**Scheme of work – Science Stage 6**

Cambridge Primary

**Introduction**

This document is a scheme of work created by Cambridge International as a suggested plan of delivery for Cambridge Primary Science Stage 6.

Learning objectives for the stage have been grouped into topic areas or ‘units’. These have then been arranged in a recommended teaching order but you are free to teach objectives in any order within a stage as your local requirements and resources dictate. The scheme for Science has assumed a term length of 10 weeks, with three terms per stage and two units per term. An overview of the sequence, number and title of each unit for Stage 6 can be seen in the table below. The suggested percentage of teaching time to spend on each unit is provided at the beginning of each unit. You should decide on the amount of teaching time as necessary, to suit the pace of your learners and to fit the work comfortably into your own term times.

Where possible, several suggested activities have been given for each learning objective; some are short introductory or revision activities and others are more substantial learning activities. You need to choose a variety of activities that will meet the needs of your learners and cover all of the requirements of the learning objectives. Scientific Enquiry learning objectives can be taught in the context of any of the learning objectives from the other strands. Sample activities that particularly focus on scientific enquiry have been included in each unit where relevant. It is recommended that you include a wide variety of scientific enquiry in your science teaching.

There is no obligation to follow the published Cambridge International scheme of work in order to deliver Cambridge Primary Science. It has been created solely to provide an illustration of how delivery might be planned over the six stages. A step-by-step guide to creating your own scheme of work and implementing Cambridge Primary in your school can be found in the Cambridge Primary Teacher Guide available on the Cambridge Primary support site. Blank templates are also available on the Cambridge Primary support site for you to use if you wish.

|  |  |  |
| --- | --- | --- |
| Term 1 | Term 2 | Term 3 |
| Unit 6.1 Human organs and systems | Unit 6.3 Food chains  | Unit 6.5 Caring for the environment  |
| Unit 6.2 Reversible and irreversible changes | Unit 6.4 Conductors and insulators  | Unit 6.6 Mass and weight |

**Unit 6.1 Human organs and systems**

It is recommended that this unit takes approximately **50% of the term**.

In this unit, learners:

* identify the organs and functions of the human respiratory, digestive, excretory, nervous and circulatory systems
* find out about diseases associated with each system.

Scientific Enquiry work focuses on:

* making a variety of relevant observations and measurements using simple apparatus correctly
* making comparisons
* suggesting and evaluating explanations using scientific knowledge and understanding and communicating this clearly to others.

Recommended vocabulary for this unit:

* body, organ, major organs, system, structure, function
* respiratory, digestive, excretory, nervous and circulatory systems
* respiration, breathing, digestion, excretion, circulation
* heart, brain, liver, stomach, intestines, kidneys, lungs
* heart rate, pulse
* disease, symptom, treatment, cure.

| Framework code | Learning objective | Suggested activities to choose from | Resources  | Comments  |
| --- | --- | --- | --- | --- |
| 6Bh26Bh1 | Identify the position of major organs in the bodyUse scientific names for some major organs of body systems | Remind learners of Stage 4 work on the skeleton. In pairs, learners discuss: *What else, other than bones, is inside your body?*Learners go outside and use chalk to draw on the ground around their partner. Together, they draw what is inside the outline where they think it is (not the skeleton). They label the parts they know and, if possible, they photograph their work.Alternatively, learners can draw around each other on a large piece of paper.Learners look at all of the class drawings and discuss them with their partner; they identify any differences with their own.Dress up a willing volunteer in a boiler suit and attach three-dimensional, fabric organs inside the suit. Pretend to be a doctor and remove the organs; discuss what they are called and what they do.In the classroom, compile a class list of the major organs. Place organs on an outline of the body and discuss their functions briefly. This class outline can be displayed and added to throughout the unit.Learners draw, and label, major organs in a body outline in their books. Key organs to include are:* respiratory system: lungs
* digestive system: stomach, intestines
* excretory system: kidneys, bladder
* nervous system: brain
* circulatory system: heart.
 | Chalk and tarmac (or concrete) area.Camera.Large piece of paper.Boiler suit with removable, three-dimensional, fabric ‘organs’. Use hook and loop fastener (or a similar tape) so the organs can be attached and removed again.Body outline and images of organs. |  |
| 6Bh36Bh1Eo1Eo4Eo8 | Describe the main functions of the major organs of the bodyUse scientific names for some major organs of body systemsMake a variety of relevant observations and measurements using simple apparatus correctlyMake comparisonsSuggest and evaluate explanations for predictions using scientific knowledge and understanding and communicate these clearly to others | Complete a table depicting the main functions of the organs introduced in the previous lesson. For example:

|  |  |
| --- | --- |
| Organ | Main function |
| lungs | Take oxygen into the body and remove waste (carbon dioxide) |
| stomach | Break food down with acid |
| intestines | Pass nutrients from food into the blood |
| kidneys | Filter blood to remove waste |
| bladder | Store urine |
| brain | Control body |
| heart | Pump blood around body |

Discuss each organ using models and/or secondary sources; read on for examples for the different organs.For example, the structure and function of the digestive system can be modelled using a jam sandwich and malt vinegar: * Use scissors to model the cutting action of the incisors and a potato masher to model the grinding action of the molars.
* Put the food into a plastic bag to model the stomach and add vinegar to represent the acid.
* Place the ‘stomach contents’ into a section of tights. Squeeze to show the absorption of nutrients.
* Absorb excess water by wrapping the tights in a tea towel to represent the function of the large intestine.
* Cut one end of the tights to become the ‘anus’ and squeeze out the faeces.

*What do you notice?**What happens to the excess water and any waste products absorbed into the blood stream?* *What are the functions of the teeth, stomach, small intestine, large intestine and anus? Why are these functions essential?***Scientific Enquiry activity**Simple approaches to investigating the respiratory system include:* Learners take several deep breaths with one hand on their breastbone and another on the soft part below the ribs. *What do you feel? Why do we need to breathe? What do we breathe in? What do we breathe out?*
* Use balloons to show how much each learner can blow out in one breath. Compare with others.
* Collect data on how long the learners in the class can hold their breath for. Learners could calculate the mean time.

**Scientific Enquiry activity**Simple approaches to investigating the circulatory system include:* Learners listen to someone else’s heartbeat through a stethoscope and count the beats for one minute.
* Show learners how to feel their pulse at their wrist or neck. Then learners count the number of beats per minute at rest. They run or do star jumps for a minute and count again. *Why is it faster? What is the connection between the heart and the pulse?*

Learners summarise learning by annotating body outlines with the names and functions of the organs they have studied. | Instructions can be found in the video available at:[https://www.youtube.com/watch?v=aemI64NAK08](https://www.youtube.com/watch?v=aemI608)or<https://www.tes.co.uk/teaching-resource/Making-Poo-The-Digestive-System-6211136/> Jam, bread, malt vinegar, water, tights, bowls, scissors, forks/potato masher, plastic bag, tea-towel, funnel, tray.Balloons.Timers.Stethoscopes (if available).Alternatively, learners can make a simple stethoscope with a cardboard tube and a funnel. Instructions can be found at:<https://www.scientificamerican.com/article/bring-science-home-stethoscope/> Timer.Templates. | Understanding enzyme activity is not required at Stage 6.Sensitivity and care may be required if any of the learners have respiratory problems (e.g. asthma).This activity provides a cross-curricular link to mathematics.Health and safety:Warn learners not to make a loud nose into a stethoscope. |
| 6Bh4 | Explain how the functions of the major organs are essential | Discuss what happens if any of the organs studied don’t function efficiently.*Are there any treatments or cures to alleviate the symptoms and/or the diseases?*Groups of learners research one organ of the body; they find out some interesting facts to present to the class and prepare themselves to answer any questions relating to their research.Learners can be given a choice of methods to present their research, e.g. spoken talk, computer presentation, video, poster, drawing, drama, short role-play, (e.g. interviewing a doctor or nurse), 3D models, demonstration, poem, song.Once learners have had time to prepare, each group makes a short presentation and answers questions; members of the class can only ask questions which relate to the presentation.  | Internet access, if availablebooks, leaflets.CD Roms. | Sensitivity and care may be required if any learners have problems with one of the organs discussed.A linked activity would be to arrange a visit by someone a health practitioner.These presentations will help the teacher identify the learning within this topic. |

**Unit 6.2 Reversible and irreversible changes**

It is recommended that this unit takes approximately **50% of the term**.

In this unit, learners:

* classify changes as reversible or irreversible
* learn about dissolving and making solutions
* separate different mixtures by filtration and/or evaporation.

## Scientific Enquiry work focuses on:

* choosing which equipment to use
* making a variety of relevant observations and measurements using simple apparatus correctly.

## Recommended vocabulary for this unit:

* solid, liquid, gas, change of state
* reversible, irreversible
* separate, mixture, dissolve, solution, soluble, insoluble, filter, filtration
* evaporation, condensation, melt.

| Framework code | Learning objective | Suggested activities to choose from | Resources  | Comments  |
| --- | --- | --- | --- | --- |
| 6Cc1 | Distinguish between reversible and irreversible changes | Remind learners of previous work on changing materials, evaporation, dissolving and changes of state.Discuss the terms ‘reversible’ and ‘irreversible’: *What do they mean? How does the meaning apply to ‘change’ in science?* Demonstrate an example of a reversible change by melting ice. *Can I turn the liquid back into a solid?*Demonstrate an example of irreversible change by burning a candle, match or piece of paper. *Can I get back to the original object?*Examples of reversible changes are:* a puddle of water evaporating
* water vapour condensing onto a window
* a bar of chocolate melting
* water freezing on a cold day.

Examples of irreversible change are:* a candle burning
* a bonfire
* toast burning in a toaster
* an egg frying in a pan.

Illustrate these examples (or others) with line drawings and pictures. Ask learners to annotate each drawing with a description of what is happening; they should decide whether the process is reversible or irreversible.Demonstrate how things change when they are burnt. Strike a match, burn a small piece of paper or light a candle.Discuss what is happening to each one. Remember to observe if there is a change in temperature or colour, or if there is a gas given off (e.g. a smell of smoke). *Are these processes reversible?*Light a candle. Learners observe the candle wax and describe what happens to it after one minute and after five minutes. *Why does it change over time?*Learners shape some different items/objects out of clay. *Can you reshape the clay?* *Is shaping clay reversible or irreversible?* Once you have some clay objects, heat them (ideally in a kiln) or if using quick-setting clay leave to air dry. Once dry, talk to the learners about how the clay has changed. *Could you still reshape the clay? What has happened to the clay?* | Ice.Surface to melt ice on (e.g. a tray or plate).Sand tray.Fire extinguisher.Paper.Matches.Candle.Line drawings and pictures of examples of reversible and irreversible changes.Candle.Clock or timer.Clay. | Health and safety:Use sand trays and have fire extinguishers nearby.Emphasise the dangers of flames. |
| 6Cc26Ep76Eo1 | Explore how solids can be mixed and how it is often possible to then separate them againChoose which equipment to useMake a variety of relevant observations and measurements using simple apparatus correctly | As a class, discuss: *What is mixing?* Physically add two solids together in front of the learners; discuss how they are mixed but still identifiable. Start with marbles and rice, move to rice and flour and finish with brown sugar and salt. In each case both solids are still identifiable. *How can we separate these mixtures?* Discuss learner’s views. **Scientific Enquiry activity***How can you separate solid/solid mixtures?*Give the learners some solids that have been mixed together and ask them to separate them, e.g. rice and flour, marbles and salt, gravel and sand. Have a range of equipment laid out so learners can choose for themselves the equipment they will use for each mixture. At least one of the mixtures should be very difficult to separate with a sieve (e.g. sand and salt).Groups of learners should try different methods to separate the solids and share findings with the rest of the class. | Mixtures of solids and powders including some that are soluble (e.g. sugar, salt) and some that are insoluble (e.g. rice, sand, gravel, marbles).Equipment that could be used to separate solids e.g. sieves, spoon, fork. | Misconception alert: Some learners may believe when objects are mixed that the original objects change, especially with powders. This isn’t true as mixing is a physical, not a chemical, process. |
| 6Cc36Cc46Cc56Ep76Eo1 | Observe, describe, record and begin to explain changes that occur when some solids are added to waterExplore how, when solids do not dissolve or react with the water, they can be separated by filtering, which is similar to sievingExplore how some solids dissolve in water to form solutions and although the solid cannot be seen, the substance is still presentChoose which equipment to useMake a variety of relevant observations and measurements using simple apparatus correctly | *How can you separate solid/liquid mixtures?*Have a large transparent tub (or tank) of water and add in different solids; start with big objects and get smaller, e.g. ball, pencil, collection of rubbers. Ensure you try out sand and discuss how it mixes with the water. Add sugar and/or salt and discuss where the sugar goes. Link back to previous work on dissolving; explain that the sugar has dissolved, but is still there. This means this is another example of a mixture. **Scientific Enquiry activity***How can you separate solid/liquid mixtures where the solid does not dissolve?*Show learners several solid/liquid mixtures, e.g. paperclips and water, rice and water, sand and water, rubbers and water (and other examples). *How could we separate these two substances? What equipment could we use?* Discuss how the difference in size between the two substances may affect the separation method they pick. Learners have a range of equipment and choose the right equipment to help separate the solid/liquid mixtures. Learners carry out the separation. As a class, discuss: *What equipment did you use? Why? Which equipment was most effective?* Introduce the term ‘filtration’. Demonstrate the use of a funnel and filter paper to filter the sand from the water.**Scientific Enquiry activity***How can you separate solid/liquid mixtures where the solid does dissolve?*Add salt to water and discuss what is happening to it. Prove it has dissolved by weighing the water and salt individually and then weighing them once mixed. Remind learners of the word ‘solution’ from Stage 5*. Is it possible to get the original solid back again?* Discuss the separation techniques the learners have covered so far; either demonstrate that they are ineffective or have learners find out for themselves. *How can the water just be removed?* Direct learners to thinking about what happens when water is heated and what happens to puddles. *What is this process called?* Have a range of equipment to support learners in heating the water/salt mixture.Discuss everyday instances of dissolving, e.g. sugar in drinks, washing powder in the washing machine.**Extension activity***How can we make a solid dissolve more quickly?*Learners identify factors that might make a solid dissolve more quickly (e.g. temperature, powder size, stirring). They design a fair test in which only one variable is changed.Learners carry out their planned investigation, use the results to draw line graphs and make a conclusion. | Large, transparent tub, objects, sand, sugar and/or salt, waterRange of equipment including; sieves, funnels, filter paper.Range of solid/liquid mixtures where the solid isn’t dissolved. Salt, water, scales.Range of equipment including sieves, dishes (evaporating dishes are optional), heat or light source, (e.g. sunny window ledge, spirit burner or candle). Soluble solid (e.g. sugar, salt, dishwasher tablets).Water (including hot water).Containers (e.g. jars, plastic cups).Stirrers (e.g. spoon).Graph paper.Thermometer (mercury free). | Misconception alert: Some learners may still struggle with the concept that a dissolved solid is still present and will need to feel the weight change themselves or use scales. Some learners may think that when something dissolves there is a reaction or change, especially if there is a colour change to the liquid. This isn’t true as mixing is a physical, not a chemical, process. Misconception alert: When the water evaporates and leaves the salt it won’t look granular like it did when it was added; it may come out as a single block or in shards. Explain how this is still salt just not broken up into small grains like the salt we buy. When using salt use table salt, not rock salt. The impurities in rock salt may lead to misconceptions around dissolving.  |

**Unit 6.3 Food chains**

It is recommended that this unit takes approximately **45% of the term.**

In this unit, learners:

* find out about feeding relationships and represent these with food chains
* identify producers, consumers, predators and prey
* compare food chains in different habitats.

Scientific Enquiry work focuses on:

* collecting evidence and data to test ideas including predictions
* making a variety of relevant observations and measurements using simple apparatus correctly.

Recommended vocabulary for this unit:

* habitat, food chain, draw a food chain, energy flow
* producer, consumer, predator, prey.

| Framework code | Learning objective | Suggested activities to choose from | Resources  | Comments  |
| --- | --- | --- | --- | --- |
| 6Be36Be4 | Know how food chains can be used to represent feeding relationships in a habitat and present these in text and diagramsKnow that food chains begin with a plant (the producer), which uses energy from the Sun | Discuss a familiar, local habitat and how the plants and animals living within it depend on each other (revision). Ask learners to identify what eats what in that habitat. Use this to create some simple food chains.*What do you notice about the food chain? What do the food chains have in common?* (e.g. they all start with a plant.)Introduce the term ‘food chain’. Demonstrate how to ‘draw a food chain’ using arrows. For example: grass → rabbit → foxExplain that the arrows show the ‘energy flow’ through the food chain, i.e. the energy in the grass goes into the rabbit and the energy in the rabbit goes into the fox.Revise what a healthy plant needs. Elicit the idea that plants need light energy and they use this to make their own food.Remind learners of the term ‘producer’; discuss how producers are the starting point for feeding relationships within a habitat.Give learners cards to make different food chains. For each food chain, learners can:* identify the producer
* describe what eats what
* describe how energy flows through the chain (remembering to start with the Sun).

Learners draw food chains for a habitat (their own choice or given); they then explain it to others in the class.Learners can discuss what would happen to animals if there were no plants. | Reference material – Internet/books/CD-ROMs.Set of cards including arrows and names (and pictures) of a range of plants and animals that can be made into food chains.  | Misconception alert: A common misconception is that ‘drawing a food chain’ means drawing pictures of the plants and animals in the food chain. Explain that a food chain is made up of words and arrows.It is sufficient to introduce plants as producers of food by using energy from the Sun; the process of photosynthesis will be covered in Lower Secondary.Show arrow conventions, i.e. producer → consumer. |
| 6Be5 | Understand the terms *producer, consumer, predator* and *prey* | Revisit the word ‘producer’ and introduce the term ‘consumer’. Identify these from local habitat knowledge.Learners choose a habitat and write a food chain for it, identifying the producer and consumers.Discuss recently used (or constructed) food chains to identify predator and prey relationships. Apply the terms ‘consumer’, ‘predator’ and ‘prey’ to each food chain. Then apply these terms to unfamiliar habitats and species.Learners make a ‘zig-zag book’ to show a food chain (with one organism on each page). They annotate their food chain with the terms producer, consumer, predatory and prey. They can share their work with a partner before they present it to the class.Show learners some incorrect food chains and see if the learners can spot the mistakes:* grass ← sheep (the arrow is the wrong way around; grass does not eat sheep.)
* zebra → grass → lion (the producer, i.e. grass, always comes first in the food chain.)
* grass → impala → hyena → tiger (tigers do not live in Africa.)
* algae → shrimps → squid → penguin → polar bear (polar bears live in the northern hemisphere, penguins in the southern hemisphere.)
 | Zig-zag books – cut a piece of A4 paper lengthways and fold it in half, fold it again one way and then the other so it stands up.Incorrect food chains. |  |
| 6Be66Ep26Eo1 | Explore and construct food chains in a particular habitat.Collect evidence and data to test ideas including predictionsMake a variety of relevant observations and measurements using simple apparatus correctly | Learners study a local habitat in detail to find out about the food chains. It is likely that this will require a combination of learner observations and use of secondary sources to find out more about the species observed. **Scientific Enquiry activity**Set up a bird hide in a classroom (or quiet area) that overlooks a quiet part of the playground. Ideally, place dark paper on the window with small slits to look through. Place a feeding table outside or make some feeding balls with fat and seeds and hang on a nearby tree.As a class, list the names of birds that might come to eat the food. Use this list to create ‘visit charts’ to record which species of birds are observed.Individually, learners predict which birds they think will visit and what they will eat. Learners observe the feeding table; they record the birds that visited and the food they ate. They use their observations to create food chains. *What do these birds eat in the wild? How would the food chains be different?*Learners compare their observations with their predictions. *Do you think you have seen all the types of bird living in this area?* **Scientific Enquiry activity**Learners survey a local area (e.g. in the school grounds) to identify the species present. They then use secondary sources to find out about the food chains these species are part of.Learners research the food chains in a contrasting area; they use secondary sources or links to another school.Alternatively, pick a migrating bird familiar to the learners. *Where are they now? Why? What food chains are they part of in the different places where they live?* | Reference material – Internet/books/CD-ROMs.A range of bird food (e.g. seeds, fat, bread, cheese, cooked potatoes, fruit).Bird identification book or internet.Dark paper/material (optional).Binoculars (optional).Camera (optional).Secondary sources.Some organisations publish satellite tracking data on bird species, e.g.<http://www.bto.org/science/migration/tracking-studies> | Adhere to school policy re educational visits if going outside school grounds.This bird feeding activity could be ongoing throughout the topic.Food chains in a particular habitat can change at different times of year. |

**Unit 6.4 Conductors and insulators**

It is recommended that this unit takes approximately **55% of the term.**

In this unit, learners:

* build on their understanding of electricity and electrical circuits
* discover which materials are good electrical conductors and insulators
* observe the effects of increasing the number of components in a circuit
* learn conventional symbols for drawing circuit diagrams.

Scientific Enquiry work focuses on:

* discussing how to turn ideas into a form that can be tested
* making predictions using scientific knowledge and understanding
* choosing what evidence to collect to investigate a question, ensuring that the evidence is sufficient
* identifying factors that are relevant to a particular situation
* choosing which equipment to use
* making a variety of relevant observations and measurements using simple apparatus correctly
* deciding when observations and measurements need to be checked by repeating to give more reliable data
* using tables, bar charts and line graphs to present results
* evaluating repeated results
* identifying patterns in results and results that do not appear to fit the pattern
* suggesting and evaluating explanations for predictions using scientific knowledge and understanding and communicating these clearly to others
* saying if and how evidence supports any prediction made.

Recommended vocabulary for this unit:

* material, conductor, insulator
* cable, wire, switch, battery, cell, lamp, bulb, buzzer, circuit, circuit diagram, conventional symbols
* metal, non-metal, copper, iron, steel, gold, silver, aluminium
* independent variable, dependent variable, control variables.

| **Framework code** | **Learning objective** | **Suggested activities to choose from** | **Resources**  | **Comments**  |
| --- | --- | --- | --- | --- |
| 6Pm16Pm26Ep46Eo16Eo66Eo9 | Investigate how some materials are better conductors of electricity than othersInvestigate how some metals are good conductors of electricity while most other materials are notMake predictions using scientific knowledge and understandingMake a variety of relevant observations and measurements using simple apparatus correctlyIdentify patterns in results and results that do not appear to fit the patternSay if and how evidence supports any prediction made | Revise previous learning on electrical circuits from Stage 4. For example, the class could repeat the following role play of an electrical circuit and identify why the buzzer will only sound when the switch is closed:* Ask learners to stand in a circle holding a rope/string loosely so it can be moved by someone else.
* Ask one learner to be the switch. When they put their hand in the air they drop the rope and the switch is open and the circuit is broken.
* Ask some of the other learners to be components that can be represented through sound (e.g. a buzzer, bell, motor). These learners hold the rope more tightly so if it is moved they feel friction. The teacher is the cell.
* When the switch is closed (and the learner being the switch holds the rope) the rope is moved in a loop by being pushed and pulled by the teacher (cell). These movements representing the current flowing round the circuit. When the current is flowing learners discuss what is happening. Learners acting as components can behave like their component if they feel their hands get warmer. When the ‘switch’ opens, all sounds and the current should stop instantly.
* The teacher can swap the roles (switches, devices) during the activity. Once the learners are confident, step out of the circuit and nominate a learner as the cell.
* Explain that the game they played is called a “model” and is a representation of how electrical current flows around a circuit.

Extend the model to discuss how some materials are better than others at allowing the current to flow; this property is electrical conductivity. Materials that are good at allowing a current to flow are called ‘conductors’; materials that inhibit current flow through them are called ‘insulators’.**Scientific Enquiry activity**Learners make a circuit using toy:* Find a toy that has two external contact points and lights up (or makes a sound) when the circuit is complete. Toys of this sort come in many types, e.g. a ‘ghost ball’, toys that make a sound (or light up) when held or placed in a bath.
* Using the toy, make a circuit with two learners each touching one of the external connections and holding hands. Then expand the circuit to four, ten, and all the learners holding hands.
* Expand the illustration by asking two learners to form a ‘switch’ by breaking the circuit (let go of each other’s hands).
* Ask two learners to hold the ends of a ‘test item’ (e.g. a spoon). Learners predict if the toy will still light up (or make a sound). Test a variety of items in this way and look for patterns in the results.
* Try out the ‘lead’ of a pencil; graphite is unusual because it is a non-metal that conducts electricity.

Discuss the terms ‘insulators’ and ‘conductors’.*Are people conductors or insulators of electricity?**In general, which materials are good conductors of electricity?*Discuss where learners can find conductors and insulators of electricity in the home.**Scientific Enquiry activity**In pairs, or small groups, ask learners to construct a circuit to make a lamp light up or a buzzer sound (revision). Demonstrate how to use crocodile clips (or uninsulated ends of wires) to insert test samples into the circuit. Provide learners with a range of samples to test which includes both conductors and insulators. Learners predict which materials will be conductors and which will be insulators. They then test the samples using the circuit, write down the results, rank the test materials and then compare the results with their predictions.*Is there a pattern in the conductors and insulators?**Did any of your results not fit the pattern?*Learners identify how many good conductors are metals and how many insulators are non-metals, e.g. plastic. Use an online game or virtual circuit maker to assess learners’ understanding of conductors and insulators. | Rope.Ghost ball (or equivalent toy)Example of a ‘ghost ball’: <https://www.youtube.com/watch?v=pgT_9a5jMqM>Items to test in the human circuit including conductors (e.g. metal knife, metal spoon) and insulators (e.g. plastic fork, wooden spoon, wooden ruler).Electrical components (e.g. wires, battery/cell, lamp, buzzer, switch).Materials to test including conductors (e.g. copper strip, iron nail, steel spoon, aluminium foil, brass key) and insulators (e.g. wooden stick, paper, plastic, glass, foam, rock, chalk, eraser, fabric).If the learners have not already tested pencil ‘lead’ then this can be done using a pencil sharpened at both ends.Virtual circuit made using <http://phet.colorado.edu/en/simulation/circuit-construction-kit-dc-virtual-lab><http://www.andythelwell.com/blobz/guide.html>  | The ‘grab bag’, in the virtual circuit software, allows a range of items to be added to the circuit including a ‘dog’ and a ‘hand’. This software can also be used to demonstrate the use of switches.  |
| 6Pm3 | Know why metals are used for cables and wires and why plastics are used to cover wires and as covers for plugs and switches | Ask learners to define the terms ‘electrical conductor’ and ‘electrical insulator’. Make sure learners understand that conductor and insulator are broad terms that describe how easily a material allows energy to move through it. There are different types of conductors/insulators depending on which energy transfer is being discussed, e.g. a material can be an electrical conductor and a thermal insulator. List which materials were identified as conductors of electricity. Give pairs of learners some plastic-coated wires and ask them to decide together: *What material are they are made of? Why?* Learners then share their ideas with another pair. *What material might have been used for the wire?*As a class, list electrical items in school or at home and their common safety features (e.g. the materials used for plugs, outer casings, sockets). If available, use real examples so learners can identify where insulators have been used. Discuss how to stay safe with electricity. Cover topics such as electricity in the home, substations and electricity pylons.*How can electricity pylons be made of metal?*Make a poster about electrical safety. Explore a website on electrical safety or show a safety video to promote awareness. | Plastic covered wires, plain copper wire, thick cable, mains electrical wire.Plugs (not connected to mains).Sockets (not connected to mains).Screwdriver with a plastic handle.Pictures of electricity pylons. Websites for electrical safety:<http://www.juniorcitizen.org.uk/kids/electricalsafety/electricalsafety.php> orSafety in the home:<http://www.switchedonkids.org.uk/electrical-safety-in-your-home> Videos are often available from local police/fire services. | Health and safety:It is essential to emphasise the difference between battery and mains electricity. Discuss safety issues associated with plugging in and unplugging main electrical appliances.Health and safety:Water is an electrical conductor; it is important not to be wet when near electrical equipment. |
| 6Pm46Ep36Ep46Ep56Ep66Ep76Eo16Eo26Eo36Eo56Eo66Eo86Eo9 | Predict and test the effects of making changes to circuits, including length or thickness of wire and the number and type of componentsDiscuss how to turn ideas into a form that can be testedMake predictions using scientific knowledge and understandingChoose what evidence to collect to investigate a question, ensuring that the evidence is sufficientIdentify factors that are relevant to a particular situationChoose which equipment to useMake a variety of relevant observations and measurements using simple apparatus correctlyDecide when observations and measurements need to be checked by repeating to give more reliable dataUse tables, bar charts and line graphs to present resultsEvaluate repeated resultsIdentify patterns in results and results that do not appear to fit the patternSuggest and evaluate explanations for predictions using scientific knowledge and understanding and communicate these clearly to othersSay if and how evidence supports any prediction made | **Scientific Enquiry activity**Present circuits and ask the learners to predict and show the effects of adding more components (revision).Learners design their own investigation question about the effect of making changes to circuits, e.g. number of components, a change in the type of components.Use the ‘fair testing method’ to demonstrate how to design a fair test:* List all the variables that could change the brightness of a lamp. Put this list down the centre of the board (or a large piece of paper).
* Identify the *dependent* variable (what you are measuring) as the ‘brightness of the lamp’; write the dependent variable on the right side of the board.
* Discuss how you can measure the dependent variable. Remind learners of the approaches they used for measuring light intensity in Stage 5 (i.e. light meter, mobile phone app). Alternatively, they can use a qualitative measure such as ‘brightest, bright, dim, dimmest’.
* Explain that the learners will be investigating only one of the variables they have listed in the centre of the board. This will be their *independent variable*. Their investigation will be to find out what effect the independent variable has on the dependent variable.
* Demonstrate choosing one of the variables from the first list and rewriting it on the left side of the board/paper. Remove this variable from the central list.
* Add the titles ‘*Independent variable’, ‘Control variables*’ and ‘*Dependent variable*’ to the left, centre and right columns of the board.

In small groups, the learners decide which independent variable to test and plan a fair test; they will only change their selected independent variable and keep all the control variables the same.Learners list the equipment they are going to use, write instructions for their method and predict their results. Before they begin, discuss the importance of measuring and recording values in an organised way (so that the value for the independent variable is paired with the corresponding value for the dependent variable). Show learners how they can do this while taking repeated readings for the experiment; give theman example of a table they can use to record their results. Learners carry out a fair test by following their plan.Learners record their results in a table; they repeat results at least three times and calculate the average mean score.*Are any of your results surprising?**Do you need to repeat any of your results an extra time?*Learners work in their groups to analyse and evaluate their results; they prepare to present them to others (as real scientists do).*Is there a pattern in your results?**Can you explain why this pattern happens?**What is your conclusion?**How confident are you in your conclusion?**Were the results what you predicted?*Learners can draw a line graph (or bar chart) to help them display their results to others.Groups prepare a short (up to five minutes) presentation of the results of their fair test. | Board or large piece of paper.Light meter, data logger or equivalent app for a mobile phone (if available).A display of the available equipment for the learners to look at while they plan their experiment (e.g. wires of different lengths, wires made of different metals, battery/cell, lamp).Electrical equipment (e.g. wires of different lengths, wires made of different metals, battery/cell, lamp).Light meter, data logger or equivalent app for a mobile phone (if available).Example of a table for organising repeated readings.Graph paper or computer software. | Health and safety:Do not use rechargeable batteries; they can get very hot. |
| 6Pm5 | Represent series circuits with drawings and conventional symbols | Learners construct, and produce a drawing of a circuit that makes a lamp light up (revision).Introduce the learners to two ways in which to record a circuit: drawing a picture and using conventional symbols to make a circuit diagram. Point out that, in a circuit diagram, wires are always drawn straight but can turn at right angles.Give learners cards with the conventional symbols and their meanings. Use these cards to learn the meanings of the symbols. For example:* In groups, play a game of ‘pairs’ where learners match the symbol with its picture, drawing or name. Turn all the cards upside down on the table and mix them. In turn, each player turns over two cards and says what they are. If they are the same, they can keep them. The winner is the player with the most pairs at the end.
* The learners can also use cards with the conventional symbols to design a circuit that would work (e.g. make a lamp light). After two minutes, stop the learners and ask them to check the circuit of the person sitting next to them. Select one good example to show the class.

Use a circus activity where learners draw and peer-assess circuit diagrams:* Ask learners to choose suitable components to make a circuit (with no branches).
* The learners then move to a circuit created by another group and draw a circuit diagram for this circuit. They leave the diagram beside the circuit it describes.
* The learners then move to another circuit and check the circuit diagram that accompanies it. If they think it is not correct they use a coloured pencil to make the correction.
* Learners return to the circuit they made and review the circuit diagram that has been drawn. *Do you agree with the circuit diagram the other learners have drawn for your circuit? If not, why is it incorrect?*
* Share class findings and check the wires are drawn as straight lines and there are no breaks in the circuit.

Use circuit diagrams to predict whether circuits will work. | Electrical equipment (including wires, lamps, cell, batteries, switches, motors, buzzers).Cards with the electrical circuit symbols, drawings of the components and names.Pencils of different colours. | The electrical circuit symbols used in this programme can be downloaded from the Cambridge Primary support site.  |

**Unit 6.5 Caring for the environment**

It is recommended that this unit takes approximately **60% of the term**.

In this unit, learners:

* consider the positive and negative ways that humans can impact their environment
* identify ways that people can care for the environment.

Scientific enquiry work focuses on:

* collecting evidence and data to test ideas including predictions
* choosing what evidence to collect to investigate a question, ensuring that the evidence is sufficient
* making a variety of relevant observations and measurements
* using simple apparatus correctly
* using tables, bar charts and line graphs to present results
* using results to draw conclusions and to make further predictions.

Recommended vocabulary for this unit:

* habitat, species, environment, landscape, impact, effect, positive, negative
* waste, disposal, reduce, reuse, recycle, landfill, litter, pollution, oil slick, developments
* greenhouse effect, climate change, energy consumption, renewable energy, non-renewable energy.

| Framework code | Learning objective | Suggested activities to choose from | Resources  | Comments  |
| --- | --- | --- | --- | --- |
| 6Be1 | Explore how humans have positive and negative effects on the environment, e.g. loss of species, protection of habitats | Protecting habitats*How have humans changed the landscape? What would this area look like if humans were not here?*Introduce the idea that humans have influence over the environment in which we live by changing the landscape. Discuss building houses, farming, industries etc. Whole class plays the game ‘Declining habitats’:* Separate the learners into three equal-sized groups. One group are the ‘owls’ and live in trees, one group are the ‘harvest mice’ and live in hedgerows and one group are the ‘hares’ who live on heathland.
* Place cards round the edges of a large space (e.g. hall). Each card has the name of a habitat (five ‘hedge’ cards, five ‘tree’ cards and five ‘heathland’ cards).
* Learners go to their habitats to start (a maximum of five animals can live in one habitat at the same time). During the day the animals leave their homes to look for food; learners run around the area. At night they return home; indicate this by switching on/off lights or blowing a whistle.
* During the day remove a habitat, one at a time, until some animals do not have a habitat to live in. Sadly, they must ‘die out’ as they do not have anywhere to live.
* Play the game more than once so learners can see the effect of different changes to the environment (e.g. cutting down trees to build roads, building houses on heathland, removing hedges on farmland).

Individually, learners summarise their understanding of the effect of losing habitats and why it is important to protect them. | A set of habitat cards (word and/or picture): five ‘hedge’ cards, five ‘tree’ cards and five ‘heathland’ cards. | Throughout this unit make links to the learners’ local context as well as some contrasting examples.This game can be adapted for the local environment. |
| 6Be16Eo16Eo7 | Explore how humans have positive and negative effects on the environment e.g. loss of species, protection of habitatsMake a variety of relevant observations and measurementsusing simple apparatus correctlyUse results to draw conclusions and to make furtherpredictions | Negative effects humans can have on the environment**Scientific Enquiry activity**Learners investigate methods for cleaning up oil slicks:* In small groups, learners model an oil slick by pouring four tablespoons of vegetable oil into a small container of water. Ask the learners to make observations about what happens:

*Do the oil and water mix? What happens if you gently shake the container?** Give the learners access to a selection of absorbent materials to ‘clean up’ the oil slick.
* Learners attempt to soak (or scoop) the oil out of the water; they make observations about how well the method worked.
* They then add a few drops of washing up liquid and try and soak/scoop the oil again; they make observations about how well this new method worked.
* Learners conclude which is the best method and suggest how real oil slicks are cleaned up.
* Discuss the similarities and differences between this model and cleaning up real oil slicks.

Learners research how places have recovered/are recovering from oil slicks.Learners, in groups, research a way in which humans can have negative effects on the environment. They present their results to their peers; they should cover: *‘What humans do?’ ‘What effects are there on the environment?’* Possible topics include:* logging in rainforests
* quarrying
* building cities and transport links
* waste disposal (e.g. landfill or marine waste)
* pollution of water, air or land
* littering
* acid rain.

Greenhouse effectIntroduce the learners to the term ‘greenhouse effect’ to explain the relationship between the Sun, Earth and our atmosphere. This is a naturally-occurring, essential process that keeps the Earth warm, but human activities are interfering with the balance of the natural gases in the atmosphere making the Earth warm up too much.Ask the learners to individually draw, and label, a diagram of the ‘greenhouse effect’.As a class, make a list of some human activities that might affect the amount of greenhouse gases (e.g. methane, carbon dioxide and nitrous oxide) in the atmosphere.*What can we do about climate change? How can we help stop climate change?*  | Vegetable oil.Container of water.A selection of materials cut into 2 cm square pieces (e.g. paper towels, cotton, cardboard).Washing up liquid.Information sources (e.g. internet and books).Information sources (e.g. internet and books). |  |
| 6Be1 | Explore how humans have positive and negative effects on the environment, e.g. loss of species, protection of habitats | Positive effects humans can have on the environmentUse a local example to illustrate that humans can have positive effects on the environment, e.g. a national park, nature reserve. *How do national parks or nature reserves protect wildlife?* Collect ideas from the learners. Explain that, in order to protect the environment, rules are established that people must abide by when they visit.Learners find out about the rules and regulations in the local example. As a class, discuss. *Why are they necessary? How do they help protect the environment?*Learners could suggest some rules to protect another familiar local habitat (e.g. local park) and share these rules with the class. | Information sources (e.g. internet and books). |  |
| 6Be26Ep26Ep56Eo3 | Explore a number of ways of caring for the environment, e.g. recycling, reducing waste, reducing energy consumption, not littering, encouraging others to care for the environmentCollect evidence and data to test ideas including predictionsChoose what evidence to collect to investigate a question, ensuring that the evidence is sufficientUse tables, bar charts and line graphs to present results | Reducing waste and littering**Scientific Enquiry activity**In groups, ask the learners to think of one area of the school to find out how much rubbish is thrown away every day (e.g. different classrooms, offices, staff room, kitchens). Allocate each group a different area to study. They will weigh the rubbish collected that day in their allocated area and they add their result to a class table. Learners can calculate the mass of rubbish thrown away every week and year, by their area and by the whole school.Waste disposal*Where do you think the rubbish goes when it leaves the school rooms?* (e.g. bin then dustbin lorry). Discuss where their rubbish ends up (e.g. in a landfill site, in rivers or seas).Discuss landfill sites and what happens when a landfill site gets full. *What do you think a landfill site smells like? Would you like to live next to one? Are landfill sites good for the environment?*Discuss what happens to waste in the sea (e.g. plastic waste). *Why is plastic in the sea a problem? What can be done to reduce it?*Reduce, reuse, recycleRemind the learners how much rubbish they calculated was thrown away by the school each year. *What can be done about this?* * Reduce:reducing the amount of waste by reducing the amount we buy. *How?*
* Reuse: using the item again so that new items do not need to be made. *What items could we reuse?*
* Recycle: breaking the item into its parts and turning it into something new. *What can we recycle?*

Learners analyse any ways in which the school already reduces, reuses or recycles waste. If there are environmental activities already set up in school, then evaluate the effectiveness of these. As a class, think of how they could further reduce, reuse or recycle the waste around the school. Discuss approaches that they could use to encourage teachers and learners to care for their environment. | Litter pickers, gloves.Table of results.Scales/balance/weights. | Health and safety:Use litter pickers and wear gloves.It would be easiest to ask for each class (or the cleaners) to collect the rubbish from a particular area of the school, on the day before this lesson.Landfill sites are known to produce and give off methane, a gas which contributes to the ‘greenhouse effect’. |
| 6Be26Ep26Ep56Eo3 | Explore a number of ways of caring for the environment, e.g. recycling, reducing waste, reducing energy consumption, not littering, encouraging others to care for the environmentCollect evidence and data to test ideas including predictionsChoose what evidence to collect to investigate a question, ensuring that the evidence is sufficientUse tables, bar charts and line graphs to present results | Reducing energy consumptionMake a class list of the items that use energy the learners have used so far today (e.g. turning on a light, radio, television, computer, telephone, hot drink, making breakfast, travelling to school, using heating/air conditioning).*What types of energy does each of these items use?* (e.g. electrical energy, chemical energy such as petrol/diesel/gas). Although electricity can be made from renewable sources (e.g. wind, water and sunlight) most electricity is made from non-renewable sources (e.g. coal, oil, gas and nuclear energy). Discuss the difference between renewable and non-renewable energy sources.Learners can find out how electricity is generated in their country.Learners can research how long fossil fuels are predicted to last. *How have scientists made these predictions? How will life be different when fossil fuels have run out?**How can we save energy?* Discuss and ask learners to make suggestions. For example, walking to school (rather than coming in a bus/car); turning off things we are not using (e.g. lights/television/appliances); using less hot water in the shower (or bath) and wearing an extra jumper in the winter rather than heating a room.Learners discuss how they could prove that they were using less energy. For example, they could time themselves doing activities that use energy (e.g. time on the computer, the time heating/lights are on) and then repeat this when they are trying to save energy. | Internet, books and other sources of information. |  |

**Unit 6.6 Mass and weight**

It is recommended that this unit takes approximately **40% of the term.**

In this unit, learners:

* begin to apply previous knowledge of forces – magnetism, gravity and friction
* find out about the direction that forces act in and how to measure forces using forcemeters
* describe how forces affect moving objects.

Scientific enquiry work focuses on:

* considering how scientists have combined evidence from observation and measurement with creative thinking to suggest new ideas and explanation for phenomena
* making predictions using scientific knowledge and understanding
* choosing what evidence to collect to investigate a question, ensuring that the evidence is sufficient
* identifying factors that are relevant to a particular situation
* choosing which equipment to use
* making a variety of relevant observations and measurements using simple apparatus correctly
* deciding when observations and measurements need to be checked by repeating to give more reliable data
* using tables, bar charts and line graphs to present results
* evaluating repeated results
* identifying patterns in results and results that do not appear to fit the pattern
* using results to draw conclusions and to make further predictions
* suggesting and evaluating explanations for predictions using scientific knowledge and understanding and communicating these clearly to others
* saying if and how evidence supports any prediction made.

Recommended vocabulary for this unit:

* mass, kilograms (kg), weight, newtons (N), force, contact force, non-contact force
* direction, energy
* friction, air resistance, lubrication
* gravity, support force, rest.

| **Framework code** | **Learning objective** | **Suggested activities to choose from** | **Resources**  | **Comments**  |
| --- | --- | --- | --- | --- |
| 6Pf16Ep16Eo36Eo6 | Distinguish between mass measured in kilograms (kg) and weight in newtons, noting that kilograms are used in everyday lifeConsider how scientists have combined evidence from observation and measurement with creative thinking to suggest new ideas and explanations for phenomenaUse tables, bar charts and line graphs to present resultsIdentify patterns in results and results that do not appear to fit the pattern | Introduce the learners to this topic by telling the story of Isaac Newton, who was born in 1642, and the story of how he discovered gravity. Discuss how he combined evidence and creative thinking to explain the phenomena he observed. **Scientific Enquiry activity**Ask the learners to weigh everyday objects in newtons (N) using a forcemeter and in kilograms (kg) using scales.Compile a table of results to compare the measurements. *What do you notice? Is there any pattern in your results?*Explain the difference between mass (measured in kilograms) and weight (measured in newtons). Explain that in science we need to use the word *weigh* only when we are talking about *weight*. We use a phrase like *measure the mass of* when we are talking about mass.A graph of weight in N (y-axis) against mass in kg (x-axis) can be drawn. Learners measure their mass (in kg) and use their graph of results to calculate their weight. Discuss gravity (a non-contact force) on the Earth and on the Moon; gravity pulls us towards the centre of the planet we are on. Tell the learners that the gravity on the Moon is very low compared to the gravity on Earth, i.e. 17 %. Discuss how the size of the force of gravity depends on the object generating the force (smaller, lighter objects have less gravity and larger, more massive objectives have more gravity).  | Story of Isaac Newton.Kitchen scales (or a mass balance and known masses) which gives a measurement in grams/kilograms.Forcemeters of different scales.Everyday items chosen by the learners (e.g. pencil case, shoe, chair). | Misconception alert: Weight is a force measured in newtons (N). Although people commonly speak about measuring weight in kilograms or pounds, these are actually measurements of mass. Try to avoid using the terms mass and weight interchangeably. |
| 6Pf2 | Recognise and use units of force, mass and weight and identify the direction in which forces act | Demonstrate dropping an object. *Why does it fall to the ground?*Draw a picture of the object with an arrow pointing down. Label this arrow ‘gravity force (weight)’. Describe how gravity is pulling the object down towards the object which generates the gravity (i.e. planet Earth). Now drop the same object onto a table. *Why does it not keep falling?*Drop the object onto the floor. *Why does it not keep falling?*Introduce the idea that the table/floor is pushing the object up. This means that the object has two forces acting on it. (We can call the force from the table/floor a support force.)Add an upwards arrow to the diagram on the board labelled ‘support force’. Make sure the two arrows are the same size. When gravity and the support force are balanced the object is at rest. Demonstrate placing some buoyant objects in water. Create a force diagram for the object. Introduce the term ‘buoyancy force’ (also known as ‘upthrust’ or ‘lift’) for the upwards force caused by a liquid or gas.Give learners several examples of objects at rest. For each example the learners should create a force diagram showing, and naming, the downward and upward forces. | Object.Example force diagram:support forcegravity force (weight)Container, water; resource list, objects that can float. | Misconception alert: The standard way of drawing force arrows may lead to misconceptions. For example, learners may think the support force is a pull on the object; it is really a push away from the surface the object is in contact with. |
| 6Pf4 | Recognise friction (including air resistance) as a force which can affect the speed at which objects move and which sometimes stops things moving | Introduce the word ‘friction’ as a force that slows things down. Ask the learners to rub the palms of their hands together quickly, and to feel the warmth generated. This heat was created by friction.*Where do we encounter friction every day?* Everywhere! Discuss examples (e.g. grips on shoes to stop them slipping, treads on car tyres to allow better braking, plastic grips on chair legs to stop them slipping). Push a toy car (keeping hold of the car and pushing it at a slow speed). *If I did this very fast, what would get hot? Where is there friction?*Explain that friction is a pushing force that goes in the opposite direction to movement. Draw a force diagram of when you continue to push the car and when you let go of it.Explain that there is always friction when the car is moving even when you are not pushing it. The friction will slow the car down until it stops. Once the car has stopped moving there is no friction; friction only applies when there is movement. Watch a video or animation about friction.**Scientific Enquiry activity**A demonstration of how friction can be reduced. Show a plate of jelly cubes to the whole class and ask a volunteer to use the chopsticks to transfer the jelly cubes from one plate to another. Repeat with another volunteer.Add some oil on top of the jelly and ask the learners to predict what will happen now if you try to transfer the cubes. Ask another volunteer to move the jelly, with the chopsticks, to the other plate.Learners discuss, in pairs, what is happening in this activity. *Why was it so much harder to move the jelly once the oil had been added?* Elicit explains based on the friction being decreased*.***Extension Activity**Introduce the idea that the oil is being used to reduce the friction; this is called ‘lubrication’. *Where might lubrication be useful?* Collect ideas (e.g. the moving parts of a car engine, a door lock or bicycle gears). | Toy car Toy Friction  PushDirection the toy is moving  Toy   FrictionDirection the toy is movingA video about friction:<http://mocomi.com/what-is-friction/> For each plate:Five jelly cubesChopsticksTwo platesTimer or stopwatchCooking oil. | Friction is a contact force resisting the movement of surfaces. There are several types of friction which can be between solid or fluid surfaces.Thermal energy can be released by friction (causing objects to heat up). |
| 6Pf46Ep46Ep66Eo16Eo36Eo46Eo66Eo9 | Recognise friction (including air resistance) as a force which can affect the speed at which objects move and which sometimes stops things movingMake predictions using scientific knowledge and understandingIdentify factors that are relevant to a particular situationMake a variety of relevant observations and measurements using simple apparatus correctlyUse tables, bar charts and line graphs to present resultsMake comparisonsIdentify patterns in results and results that do not appear to fit the patternSay if and how evidence supports any prediction made | **Scientific enquiry activity:**Discuss with learners how friction is created when an object moves over a surface; it is the force, created by the level of contact with the surface, that acts in the opposite direction to the movement. *What difference does the surface make to the level of friction? What difference does the size of the object make?* Discuss why this is useful to think about (e.g. cars versus lorries travelling on roads, someone walking over grass versus walking over ice). Learners will be presented with a range of surfaces along which they will pull/push an object (e.g. a tray or shoe) into which small masses can be put. Discuss the variables they need to consider. *What will they will measure?* For example, the force it takes to pull an object using a forcemeter in newtons (N). This force is the force needed to counteract friction. *How does the level of force differ based on the surface and/or mass of the object?* Learners make predictions and then carry out the investigation. They record their results and make a statement about their ideas about friction. **Extension activity***Why is it so difficult to walk on ice? What are the differences between winter and summer tyres?* | A selection of objects (different sizes).A range of surfaces (e.g. wood, stone, ice, plastic).Weighing scales.Forcemeters.For each group:An object such as a shoe or traySeveral known masses (e.g. 100g masses that can be added to the shoe/tray)Forcemeter.Results table. |  |
| 6Pf46Ep46Ep56Ep66Ep76Eo26Eo36Eo56Eo66Eo76Eo8 | Recognise friction (including air resistance) as a force which can affect the speed at which objects move and which sometimes stops things movingMake predictions using scientific knowledge and understandingChoose what evidence to collect to investigate a question, ensuring that the evidence is sufficientIdentify factors that are relevant to a particular situationChoose which equipment to useDecide when observation and measurements need to be checked by repeating to give more reliable dataUse tables, bar charts and line graphs to present resultsEvaluate repeated resultsIdentify patterns in results and results that do not appear to fit the patternUse results to draw conclusions and to make further predictionsSuggest and evaluate explanations for predictions using scientific knowledge and understanding and communicate these clearly to others | Take the learners outside; they run from one side of the playground to the other and back again.Give them a large piece of card (or a box lid) to hold flat against their body in front of them and ask them to run again. *What is the difference? Can you feel the resistance of the air?***Scientific Enquiry activity**Pairs of learners will explore how a piece of A4 paper falls at different stages of being scrunched up into a ball.They start with the paper flat and drop it. Another learner times how long it takes for the paper to touch the floor.They repeat with the paper folded in half, lightly scrunched up, tightly scrunched up and scrunched into a very tight ball (each time making sure the paper is dropped from the same height). Learners record the results as they carry out the investigation.*Has the weight of the paper changed? Why does it fall at different rates?***Scientific Enquiry activity**Show learners a heavy book and a piece of paper. *Which will hit the ground first if I drop them at the same time?* Demonstrate dropping them (start with one in each hand). Then place the paper under the book. *Which will hit the ground first now?* Demonstrate dropping the two objects.Next place the paper on top of the book. *What will happen to the paper?* Demonstrate dropping the two objects.Finally scrunch up the piece of paper. *Which object will hit the ground first?* Demonstrate dropping them again (start with one in each hand). *Does the mass of an object affect how fast it falls? Why did the paper fall at different speeds even though it is the same mass?**Does air resistance affect how fast an object falls?***Scientific Enquiry activity***How fast will a parachute fall?* Learners design, plan and carry out a full investigation using a fair test. Remind learners of the steps in the ‘fair testing method’ that they used in Unit 6.4 Conductors and insulators (6Pm4). Learners report back using force diagrams, which should indicate the direction in which the forces are acting.The speed the parachute falls depends on a number of variables. Identify these with the class (e.g. size of canopy, length of string, material of canopy, shape of canopy, shape of hole in top of canopy). Discuss the impact each of these variables might have on the air resistance.Identify the dependent variable as the time taken to fall from a fixed height to the ground; discuss how the learners can measure this.In groups of four, learners decide which independent variable to test and plan a fair test for it; they should only change their chosen ‘independent variable’ and keep all the other ‘control variables’ the same). They plan a method for their experiment.Discuss how to record measurements in an organised way and the need for repeated results.Learners carry out a fair test by following their plan to collect the evidence. They should repeat each reading at least three times and then calculate an average; results should be recorded in a table.Discuss results: *Were they as you predicted? How confident are you in your evidence?*Work in groups to analyse and evaluate their results before preparing to present them to others (as real scientists do).*Is there a pattern in your results?**Can you explain why this pattern happens?**What is your conclusion?**How confident are you in your conclusion?**Were the results what you predicted?*Learners can draw a line graph (or bar chart) to help them display their results to others.Groups will prepare a short (up to five minutes) presentation of the results of their fair test. | Large piece of stiff card or plastic box lid.A4 paper. Timers or stopwatches.Table for recording results.Heavy book.Piece of paper.Worksheet for learners to complete with three columns ‘Independent variable’, ‘Control variables’ and ‘Dependent variable’.Equipment that the learners can use e.g. timers, stopwatches, clock, rulers, metre sticks, string of different thicknesses, scissors, small masses and different types of materials for the canopy (e.g. paper, fabric, aluminium foil, tissue paper, plastic bags).Graph paper or computer software. | Remind learners of the importance of repeating measurements.Misconception alert: It is a common misconception that heavier objects fall faster. Note: Avoid investigations of the effect of changing the mass as this will be studied in Stage 7.Health and safety:make sure learners do not plan to stand on any furniture during the investigation.Remind learners of the results table they have previously used for organising repeated readings.The group members have specific roles: Equipment manager: gathers, looks after and puts away the resources and equipment.Fair test supervisor: watches the tester and makes sure only one variable is changed each time.Recorder: decides how to record the results, devises a record sheet and records the results as paired values.Tester: carries out the fair testing. |
| 6Pf3 | Understand the notion of energy in movement | Show the learners some pictures of everyday objects that move. Remind learners that pushes are forces. *What is giving the push in the example?* Illustrate this example by drawing a force diagram showing the push forces.The learners can draw similar force diagrams for the other examples.Demonstrate pushing a small toy and letting go. *Why does the toy keep moving?* Many learners will give an answer that something is still pushing it (or pulling it). Point out that there is nothing pushing or pulling the toy forwards. Introduce the idea that when you push the toy you transfer energyto the toy. When the moving object interacts with something else this energy can be transferred again, e.g. during movement, due to friction, some energy is transferred to the surface the object is travelling over. Show videos of examples of people pushing or throwing items. *When does there stop being a force pushing the object forwards?*Have two learners throw a ball to each other. *When does there stop being a push force on the ball? What keeps the ball moving?*Learners draw pictures with arrows showing the direction of the forces involved (revision).Conclude that a moving object has energy. This energy can be given by a force. When the force stops the object can still keep moving; it still has energy. | Pictures of things moving:* a car
* an aeroplane
* a person pushing a shopping trolley.

Small toy.Bowling ball video<https://www.youtube.com/watch?v=TZ9JbvClnZA> Ball. | Balanced forces = no change in movement.Unbalanced forces change the speed or direction of moving objects.When a force moves an object, energy is transferred and work is done:Work done = energy transferred.Misconception alert: A moving object can have energy when there is no longer a force pushing the object forwards; this idea is a confusing one for many learners. Give the learners lots of practice at identifying the point at which there stops being a push force on different objects. |