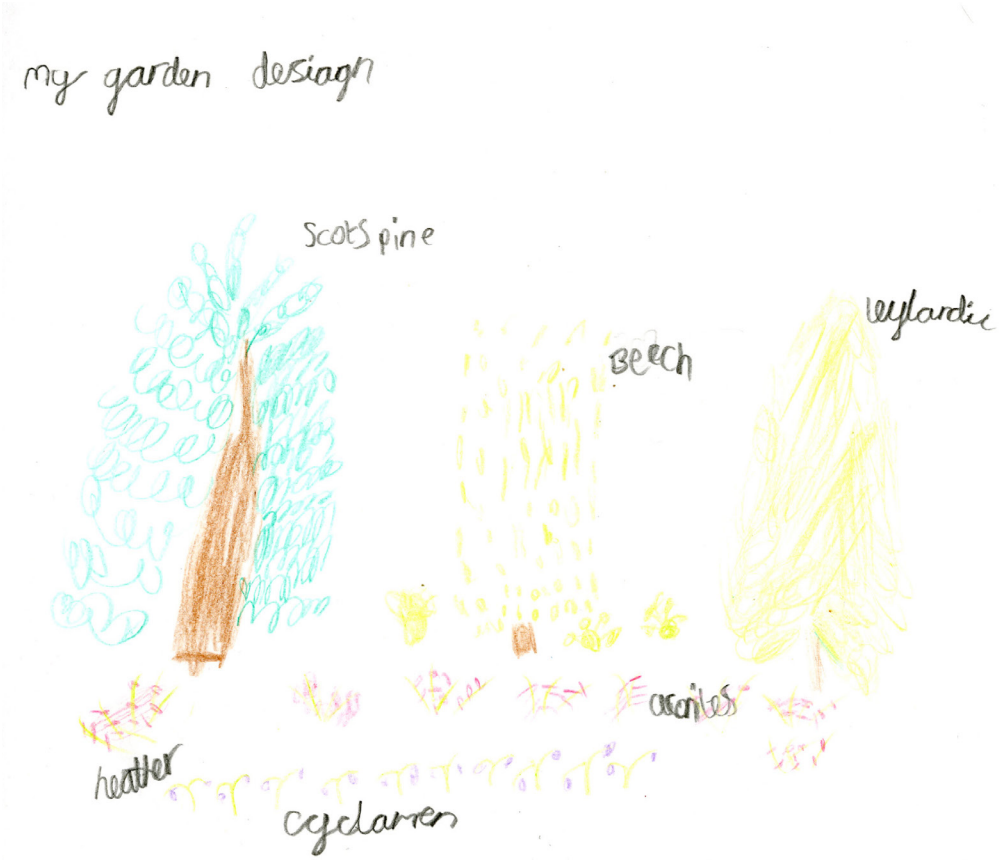
See an example on page 128

Milestone 1 Deep Activity Examples

Milestone 1 – Biology To understand plants

Identify and name a variety of common plants, including garden plants, wild plants and trees and those classified as deciduous and evergreen.

Suggest a garden **design** for someone who likes privacy and bright autumn colours.



for my design I need privacy and bright autumn colours.

for the privacy I have chosen evergreen trees such as Scots pines. I have also put some deciduous trees such as Beech because it turns a bright orangl colour in autumn but also keeps it leaves. I have put folowering plants at the bottom that have flowering in autumn. some are bulbs. other are shrubs.

Milestone 1 – Biology To understand plants

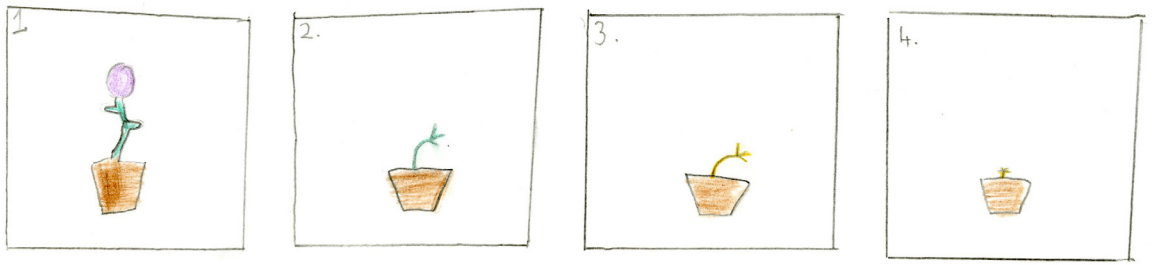
Find out and describe how plants need water, light and a suitable temperature to grow and stay healthy.

Devise a way of **proving** that plants need certain conditions for growth.

Prove that plants need the right conditions for groth.

The main things that plants need are:
- warmth
- light
- water

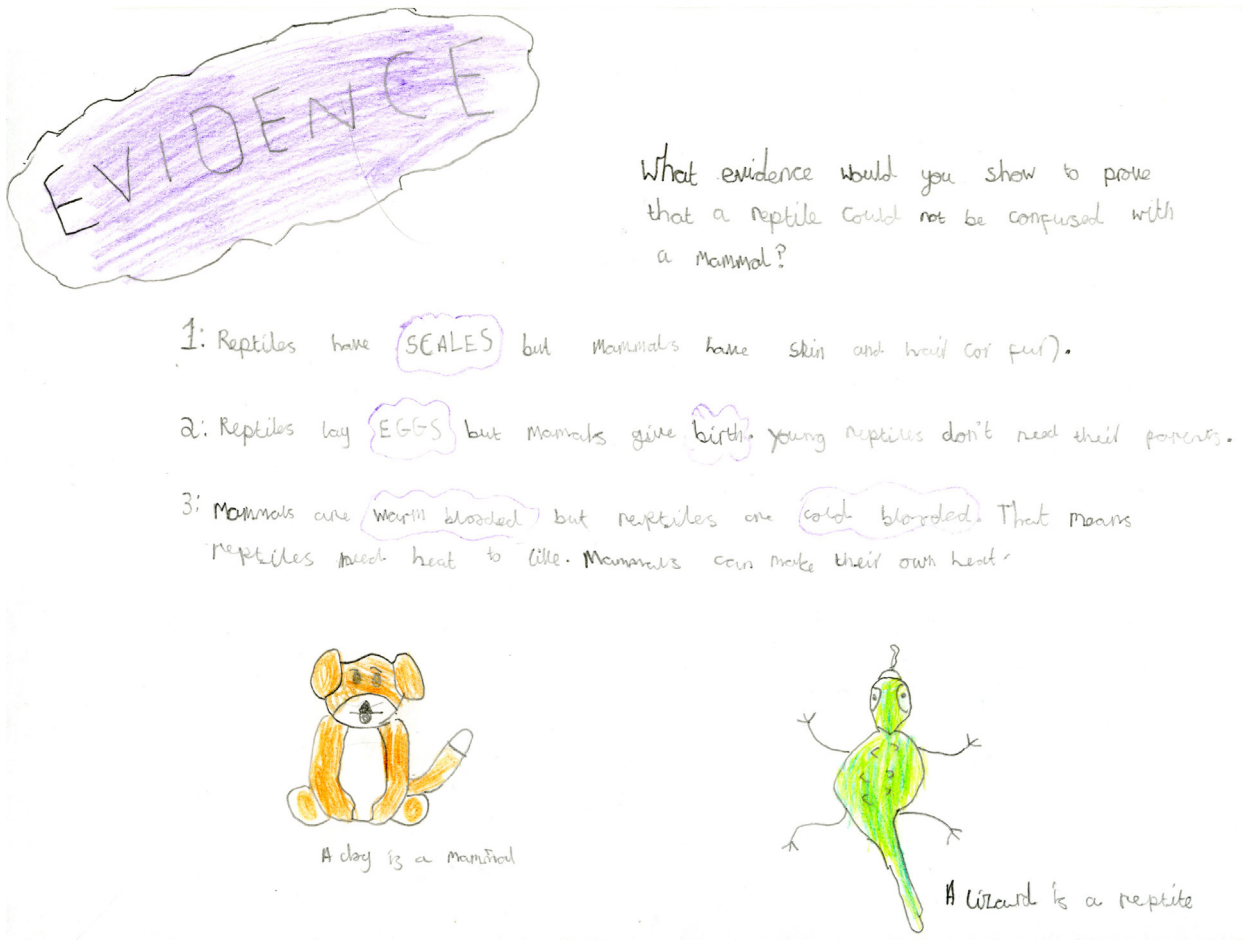
To prove this I will do for experiments.
This will prove that plants need warmth, light and water.



Milestone 1 – Biology To understand animals and humans

Describe and compare the structure of a variety of common animals (birds, fish, amphibians, reptiles, mammals and invertebrates, including pets).

What **evidence** would you show to prove that a reptile could not be confused with a mammal?



Milestone 1 – Biology To investigate living things

Explore and compare the differences between things that are living, that are dead and that have never been alive.

Give evidence to show that a glass bottle has never been alive.

Milestone 1 – Biology To investigate living things

Describe how animals obtain their food from plants and other animals, using the idea of a simple food chain, and identify and name different sources of food.

Always, sometimes or never? All food chains end with a carnivore.

Always, Sometimes or never ?

Food chains are links that show what eats what.
Here is an example

The sun grows the sunflower, the fly eats the flower, the sparrow eats the fly and the sparrow hawk eats the sparrow ... But does anything eat the sparrow hawk?

YES!

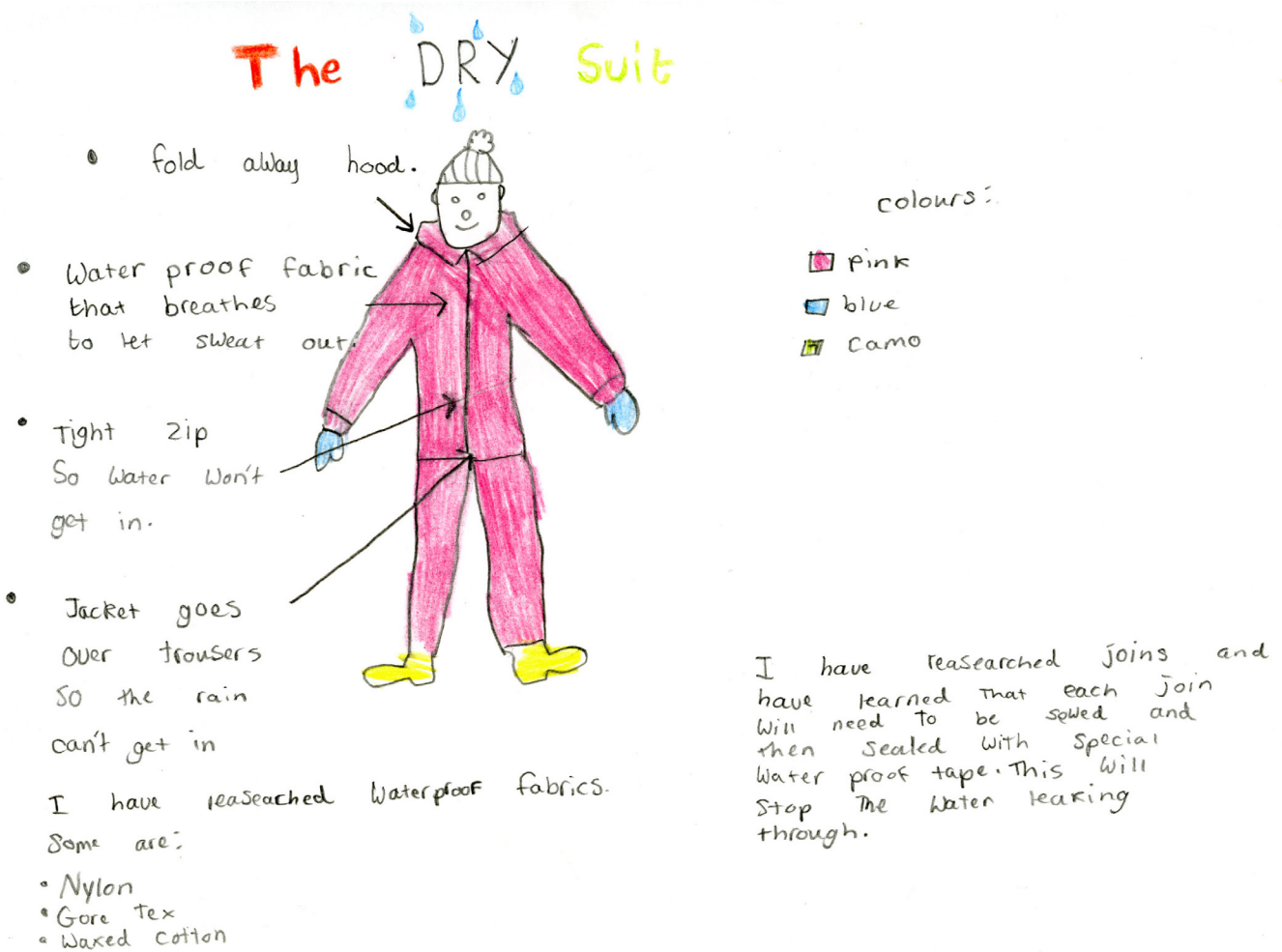
When it dies it gets eaten by bugs and bacteria

So... food chains don't end with a carnivore. The answer is NEVER.

Milestone 1 – Chemistry To investigate materials

Describe the simple physical properties of a variety of everyday materials.

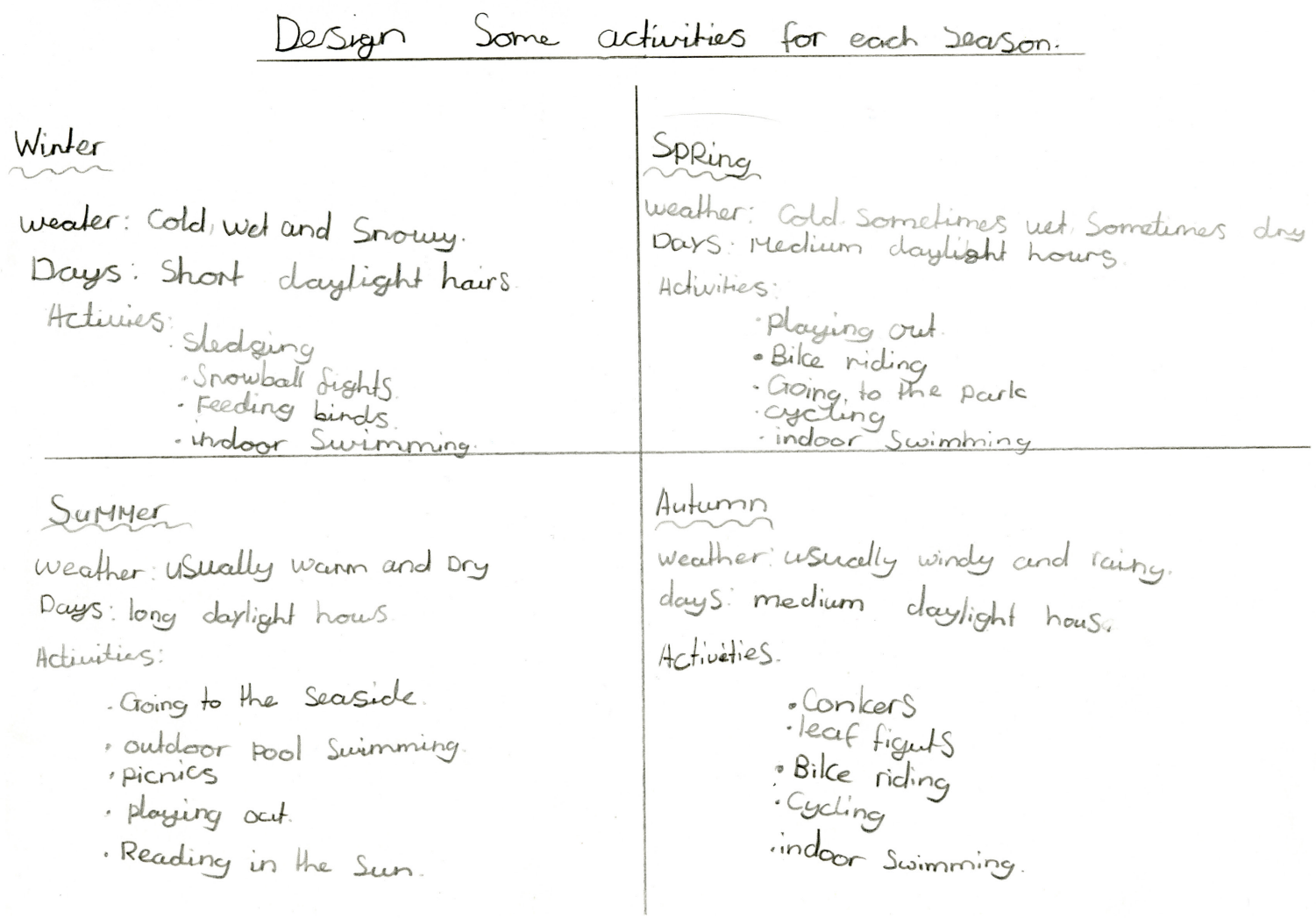
Design an item of clothing to keep the wearer dry.



Milestone 1 – Physics To understand the Earth's movement in space

Observe and describe weather associated with the seasons and how day length varies.

Plan some activities that would be suited to each season.



Milestone 2

Milestone 2 – Biology
To understand plants

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

Basic

Describe and illustrate the functions of different parts of flowering plants.

Advancing

Explain how leaves are important in creating food for a plant.

Deep

Prove or **disprove** that roots act like straws sucking up water for the plant.

Milestone 2 – Biology

To understand evolution and inheritance

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

Basic

Name a variety of animal and plant fossils.

Describe the conditions in which the fossils once lived.

Note, **name** and **describe** plants and animals that inhabited the Earth millions of years ago.

Advancing

Categorise fossils in a number of ways.

Compare and **contrast** different fossils.

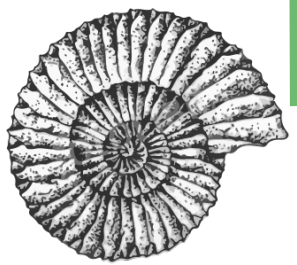
Explain the process of the formation of fossils.

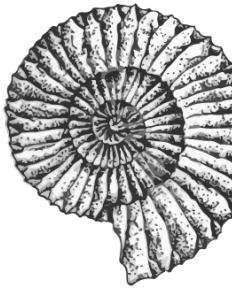
Deep

Investigate the conditions in which life on Earth survived millions of years ago.

Burning fossil fuels is widely thought by scientists to contribute to a rise in worldwide temperature. **Investigate** this and **cite evidence** that supports or questions this view.

See an example on page 184






Identify how animals and plants are suited to and adapt to their environment in different ways.

Basic

Match a range of animals and plants to the environments in which they are found.

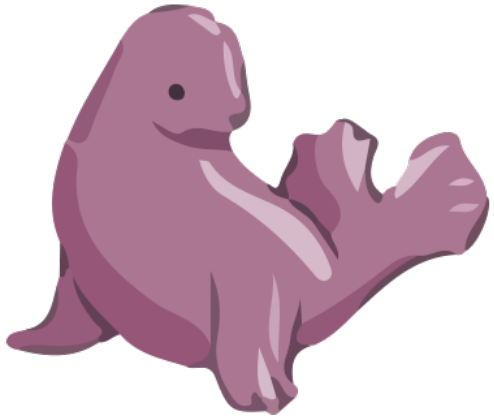
Describe how animals and plants are suited to the environments in which they are found.

Illustrate how animals and plants adapt to environments in different ways.

Advancing

Explain and give examples of the idea of adaptation.

Compare and **contrast** different types of adaptation.

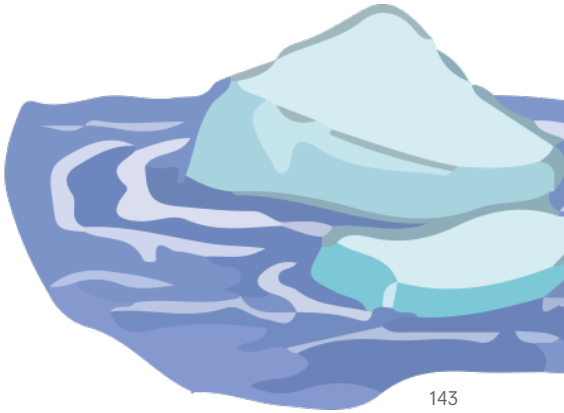


Deep

True or false? Plants and animals would not survive if they could not adapt.

Which do you think are the best examples of an animal and a plant that shows adaptation? (**suggest**)

See an example on page 185



Relate the simple physical properties of some rocks to their formation (igneous or sedimentary).

Basic

Observe and **describe** the properties of igneous and sedimentary rocks.

Describe rocks as igneous or sedimentary.

Describe the properties of igneous and sedimentary rocks.

Illustrate how igneous and sedimentary rocks are formed.

Advancing

Explain the main differences between igneous and sedimentary rocks.

Compare the origins of different types of rocks and **identify patterns** that would help you to **infer** the type of rock.

Deep

Generalise: how can the hardness of a rock be **related** to its origins?

Recognise that soils are made from rocks and organic matter.

Basic

Observe and **describe** the properties of soils.

Observe and **name** different types of soils.

Find out about and **describe** how soil is formed from rocks and organic matter.

Name the 'parent' materials of different types of soils.

Advancing

Explain how weathering contributes to the formation of soils.

Compare and **contrast** different types of soils.

Categorise soils using a range of different criteria.

Test soils in various ways in order to **identify** them.

Deep

Recommend plants for different soil conditions.

True or false? Alluvial soils are richer in nutrients than most other soils.

See an example on page 187

Investigate the flooding of the River Nile in ancient Egyptian times and **relate** this to your knowledge of soils.

Milestone 2 – Chemistry
To investigate materials

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

Basic

Describe the water cycle.

Observe evaporation.

Observe and **describe** the different rates of evaporation in different temperatures.

Advancing

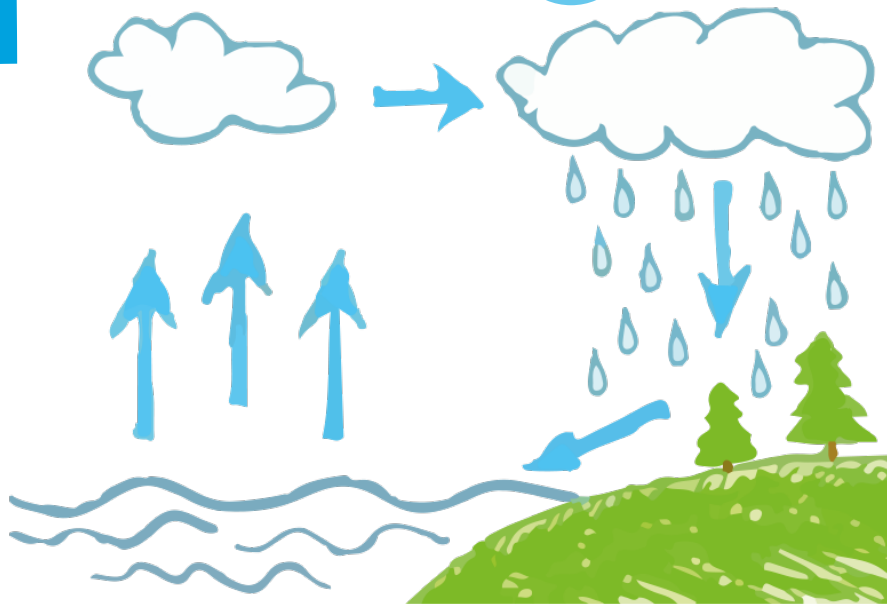
Graph the relationship between temperature and evaporation.

Summarise your results.

Deep

Suggest practical uses for the relationship between temperature and evaporation.

See an example on page 189



Milestone 2 – Physics

To understand movement, forces and magnets

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

Basic

Observe and **illustrate** how objects need a contact force for them to move.

Name the contact forces that move objects.

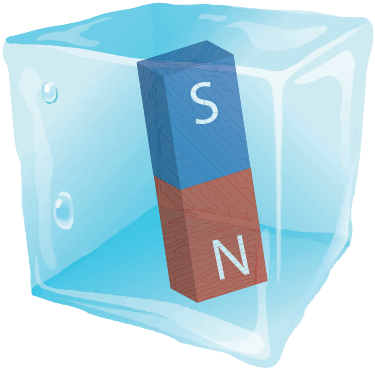
Observe and **illustrate** how magnetic forces act at a distance.

Advancing

Experiment with magnets to explore whether the force of magnetism can act through materials (e.g. by placing magnets in ice). **Identify** any **patterns** in the type and amount of material the force is acting through.

Deep

Investigate practical applications of magnetism in everyday life.



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

Basic

Observe and **describe** how magnets attract or repel each other.

Observe and **describe** that magnets attract some materials and not others. (**name**)

Advancing

Experiment with iron filings to see how they act when magnets attract and repel each other. **Record** your findings and **explain** what is happening.

Deep

Explain the concept of magnetic fields and how magnets attract or repel one another when placed near each other.

See an example on page 191

Prove that there are magnetic fields by making them 'visible'.

Describe magnets as having two poles.

Basic

Label the north and south poles of magnets.

Advancing

Explain why magnets have poles.

Experiment with cutting magnets in two. **Observe** and **explain** what happens.

Deep

Why do we call parts of Earth the North and South Poles? (**explain concept**)

Investigate the Aurora Borealis and explain how this (**the concept**) is linked to magnetism.

Milestone 2 – Physics

To understand movement, forces and magnets

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

Basic

Observe and **describe** the effect of placing like and different poles of a magnet next to each other.

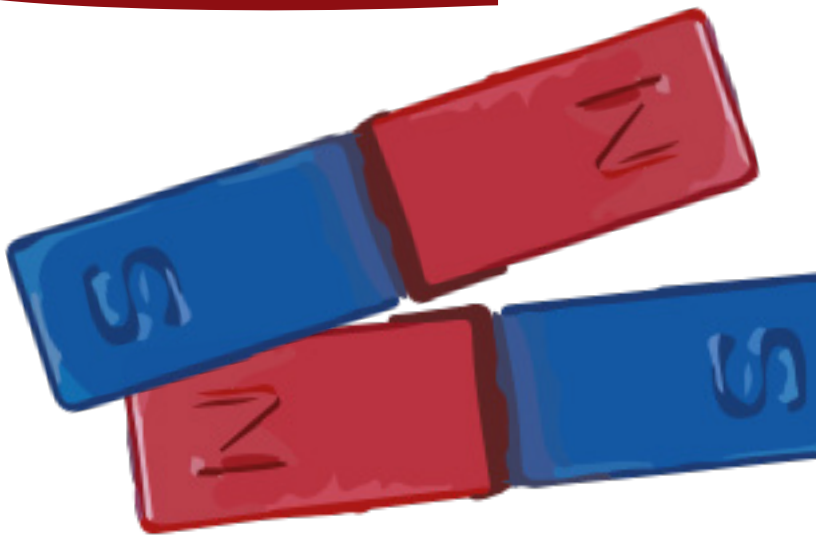
Complete tables that show what you expect to happen when different combinations of poles are facing each other.

Advancing

Apply your knowledge of magnetic poles to create a game that uses the idea that magnets attract or repel each other.

Deep

Is it possible to make a magnet? (**prove** or **disprove**).



Milestone 2 – Physics

To understand light and seeing

Notice that light is reflected from surfaces.

Basic

Observe light reflected from surfaces.

Describe the effect of light reflecting from surfaces.

Label a number of effects of reflection.

Advancing

Experiment with light reflecting from a variety of different surfaces.

Categorise surfaces in terms of their reflective properties.

Deep

Always, sometimes or never? Dark surfaces do not reflect light as well as those that are light.

Find patterns in the way that the size of a shadow changes.

Basic

Observe and **record** the length of shadows at different times of the day.

Observe and **record** how the size of a shadow changes when the source of light is moved closer or further away from the object causing the shadow.

Advancing

Explain why shadows change size.

Predict when shadows will take a particular shape (e.g. the shadow of a tree on a bright summer evening with the Sun in a particular position).

Deep

What is the **relationship** between the height of a light source and the object that is causing the shadow?

See an example on page 193

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

Basic

Listen to and **describe** sounds through a variety of mediums.

Draw a **labelled** diagram that shows how vibrations travel through a medium to the ear.

Advancing

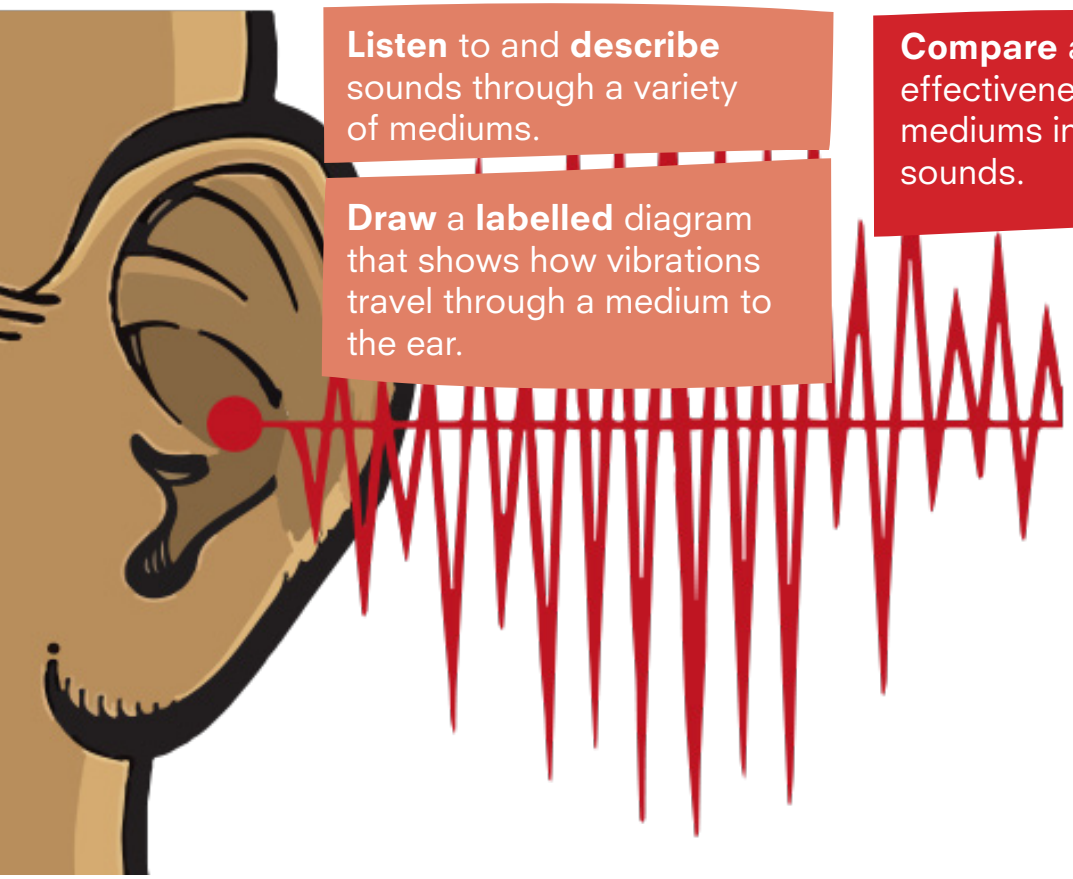
Compare and **contrast** the effectiveness of different mediums in transmitting sounds.

Deep

Suggest reasons why whales and dolphins can communicate over long distances.

See an example on page 195

Air is not a very good medium for transmitting sounds. **Do you agree?**



Milestone 2 - Physics

To understand the Earth's movement in space

Describe the movement of the Moon relative to the Earth.

Basic

Identify the Moon and Earth, and label them on a diagram

Describe the Moon's movement relative to the Earth.

Answer questions about the Moon's movement relative to the Earth.

Observe, **name** and **record** the phases of the Moon.

Advancing

Explain why the Moon's movement affects the tides of oceans and seas on Earth.

Explain how we can predict the times of high and low tides.

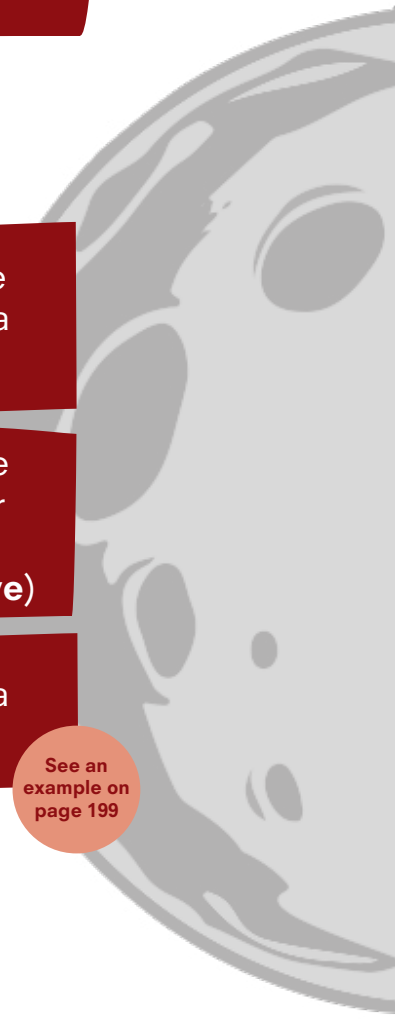
Deep

True or false? The shape of the Moon's phases is a natural calendar.

Is it possible to calculate how long until a particular moon shape will appear again? (**prove** or **disprove**)

Explain the concept of a leap year.

See an example on page 199

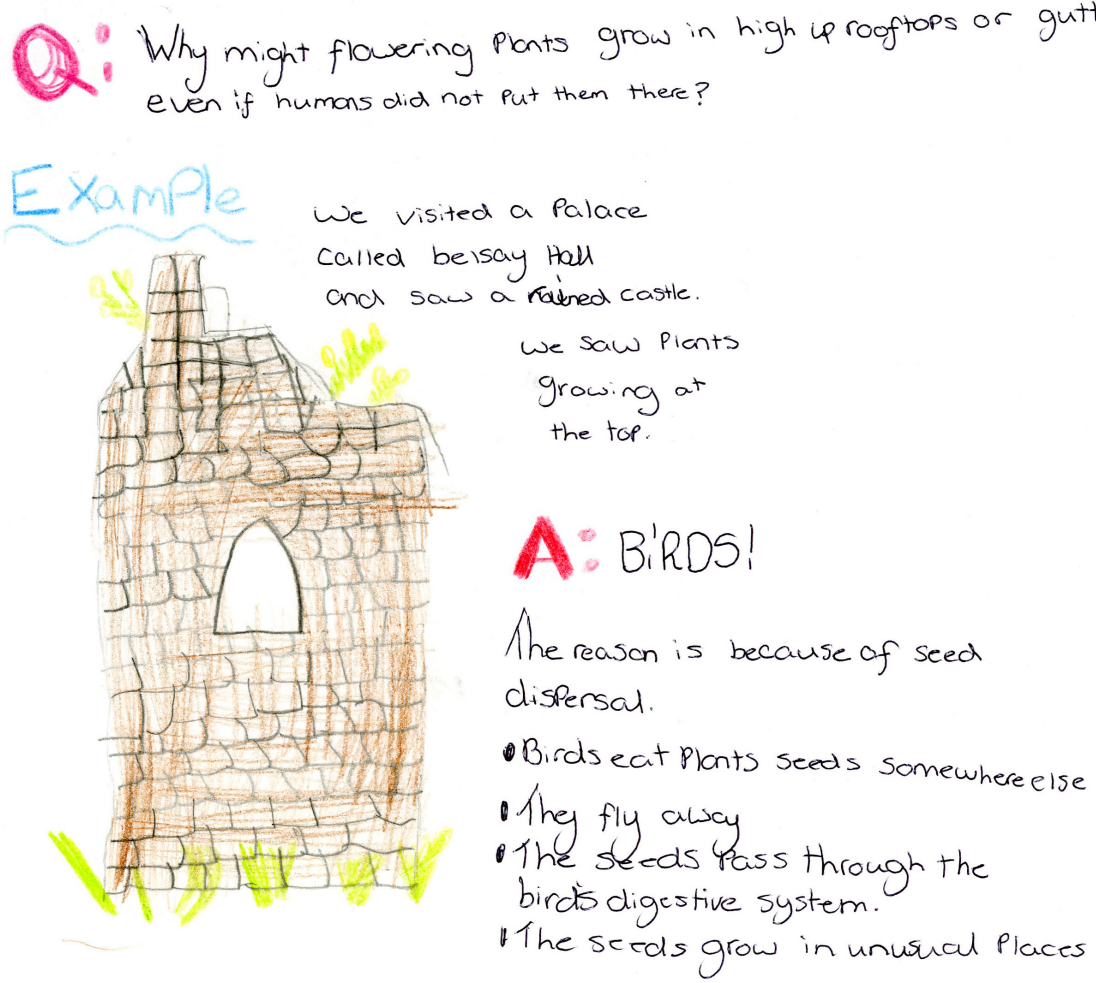


Milestone 2 Deep Activity Examples

Milestone 2 – Biology To understand plants

Explore the role of flowers in the life cycle of flowering plants, including pollination, seed formation and seed dispersal.

Why might flowering plants grow in high up rooftops or gutters even if humans did not put them there?



Milestone 2 – Biology To understand animals and humans

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

If the population of sparrowhawks increase then:

1. There will be fewer song birds because sparrowhawks eat songbirds, such as the nightengale.
2. There will be more insects, snails and slugs in gardens because there won't be enough songbirds to eat them.

3. Garden vegetables and plants might be eaten by the insects causing a problem for gardeners.

Suggest reasons why a growth in sparrow hawks might lead to a reduction in songbirds and too many insects, snails and slugs in gardens.

Milestone 2 – Biology To understand animals and humans

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

Cite evidence of how diet is linked to the health of human teeth.

The science of tooth Decay

Cite evidence of how diet is linked to the health of human teeth.

To do this we used EGG SHELLS because they are similar to teeth. We tested the before and after weight of the eggshells.

1: Sugar

	Sugary water	normal water
Start weight	0.1g	0.1g
End weight	0.25g	0.1g

This shows that sugary water caused decay.

2: Acidy Drinks

	Acid drink (Cola)	water
Start weight	0.1g	0.1g
End weight	0 (gone!)	0.1g

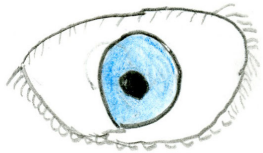
This showed that the acid drink caused complete decay

Milestone 2 – Biology To understand evolution and inheritance

Identify how plants and animals, including humans, resemble their parents in many features.

Investigate how scientists and doctors are researching conditions that are inherited from a parent.

Inheritance



Inside your body are things called genes. They are a set of instructions that tell your body how to grow. They can affect:

- hair colour
- eye colour
- health

Sometimes your genes can give medical conditions, Some examples are:

- Muscular dystrophy – this causes muscles to weaken
- Downs Syndrome – this affects growth and learning
- Cystic fibrosis – this causes the lungs to become clogged

The National Health Service (NHS) is researching 100,000 people with illnesses to see if the cause is genetic. They hope this will help to give the right medicines to give to people with cancer.

Milestone 2 – Chemistry To investigate materials

Recognise that soils are made from rocks and organic matter.

True or false? Alluvial soils are richer in nutrients than most other soils?

True or false ?

Alluvial soils are richer in nutrients than most other soils?

What are alluvial soils?

Alluvial soils are fine, fertile soils formed by water flowing over flood plains or in river beds.

Where do you find alluvial soils?

Alluvial soils are formed in places like the flood plains of the river Nile in Egypt. When the Nile floods, it spreads fertile soil on the ground which was good for planting crops.

Can we prove alluvial soil is better?

Scientists have tested soils and have found that for:

- grasses
- Crops

alluvial soil is good and crops grow well. the problem is that Somtimes Crops are ruined by the river floods at the wrong time.

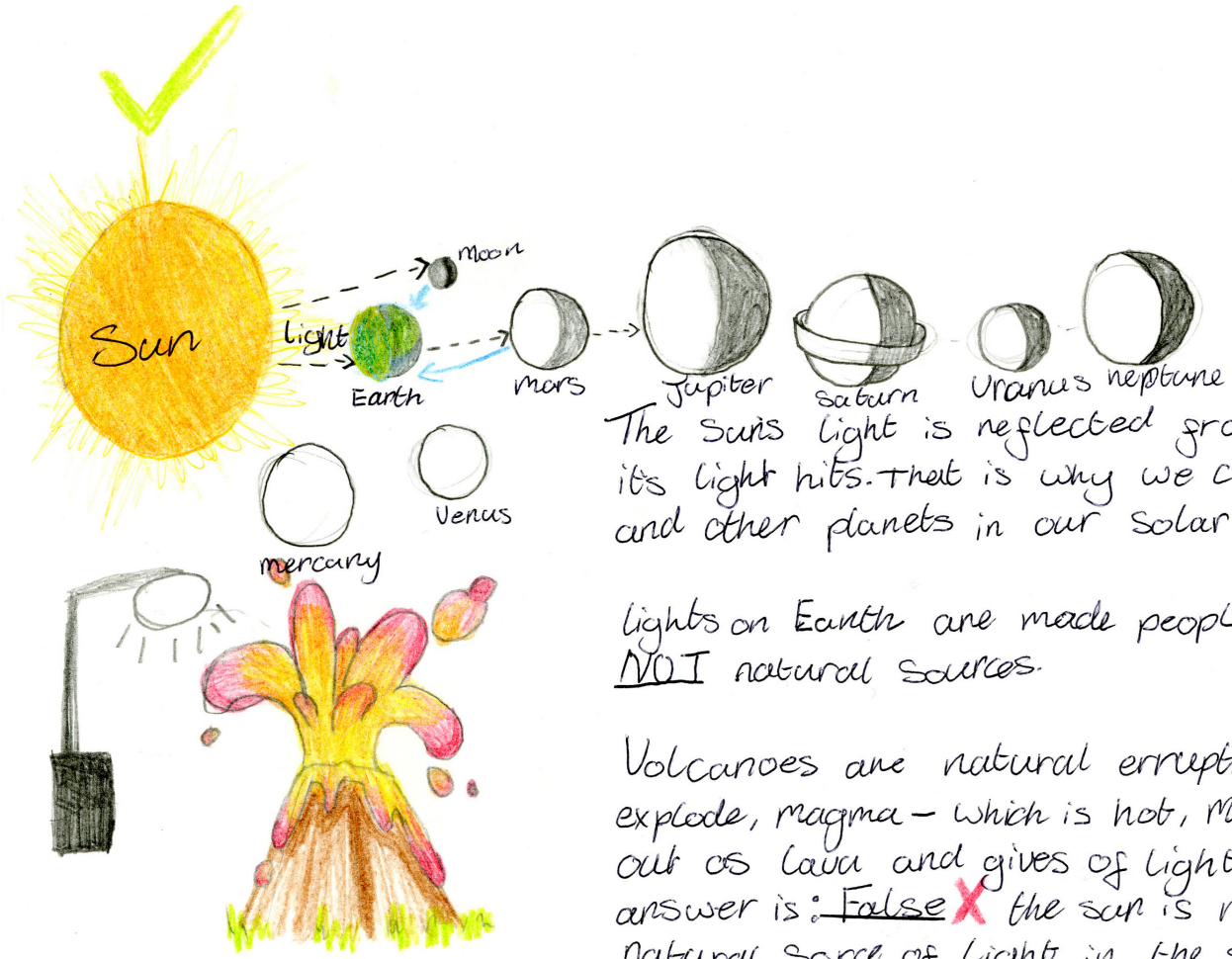
Milestone 2 – Physics To understand light and seeing

Recognise that light is required in order to see things and that dark is the absence of light.

Relate your knowledge of the Earth's rotation in space to your understanding of light and dark.

True or false? The Sun is the only natural source of light in our solar system.

True or False: The sun is the only natural source of light in our Solar System?



The Suns light is reflected from each surface its light hits. That is why we can see the moon and other planets in our solar system.

Lights on Earth are made people and are therefore NOT natural sources.

Volcanoes are natural errruptions and when they explode, magma – which is hot, moulten rock – comes out as lava and gives of light. Therefore, the answer is: False X the sun is not the only natural sorce of light in the solar systm.

Milestone 2 – Physics To understand sound and hearing

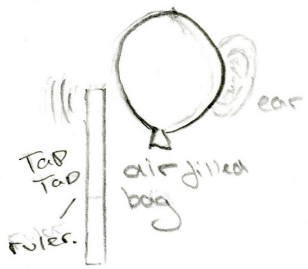
Recognise that vibrations from sounds travel through a medium to the ear.

Air is not a very good medium for transmitting sounds. **Do you agree?**

DO you agree : air is not a very good meduim for transmitting Sounds?

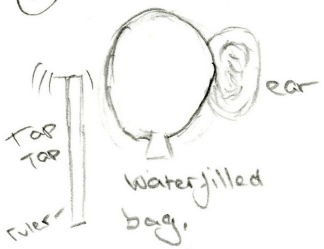
To answer this question I did an experiment to see wich medium gave the loudest Sound.

1



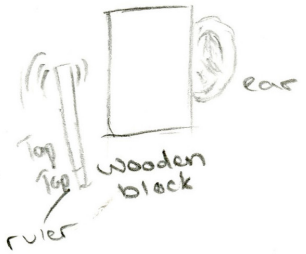
The Sound I heard was quiet

2



The Sound I heard was loud

3



The Sound I heard was very loud

The experiment shows that solids are best at transmitting Sounds followed by liquids and then air. This is because the molecules are closer together in solids and so they transmit Sounds well. Air is a gas and it's molecules are further apart. However, air is good enough to hear eachother talking, Singing or playing music so I do not agree with the Statement.

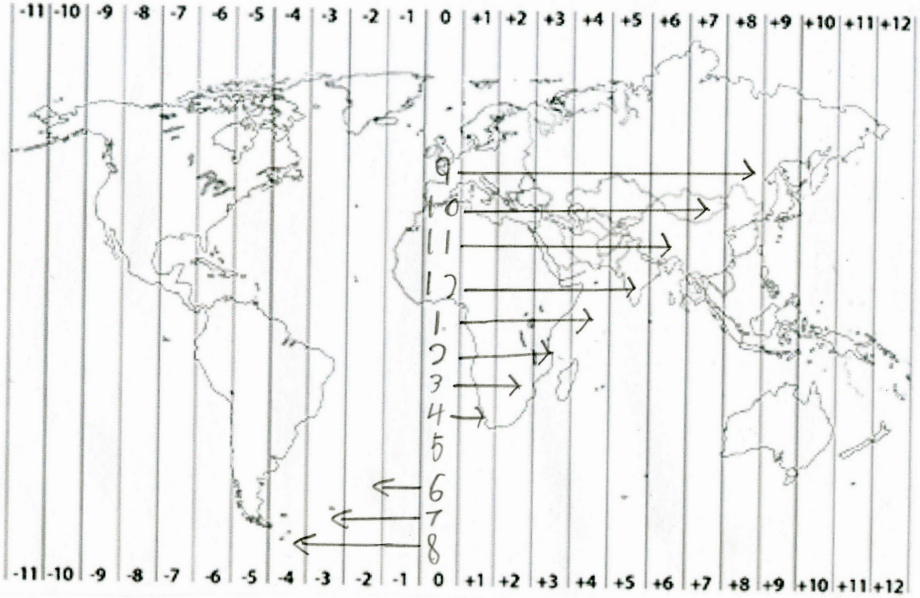
Milestone 2 – Physics To understand the Earth's movement in space

Describe the movement of the Earth relative to the Sun in the solar system.

At any time of day it is always 5 o' clock somewhere on Earth. **Do you agree?**

Do you agree: At any time of day, it is always 5o'clock somewhere?

We have 24 hour time zones because the Earth takes 24 hours to rotate. That means that each hour from Midnight to 11pm will always be happening somewhere in the world.
Here is a Map showing time zones:



This shows that if it is ON A HOUR It will always be 5o'clock somewhere.

However if it is 2 minutes past an hour it will be 5:02 somewhere.

So... It is NOT TRUE that it is always 5 o'clock somewhere

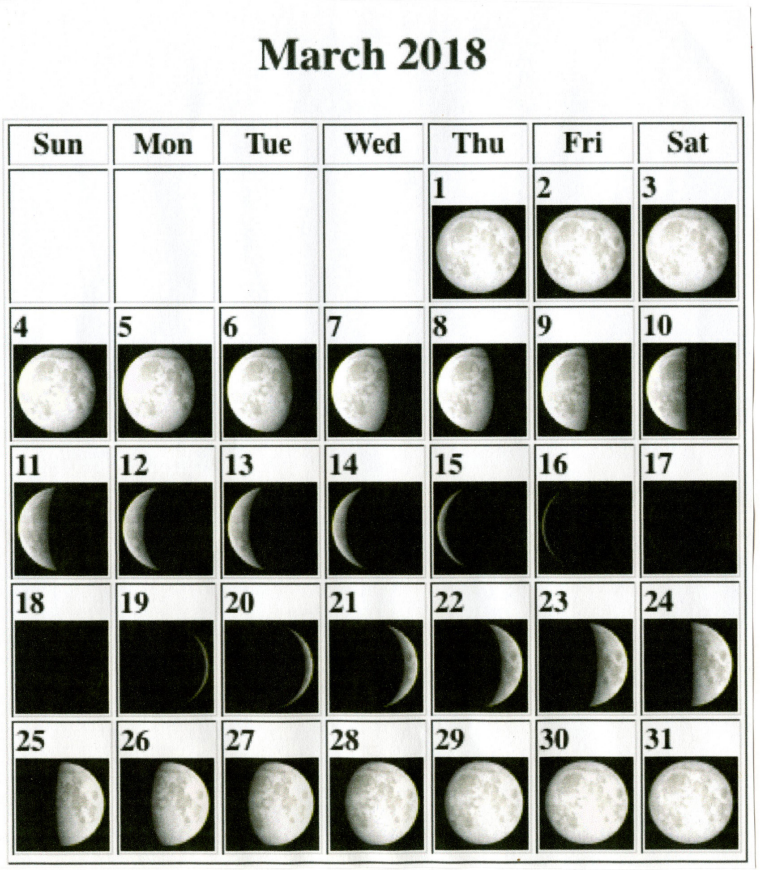
Milestone 2 – Physics To understand the Earth's movement in space

Describe the movement of the Moon relative to the Earth.

True or false? The shape of the Moon's phases is a natural calendar?

Is it possible to calculate how long until a particular Moon shape will appear again? (**prove** or **disprove**)

Is it possible to calculate how long until a particular moon phase will appear again?



March 2018

Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

The chart shows each phase of the Moon for March 2018. It shows that the pattern takes 29 days to repeat.

This can be used to calculate how long it will take until a particular moon phase will appear again.

For example, on the 8th March there is a waning (getting smaller) gibbous moon. It will take 29 days to see this again which would be April 6th.

Yes! It is possible and we know this because we know the moon takes 28 days to orbit the Earth and it takes 29 days to see the full phases of the moon.

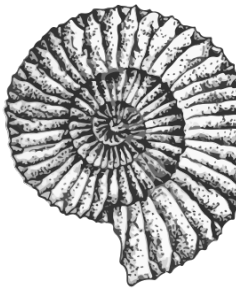
Milestone 3

Milestone 3 – Biology

To understand evolution and inheritance

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

Note: this standard also appears in Milestone 2 and the tasks here are replicated.



Basic

Name a variety of animal and plant fossils.

Describe the conditions in which the fossils once lived.

Note, **name** and **describe** plants and animals that inhabited the Earth millions of years ago.

Advancing

Categorise fossils in a number of ways.

Compare and **contrast** different fossils.

Explain the process of the formation of fossils.

Deep

Investigate the conditions in which life on Earth survived millions of years ago.

Burning fossil fuels is widely thought by scientists to contribute to a rise in worldwide temperature. **Investigate** this and **cite evidence** that supports or questions this view.

See an example on page 251

Milestone 3 – Biology

To understand evolution and inheritance

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

Basic

Observe and **describe** differences between living things and their offspring.

Observe and **name** offspring that are not identical to their parents and **describe** how they vary.

Advancing

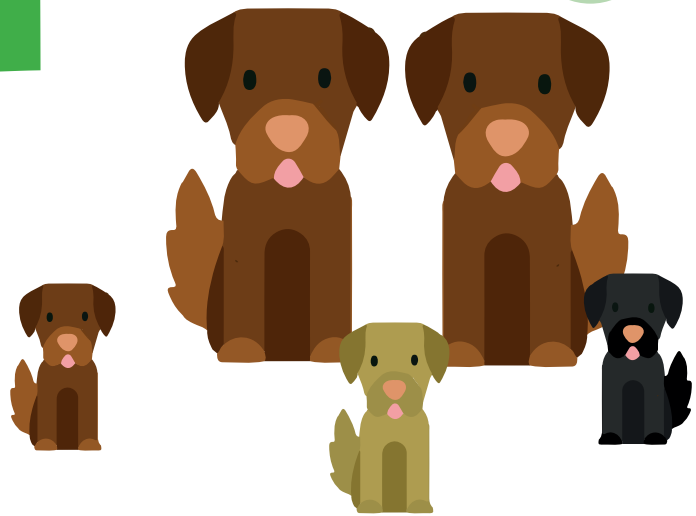
Categorise differences in living things and their offspring.

Explain, with examples, how offspring are not identical.

Deep

Is it possible that a litter of cocker spaniel puppies from two parents of the same colour may vary in colour?

See an example on page 252



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

Basic

Match a range of animals and plants to the environments in which they are found.

Describe how animals and plants are suited to the environments in which they are found.

Illustrate how animals and plants adapt to environments in different ways.

Describe the theory of evolution.

Advancing

Explain and give examples of the idea of adaptation.

Compare and **contrast** different types of adaptation.

Explain why adaptation may lead to evolution.

Deep

True or false? Plants and animals would not survive if they could not adapt.

Which do you think are the best examples of an animal and a plant that shows adaptation? (**suggest**)

See an example on page 253

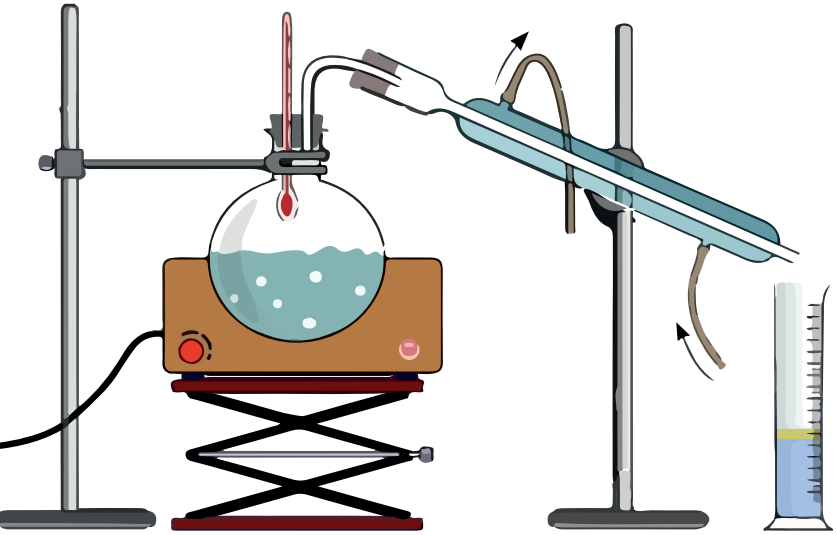
Evolution is the only way a species can survive. **Do you agree?**

Milestone 3 – Chemistry
To investigate materials

Use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating.

Basic

Observe and **describe** how items may be separated through filtering, sieving and evaporation.



Advancing

Experiment with ways to separate pebbles and silt in a solution of salt.

Explain your methods and **summarise** your results.

Deep

Is there a way to recover water after recovering a substance from a solution after evaporation? (**propose**) **Prove it**.

Give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic.

Basic

Observe and **describe** materials on the basis of their hardness and conductivity.

Label materials, including insulators and conductors using a range of scientific vocabulary.

Carry out comparative tests to assess the suitability of everyday materials for a purpose (follow instructions).

Carry out fair tests to assess the suitability of everyday materials for a purpose (follow instructions).

Advancing

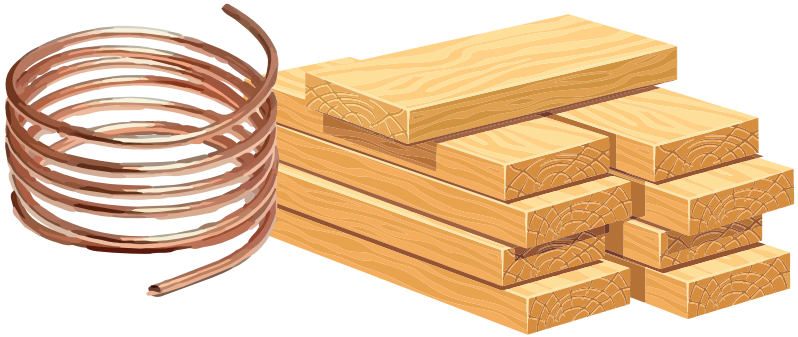
Apply your understanding of the properties of materials to **explain** why a range of everyday items have been made from a particular material.

Deep

What might happen if a bird sits on a live, uninsulated power line? (propose)

Explain the concepts you are using to give your answer.

See an example on page 256



Explain that some changes result in the formation of new materials, and that this kind of change is not usually reversible. This including changes associated with burning, oxidisation and the action of acid on bicarbonate of soda.

Basic

Observe and **describe** how burning a material creates a new material and is not reversible.

Observe and **describe** how oxidisation of (e.g. of steel) creates a new material and is not reversible.

Observe and **describe** how adding an acid (e.g. to bicarbonate of soda) creates a new material and is not reversible.

Advancing

Categorise changes as reversible or not reversible, and **give examples**.

Experiment with making plaster of Paris moulds. Observe, record and **explain** what happens to the material as water is added to the powder. **Summarise** your findings.

Deep

True or false? Changes in temperature cause only reversible and not irreversible changes. **Cite evidence.**

See an example on page 257

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

Note: this standard also appears in Milestone 2 and the tasks here are replicated.

Basic

Observe and **describe** the effect of placing like and different poles of a magnet next to each other.

Complete tables that show what you expect to happen when different combinations of poles are facing each other.

Advancing

Apply your knowledge of magnetic poles to create a game that uses the idea that magnets attract or repel each other.

Deep

Is it possible to make a magnet? (**prove** or **disprove**)

Milestone 3 – Physics

To understand movement, forces and magnets

Explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object.

Basic

Observe and **describe** the effect of the force of gravity.

Advancing

Interpret data about the rate that different materials fall towards Earth. Summarise you findings.

Deep

Which will reach Earth first if dropped from the same height: 1kg of feathers or 1kg of steel? (**explain concepts**)

Milestone 3 – Physics

To understand movement, forces and magnets

Describe, in terms of drag forces, why moving objects that are not driven tend to slow down.

Basic

Observe and **describe** how objects tend to slow down because of drag forces.

Advancing

Apply your knowledge of drag forces to some positive applications.

Deep

Always, sometimes or never? The slowing effect of drag forces can be overcome if an object is driven.* (**explain concept, make generalisations**)

See an example on page 259

*Emphasise continuous variables where the comparative degrees end in **er**.

Describe the Sun, Earth and Moon as approximately spherical bodies.

Basic

Observe pictures and videos of the Sun, Earth and Moon and **describe** them using mathematical vocabulary.

Advancing

Explain, using your knowledge of gravity, why the Sun, Earth and Moon are almost spherical.

Deep

Investigate reasons why planets and moons are not completely spherical. Explore terms such as 'equatorial bulge' and suggest an experiment that would **prove** this phenomenon.

See an example on page 270

Milestone 3 – Physics

To understand the Earth's movement in space

Use the idea of the Earth's rotation to explain day and night and the apparent movement of the Sun across the sky.

Basic

Draw, **label** and **describe** how the Earth's rotation gives rise to day and night.

Advancing

Explain and **demonstrate** how and why a sundial, used to tell the time, works.

Deep

At night, sundials do not work. **Suggest** or **investigate** other ways you could tell the approximate time using views of the night sky.

See an example on page 271

Milestone 3 Deep Activity Examples

Milestone 3 – Biology To understand plants

Relate knowledge of plants to studies of all living things.

Why do the leaves of deciduous trees change colour and fall off in autumn? (**generalise**) How does this **relate** to any life processes of animals?

Why do the leaves of deciduous trees fall off in Autumn?

The etymology of the word deciduous comes from the Latin word deciduus, which means 'that which falls off'.

Latin is useful in understanding why deciduous trees lose their leaves in the Autumn: a process called abscission takes place. Abscission shares the latin root of the word scissors - scindere - which means 'to cut'.

Abscission is a deciduous tree's survival strategy: in the winter leaves would become damaged by cold weather and so the tree protects itself. First, chlorophyl is broken down to provide the tree with nutrients. These nutrients are absorbed into the tree. As a result of this, leaves lose their green colour and turn bright colours such as red, orange and gold depending on which type of tree it is. Second, the leaves fall off the tree.

Some Scientists think that pollination in the spring is helped by the lack of leaves on a tree: because there are no leaves, the tree's pollen can be blown further. ~~or~~

Abscission is similar to hibernation in animals such as hedgehogs, bats and doormice. Although the process is different, the reasons for it are similar: Survival.

In conclusion, the reason why deciduous trees lose their leaves in winter is a survival strategy.

Milestone 3 - Biology To investigate living things

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

Always, Sometimes or never: eggs are common to the life cycles of mammals, amphibians, insects and birds?

To answer this question it is first necessary to tell you about the life cycles of mammals, amphibians, insects and birds.

Mammals: Female mammals have eggs inside their ovaries. If they are fertilised by a male they grow inside the womb until birth. Then the young grow into adults and can then also reproduce. So, mammals do have eggs.

Reptiles: Female reptiles form eggs which are then fertilised by males but, unlike mammals, they lay the eggs. They hatch and grow into adults and reproduce. So, reptiles do have eggs.

Amphibians: All amphibians start as an egg laid in jelly in water. They then go through a metamorphosis that transforms them from a juvenile into an adult. So, amphibians do have eggs.

Insects: Insects have four life stages: egg, larva, pupa and adult. The female eggs are fertilised by the male and then laid and they turn into larvae. So, insects do have eggs.

Birds: Birds have seven stages: egg, hatchling, nestling, fledgeling, juvenile, sub-adult, adult. So, birds do have eggs.

In conclusion, it is Always true that eggs are common to the life cycles of mammals, reptiles, amphibians, insects and birds.

True or false? All young offspring look like smaller versions of their adult parents.

Always, sometimes or never? Eggs are common to the life cycles of mammals, amphibians, insects and birds.

Milestone 3 – Biology To investigate living things

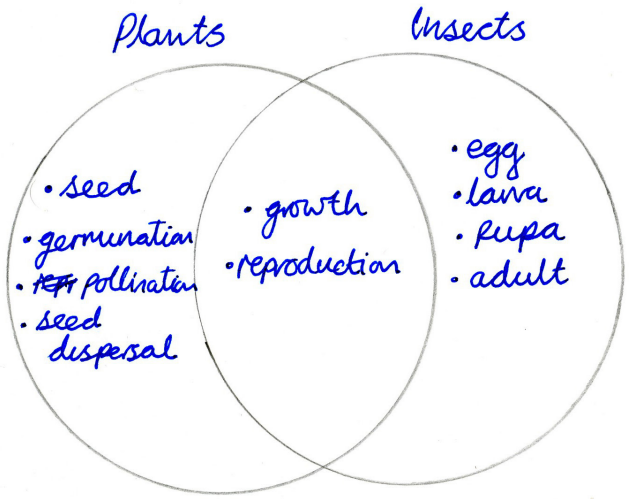
Describe the life process of reproduction in some plants and animals.

Relate the reproduction of plants to your knowledge of the life cycle of insects.

Relate the reproduction of some animals and plants to your knowledge of food chains.

Relate the production of plants to your knowledge of the life cycle of insects.

To best answer this question I have decided to use a Venn diagram, which will show the similarities and differences between the life cycles of flowering plants and insects.



As you can see in the Venn diagram, the similarities are growth and reproduction. One major difference between plants and insects is that some insects go through a complete metamorphosis. This means they change from one thing into another. For example, at the larva stage the insect may be a caterpillar, but after it has been a pupa it becomes a butterfly. That means that, although an insect grows, it actually transforms whereas plants get gradually bigger.

Milestone 3 – Biology To understand evolution and inheritance

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

True or false? Plants and animals would not survive if they could not adapt.

True or False ? plants and animals would not survive if they could not adapt ?

What is adaptation ?

Adaptation is a change in an animal or plant that improves its chances of survival or reproduction.

Types of adaptation.

1. Changes in behavior
2. Processes in its body
3. Features.

Examples

Penguins huddle together to keep warm. This is a change in behavior. They can go without food for a long time. This is a body process. Its body of black and white is a feature that protects it from predators.

I think the answer is: true - plants and animals would not survive if they could not adapt.

For example, if the penguin could not go a long time without food it would starve and if lots died, the species would die out.

Sometimes birds migrate, which is a behavior change. When the weather turns cold they fly to warmer areas. This helps them to survive.

Milestone 3 – Chemistry To investigate materials

Compare and group together everyday materials based on evidence from comparative and fair tests, including their hardness, solubility, conductivity (electrical and thermal), and response to magnets.

Devise an experiment that **proves** or **disproves** a **hypothesis** you have created about the properties of materials.

Devise an experiment that proves or disproves a hypothesis you have created about the properties of materials.

My hypothesis is: plasticine can float.

The reason for this hypothesis is that, in year 3, I remember doing an experiment to see which materials floated and which sank. I now have thought about materials and asked: "Why does a heavy ship float in water?" I thought that if a ship could float so could plasticine.

My theory is: That it is the shape of the plasticine, not how heavy it is that will make it sink or float.

My experiment is:

Experiment 1: Roll the plasticine into a ball and record whether it floats or sinks.

Experiment 2: Shape the plasticine into a boat shape and see if it floats or sinks.

To be fair: I will need to keep two things the same: the water I use and the piece of plasticine.

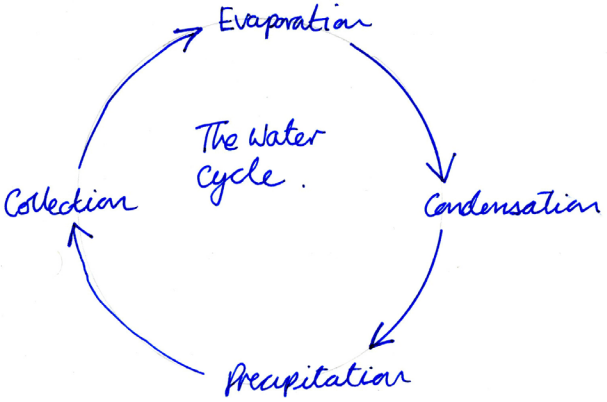
I think this will prove that plasticine can float.

Milestone 3 - Chemistry To investigate materials

Understand how some materials will dissolve in liquid to form a solution and describe how to recover a substance from a solution.

Relate, **citing evidence**, your understanding of solutions to your understanding of the water cycle.

Relate, citing evidence, your understanding of solutions to your understanding of the water cycle.



There are 4 main stages of the water cycle:

- Evaporation is when heat from the sun changes the state of the water from a liquid to a gas called water vapour.
- Condensation is the process where water vapour is cooled and forms a condensate – water. The state changes from a gas into a liquid.
- Precipitation is the process of water falling back to Earth, as rain, hail or snow.
- Collection is the process where gravity makes water flow and collect in low lying areas.

A Solution is a liquid mixture where the solute has dissolved. For example, sugar is a solute. To recover a solute, heat the solution to cause evaporation and eventually all that will be left is the sugar.

Milestone 3 – Physics To understand movement, forces and magnets

Understand that some mechanisms, including levers, pulleys and gears, allow a smaller force to have a greater effect.

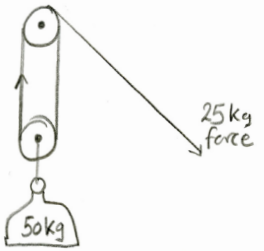
Using a pulley allows a small force to have a greater effect but increases the amount of pulls one has to make. Make **generalisations** about the **relationship** between forces and effect.*

*Emphasise continuous variables where the comparative degrees end in **er**.

Using a pulley allows a small force to have a greater effect but increases the amount of pulls one has to make.
Make generalisations about the relationship between forces and effect.

A pulley is a wheel or wheels that you put a rope through to make it easier to lift things. They help to multiply forces so that if you want to lift something really heavy you can.

How pulleys multiply forces:



two wheels 'share' the 50kg load so that only 25kg of force (or 250 newtons) is needed to lift 50kg.

Generalisations

- The greater the number of wheels in a pulley, the lower the force needed to lift it.
- The easier a heavy object is to lift, the greater the number of pulls on the rope it will take to lift it.

Milestone 3 – Physics To understand light and seeing

Understand that light appears to travel in straight lines.

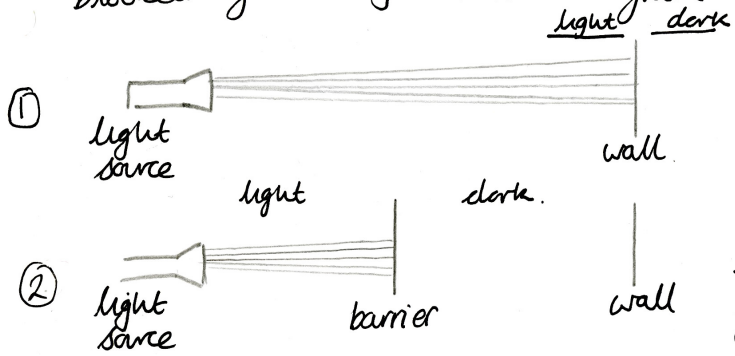
Does blocking light prove that it travels? (**reason, investigate**)

Does blocking light prove that it travels?

To answer this question there are two things to keep in mind:
1. light does travel.
2. it travels in straight lines.

1. How can we prove that light travels?

Light comes from a source and must travel from the source until it is blocked by an object. The diagram below shows this.



Behind the wall is dark because the wall has blocked the light.

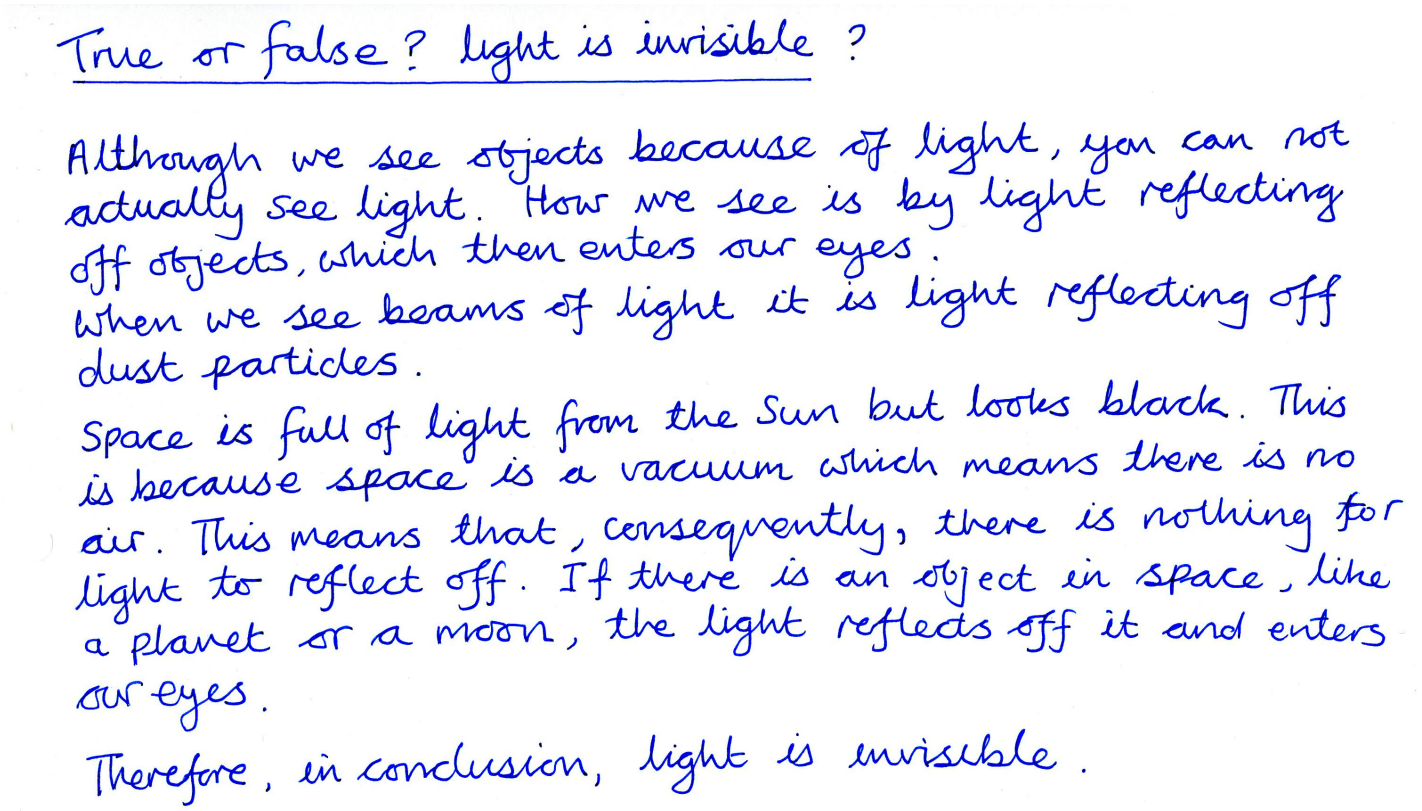
After the barrier is dark because the barrier has blocked the light. This proves light must travel because earlier, the light reached the wall.

Because light travels in straight lines the light can not travel around the barrier.

Milestone 3 – Physics To understand light and seeing

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

True or false? Light is invisible.



True or false? light is invisible ?

Although we see objects because of light, you can not actually see light. How we see is by light reflecting off objects, which then enters our eyes.
When we see beams of light it is light reflecting off dust particles.
Space is full of light from the Sun but looks black. This is because space is a vacuum which means there is no air. This means that, consequently, there is nothing for light to reflect off. If there is an object in space, like a planet or a moon, the light reflects off it and enters our eyes.
Therefore, in conclusion, light is invisible.

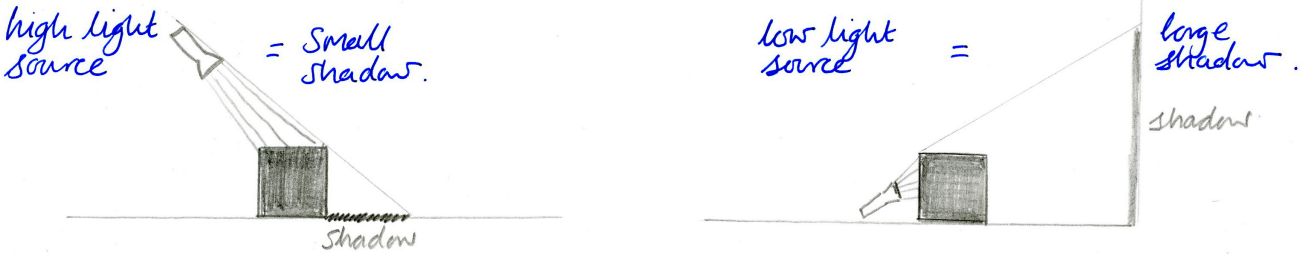
Milestone 3 – Physics To understand light and seeing

Use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them, and to predict the size of shadows when the position of the light source changes.

Is it possible that a shadow can be formed that is smaller than the object that created it? (**reason**)

Is it possible that a shadow can be formed that is smaller than the object that created it?

The diagram below shows that it is possible to have a small shadow from a large object and that it is also possible that a small object can form a large shadow.



The higher the light source, the smaller the shadow.
The lower the light source, the lager the shadow.

In conclusion, if a light source was very high the shadow to the side of the object could be smaller but the surface underneath the object will always be in shadow - so for that reason - the shadow couldn't be smaller than the object.

Milestone 3 – Physics To understand light and seeing

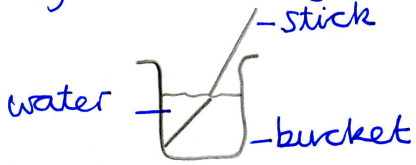
Explain that we see things because light travels from light sources to our eyes or from light sources to objects and then to our eyes.

Investigate and **present information** on how objects, such as a stick, appear to bend when placed in water.*

*This is called refraction.

Investigate and present information on how objects, such as a stick, appear to bend when placed in water.

I first investigated light in water. This is what I observed:



The stick looked like it had bent in the water.

I then researched why this happens. It is called refraction. The stick did not bend, the light did. That is because light travels at a slower speed than through air.

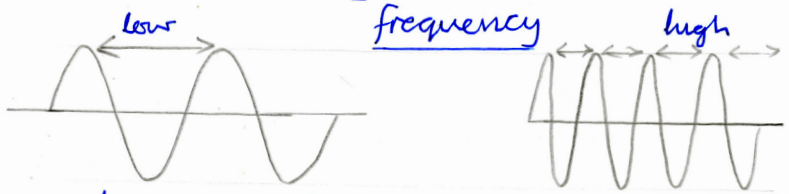
Milestone 3 – Physics To investigate sound and hearing

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

Relate your understanding of pitch to musical instruments.

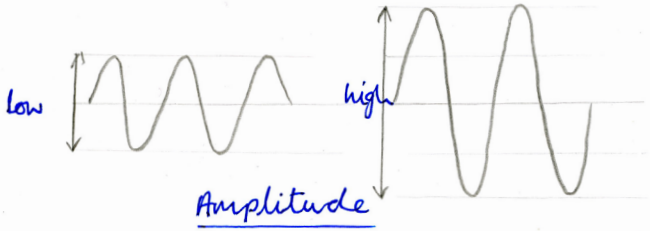
Relate your understanding of pitch to musical instruments.

Pitch is the description of a sound: low or high.
The thing that effects pitch is the frequency of a sound as shown in the diagram below.



lower pitch higher pitch

The diagram showing lower pitch has a lower frequency, which means it vibrates more slowly than the diagram with a higher pitch. Frequency is measured in Hertz. The faster the guitar string, for example, vibrates, the higher the pitch. On a guitar this can be done by either tightening or shortening the strings. On a brass instrument it is the air vibrating in the tubes of the instrument. To lower the pitch, shorten the tube using valves.



Amplitude is the volume of a sound. A note of the same pitch can be low or high. On a guitar, the harder you strum, the greater the amplitude. On brass instruments, the harder you blow, the greater the amplitude.

Milestone 3 – Physics To investigate sound and hearing

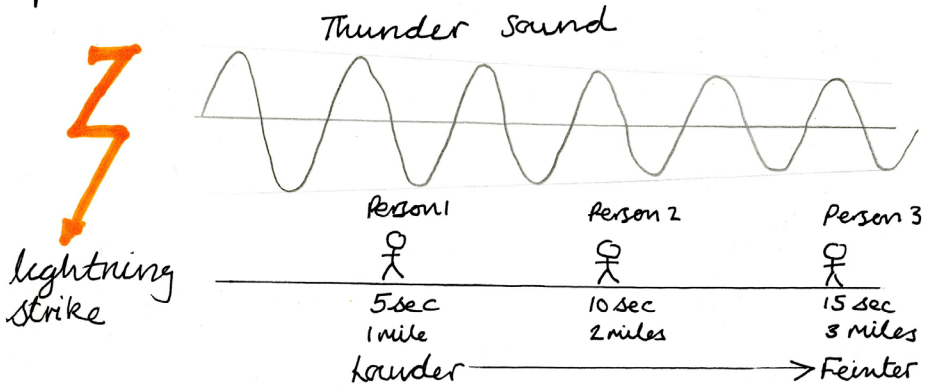
Recognise that sounds get fainter as the distance from the sound source increases.

Why might a thunderclap sound loud to some and faint to others? (**suggest, reason**)

Why might a thunderclap sound loud to some and faint to others?

Thunder and lightning both happen at exactly the same time but light travels much faster than sound. That is why you see lightning before you hear the thunder. However, if you are very close to where the lightning struck, then you will hear the thunder almost immediately because it has not had to travel very far.

Sound travels at about 1 mile every 5 seconds so that explains why people might hear it at different times. As sound travels, the further it goes the more it loses its amplitude. This means that its volume decreases.



Milestone 3 – Physics To understand electrical circuits

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

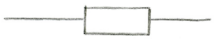
Investigate the concept of resistance and **prove** or **disprove** that components, including wire, are resistors.

Investigate the concept of resistance and prove or disprove that components, including wires, are resistors.

Resistance is the difficulty electricity has passing through an electrical component such as a bulb. Sometimes the voltage of a cell is too high and special components, called resistors, are used to reduce the amount of electricity.

The symbols for a resistor are:

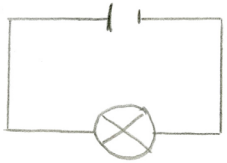
a) 

b) 

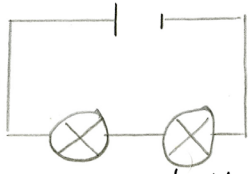
You can use either symbol.

Electricity will always have some resistance even though that might be quite small.

To prove this I will show you what happens when you put two bulbs together in a series circuit:

a) 

bright bulb

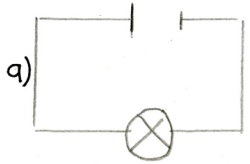
b) 

Dimmer bulbs

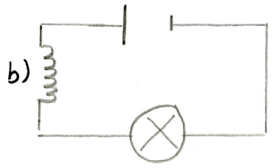
The bulbs act as resistors.

Is wire a resistor? Yes!

To prove this I will show you how passing electricity through a coil of wire effects a bulb's brightness.

a) 

no coil – bright bulb.

b) 

Coil – dim bulb.