**Scheme of Work – Science Stage 5**

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 5. 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 5 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.

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| --- | --- | --- |
| Term 1 | Term 2 | Term 3 |
| Unit 5.1 The way we see things | Unit 5.3 The life cycle of a flowering plant | Unit 5.5 Earth’s movements |
| Unit 5.2 Evaporation and condensation | Unit 5.4 Investigating plant growth | Unit 5.6 Shadows |

**Unit 5.1 The way we see things**

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

In this unit, learners:

* build on previous learning about light and dark
* discover that surfaces and mirrors reflect beams/rays of light
* understand that we are able to see because reflected light enters our eyes.

Scientific Enquiry work focuses on:

* knowing that scientists have combined evidence with creative thinking to suggest new ideas and explanation for phenomena
* making relevant observations.

Recommended vocabulary for this unit:

* light, source, beam, rays
* reflect, surface, mirror, object
* bright, dull, faint, brightness, intensity
* eyes.

| **Framework code** | **Learning objective** | **Suggested activities to choose from** | **Resources** | **Comments** |
| --- | --- | --- | --- | --- |
| 5PI4  5Eo1 | Know that light intensity can be measured  Make relevant observations | As a class, discuss different light sources and make a list.  Learners draw or collect pictures of these different light sources. They order the pictures by light intensity from the brightest to the dullest, discussing the order and reasons for their choices.  Show learners how light intensity can be measured with a light meter (free apps for smart phones can also give light intensity readings). Using a darkened room, measure the light intensity of different light sources (e.g. torch, candle). As a class, conclude that we see light in different levels of brightness. | Pictures of a torch, candle, match, sun, fire, lamp, fluorescent light, television, projector.  Light meter, data logger or equivalent app (if available).  Light sources (e.g. torch, candle). | Health and safety:  Explain that you must never look directly at the Sun as it can cause damage to the eyes and even blindness.  Misconception alert: Learners may suggest the Moon as a source of light. In reality the Moon, when visible, is reflecting light that originates from the Sun. This can be discussed in the context of light reflection later in the unit. |
| 5PI6  5Ep1 | Know that we see light sources because light from the source enters our eyes  Know that scientists have combined evidence with creative thinking to suggest new ideas and explanations for phenomena | Discuss with learners how our eyes work. Show a diagram of the eye and point to the opening at the front of the eye. *Why is it there?* Discuss how something must be either coming in, or coming out, of the eye; that something is light. Have some blindfolds for the learners (ideally with a coloured fabric on the inside, i.e. by the eyes). *What would you expect to see if light comes from our eyes first?* If this was the case, they would see the colour on the back of the blindfold. Put the blindfolds on. *What do you see?* Darkness. *What would you expect to see if light was entering the eye?* *What would the blindfold do?* Conclude that light enters our eyes.  Before the lesson, create one or more ‘black boxes’ (depending on the number of learners in your class). For each box, put two small holes (eye-width apart) on one side of the box and cut a hole for a torch in the top of the box. Paint the inside of the box black.  Use a ‘black box’ to demonstrate how we cannot see things without light, by turning the torch on and off. Learners record how the light travels from the torch by adding arrows to a diagram.  Show learners a variety of light sources – discuss how we can see them. Use a piece of string to represent the light and show how the light goes in a straight line from the light source to their eye. Repeat this with a light source behind an obstacle. *Can you still see the light source?* They may see ‘the light’ but not the source. Use string again to show the straight path of light and discuss how light always travels in straight lines. Make sure that learners use a straight edge (or ruler) when drawing light rays.  Look at scientists from history who have studied light (e.g. Ibn al-Haytham). Talk about how they had to take evidence and apply creative thinking to reach conclusions which challenged previous understanding. | Blindfolds.  Boxes (e.g. shoe boxes), torch, black paint.  Prepared black box, torch, black paint.  Examples of light sources (real objects and/or pictures).  String. | Misconception alert: Learners often think that light comes from our eyes. Make sure diagrams of light rays are drawn with a ruler and show the direction the light travels.  Health and safety: Explain that you must never look directly at the Sun as it can cause damage to the eyes and even blindness. |
| 5PI7  5Eo1 | Know that beams/rays of light can be reflected by surfaces including mirrors, and when reflected light enters our eyes and we see the object  Make relevant observations | Play a game of ‘I spy’ with the learners using objects in the classroom. Discuss, after a few rounds, how they are seeing the objects. Recap how light enters our eyes. *Where is the light coming from?* The objects aren’t all sources of light (although some of them may be).  Introduce the concept of light rays reflecting off objects before they enter our eyes. Use string to show how light travels from a light source, bounces/reflects off a surface and then enters our eye. When the light reflects it changes slightly, depending on the object it reflects off, and it is this reflection that enters our eye allowing us to see the object. Have the learners identify the source of light, the object being seen and the likely path of the light. The learners can then draw diagrams showing how they see light (using straight lines and arrows to show the light going into their eyes).  Discuss everyday uses of mirrors (e.g. for checking appearance or for reversing in cars). *Where does the image shown by the mirror come from?*  Ask learners to explore what they can see with a mirror by suggesting a series of questions. *Can you see behind you?*  *Can you make a beam of light move around the classroom?*  Encourage learners to create their own questions to explore, answer and record.  Stand a learner with their back to a light source – discuss if they can see the light source. Place a mirror in front of the learner, and ask if they can now see the light source. Discuss how that is possible. Have some string and show the path of the light from the light source, reflecting off the mirror and to the eye of the learner. Even though they couldn’t see the light source, the mirror reflected the light from it back to their eye, allowing them to see it.  Repeat this demonstration with other volunteers and a range of objects in the classroom (e.g. chairs, tables, classroom displays). Discuss with the learners how they can see them, even though they are not light sources. Use string to model light originating from the light source, reflecting off an object, then reflecting off the mirror into the learner’s eye. Explain that when light bounces off a mirror it does not change a lot, which is why the reflection shows the objects.  Discuss how we see the Moon at night. Look at images of and facts about the Moon, e.g. *What is it made of?* Establish that the Moon is not a source of light (e.g. it is made of rock, it isn’t always visible). Use learners as the Sun, Earth and Moon to model how the Moon reflects light and it is the reflected light that we see. Reinforce this learning using diagrams of the Sun, Earth and Moon.  Hide an object behind a screen and ask learners about the object. *What can you tell me about the object?* Discuss how they cannot see it because light travels in straight lines and the screen stops the reflected light from getting to their eyes. Discuss how they could describe the object, e.g. move the screen, move the object, move themselves, use a mirror. Describe, in terms of light ray paths and reflections, how moving these items would enable them to see, and therefore, describe the object. | Range of objects (some of which are light sources).  String.  Mirrors.  String.  Images of the Moon.  Diagram of the Earth, Sun and Moon.  Object, screen. | Be aware that when light is reflected it can change – this is the reason not all objects look like sources of light. The energy in light can be transferred to an object a light ray hits. The reflected light ray is therefore different to the light ray that hit the object and our eyes can detect that difference (e.g. a change in colour).  Be aware that light rays do not interact in standard conditions, e.g. they do not reflect/bounce off each other. |
| 5PI8  5Eo1 | Explore why a beam of light changes direction when it is reflected from a surface  Make relevant observations | Demonstrate to learners, in a dimly lit room, what happens when a torch with a powerful beam is shone at a mirror. By using large sheets of white paper under the torch and mirror it is possible to see the light ray before and after it has been reflected. Ask learners to trace the path of the original light beam and the reflected beam. They then explore what happens when the light hits the mirror at different angles.  Discuss what the learners have observed and what they think is happening. Record all answers on the classroom board to be reviewed later.  With the learners sitting in a semi-circle; using a table on its side, a tennis ball and a large mirror; demonstrate the angle of reflection from a mirror. Explain that the reflection of light off a mirror can be compared to the way a ball bounces off a wall.  Revisit the learners’ thoughts on the board from earlier in the lesson.  *Which is the best explanation?*  Explain to the class they are going to use what they have learned about mirrors to make a periscope; it will help them look around a corner, look over a wall, under a cupboard, etc.  Demonstrate to the learners several different designs of periscopes.  Individually, the learners will design a periscope marking their drawing with the direction they predict the light beams will travel with arrows.  Allow the learners time to make their periscopes. Then they test them by getting a partner to hold up a secret object out of sight and attempting to identify it with the periscope.  Discuss modern uses of periscopes in tanks and submarines.  *Are there any other uses for periscopes?* | Powerful torch.  Mirror.  Dimly lit room.  Large sheet of white paper.  Pencil and paper.  Table on its side.  Tennis ball.  Mirror.  Examples of designs for periscopes  <http://www.webinnate.co.uk/science/week8.htm>  Plastic-coated mirrors.  Tall box such as a milk or juice carton or cardboard.  Sticky tape. | Health and safety: Ensure that every edge on the mirrors is bound. |

**Unit 5.2 Evaporation and condensation**

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

In this unit, learners:

* learners consolidate their ideas about changes of state which can be reversed
* use their understanding to explain a range of familiar phenomena
* understand what evaporation and condensation are and how they are related.

## Scientific Enquiry work focuses on:

* making relevant observations
* measuring volume, temperature, time, length and force.
* presenting results in bar charts and line graphs
* recognising and making predictions from patterns in data and suggesting explanations using scientific knowledge and understanding
* interpreting data and thinking about whether it is sufficient to draw conclusions.

## Recommended vocabulary for this unit:

* matter, particle, state of matter, solid, liquid, gas
* evaporation, evaporate, condensation, condense, solidify, freeze, water vapour, water cycle
* melting point, boiling point
* surface effect, steam
* solution, soluble, insoluble, dissolved, crystal.

| **Framework code** | **Learning objective** | **Suggested activities to choose from** | **Resources** | **Comments** |
| --- | --- | --- | --- | --- |
| 5Cs1  5Ep4  5Eo2  5Eo4  5Eo7  5Eo8 | Know that evaporation occurs when a liquid turns into a gas  Use knowledge and understanding to plan how to carry out a fair test  Measure volume, temperature, time, length and force  Present results in bar charts and line graphs  Recognise and make predictions from patterns in data and suggest explanations using scientific knowledge and understanding  Interpret data and think about whether it is sufficient to draw conclusions | Give the learners a concept map of the key vocabulary linked to solids, liquids and gases. Ask them to use specific vocabulary associated with the topic to complete the map. If necessary, provide a word bank of the vocabulary from Stage 4 (Solids, liquids and gases).  Recap prior learning. In small groups, challenge the learners to model the particle arrangements and movements of solids, liquids and gases by pretending to ‘be’ particles in different arrangements. They will demonstrate these to the rest of the class.  Discuss how each process has a name, e.g. when a solid turns into a liquid it is melting, when a liquid turns into a gas it is often called evaporation.  On a dry day (before the lesson) show the learners a puddle in the school yard on an impermeable material such as concrete or tarmac (a puddle may need to be made for this activity). Explain to the learners that they will be observing what happens to the puddle throughout the day. Draw a line around the outside of the perimeter in chalk. Ask a learner to draw the perimeter every 30 minutes with a different colour chalk each time. The learners should be able to see that, as the day progresses, the puddle gets smaller. The learners explain that the liquid water in the puddle evaporated. *Where has the water gone?* Discuss. Make sure that all learners can explain that the water has not disappeared but has turned into water vapour and is in the air around us. Explain that when a hot bath is run the windows and cold surfaces get water on them. The water vapour in the air, that came from evaporation of the hot bathwater, is becoming a liquid again as it cools down.  Demonstrate to the learners that the evaporation process does not just occur with water. Put a little perfume in a dish and waft the smell towards the learners with a fan. Then show them that there is no longer any liquid in the dish; it has evaporated into a gas which is how the learners are able to smell it.  Ask the learners to discuss, in small groups, what is happening when something dries out, e.g. a towel after they have been swimming. Each group reports back to the rest of the class. Make sure that no learner believes that the water is vanishing.  Discuss how evaporation is a surface effect; it occurs where water and air meet. Water does not evaporate from the middle of a body of water, only at the surface.  Ask learners, in small groups, to write a definition of ‘evaporation’ on a small piece of paper (or sticky note) and collect these at the front of the class. Work through each one, agreeing or disagreeing, until a class definition is achieved.  **Scientific Enquiry activity**  *What variables affect the rate of evaporation (i.e. how quickly it happens)?*  Ask learners, in small groups, to think about the different variables that could be investigated (e.g. temperature, surface area of the water). Decide at a class level, or in groups, what variables they will investigate. Learners plan an investigation where they can measure a change in water level over time while changing one variable.  Learners can use the data collected to draw a line graph.  Learners could present their results to the rest of the class. | Concept map of the key vocabulary linked to solids, liquids and gases.  A puddle outside.  Chalk in different colours.  Perfume.  Small dish (e.g. a saucer).  Fan (can be battery powered).  Small dishes (e.g. a saucer).  Water.  Clock or other way of measuring time.  Graph paper. | Misconception alert: The water has not disappeared during evaporation; it remains in the air as water vapour.  Misconception alert: Some learners may refer to boiling and the production of steam when thinking about evaporation. Boiling and evaporation are different processes; evaporation is a surface effect, boiling is when the body of a liquid forms bubbles. Boiling happens when the temperature of a liquid has reached the point at which the pressure of the gas produced is greater than the pressure of the liquid; gas/vapour is then produced within the body of a liquid so bubbles are formed.  Steam, as a scientific term, is invisible. However, learners associate ‘steam’ with the common use of the word, i.e. hot water vapour condensing in the air as water droplets before evaporating back into the air due to their small size. It is important to clarify to learners that the ‘steam’ they see is not a gas but water droplets in air cooling before evaporating again. |
| 5Cs2  5Cs3 | Know that condensation occurs when a gas turns into a liquid and that it is the reverse of evaporation  Know that air contains water vapour and when this meets a cold surface it may condense | Remind learners of the process of condensation by showing the learners an object (e.g. glass, drinks can) that has been kept in the freezer. Ask learners to observe what happens as the object is kept in a warm room. At the beginning, the surface of the object will be covered in water; the water vapour in the air around the object is cooling down and turning into a liquid. Eventually, the object will warm up to the same temperature as the room and the water on the surface will ‘disappear’ as the water droplets on the object evaporate back into the air as water vapour.  Explain that this process of cooling a gas into a liquid is called ‘condensation’ and is the opposite of ‘evaporation’.  Recap prior learning. In small groups, challenge the learners to model the particle arrangements (and the movement) of solids, liquids and gases by pretending to ‘be’ particles in different arrangements and to demonstrate this to the rest of the class.  Discuss how each process has a name:   * When a solid turns into a liquid it is ‘melting’. * When a liquid turns into a gas the process is called ‘evaporation’. * When a gas turns into a liquid it is ‘condensation’.   Show the learners how evaporation and condensation are important in the water cycle by using an animation from a website.  *Are clouds solid, liquid or gas?* Most learners will misidentify clouds as being made of gas. Use questioning to help learners work out for themselves that clouds are made of water droplets or ice. *When you boil a kettle what does water vapour look like? What happens to the temperature when you go higher into the atmosphere? What happens to water vapour when it cools down?*  Use information sources to reinforce learners understanding. Clouds are made of droplets of liquid water (or ice crystals in high clouds that are very cold), and when it rains it is due to the droplets reaching a large size.  An annotated, large version of the water cycle can be made by the learners and displayed in the classroom.  Learners can set up an experiment to observe evaporation and condensation. Place some warm/hot water in the bottom of a glass bowl. In the middle, place an empty glass. Place some plastic wrap over the bowl and, using ice, weigh down the plastic wrap over the empty glass. In this sealed system, the warm water will evaporate; condensation will occur on the ice-cold plastic wrap forming liquid water that will drip down into the empty glass. These two processes, evaporation and condensation, effectively move the water from the bowl into the glass.  As a class, discuss where learners may have experienced condensation in their homes.  *What caused the condensation? Where did the water vapour come from?*  Give learners a picture of the inside of a house. Ask them to identify, on the picture, where condensation may take place and the cause of the water vapour. *Why does condensation happen in these particular places?*  **Extension activity**  Some learners may identify that they can see ‘steam’ from a kettle. Show learners a boiling kettle (or a picture) and help them to observe that there is a gap between the spout of the kettle and the start of the steam. In this gap there is invisible water vapour. As the water vapour gets further away from the heat source, some of it cools and condenses forming droplets of liquid water which can be seen. The water droplets that make up ‘steam’, evaporate into the air again due to their small size, which is why ‘steam’ looks like it disappears. | Drinks can that has been in a freezer.  <http://www.metoffice.gov.uk/learning/weather-for-kids/water-cycle>  <https://www.youtube.com/watch?v=gqp__Mf8g5M&list=PLLnAFJxOjzZvleYQDHjPeXrxLyp9c3l_2&index=4>  <https://www.metoffice.gov.uk/learning/clouds/what-are-clouds>  Glass bowl, warm/hot water, collecting glass, plastic wrap, ice.  Picture of the inside of a house.  Kettle. |  |
| 5Cs4  5Eo1  5Eo4  5Eo8 | Know that the boiling point of water is 100°C and the melting point of ice is 0°C  Make relevant observations  Present results in bar charts and line graphs  Interpret data and think about whether it is sufficient to draw conclusions | **Science Enquiry activity**  Boil a pan of water in front of the learners. If possible, use a data logger to take regular measurements of the temperature. If one is not available, use a thermometer to measure the temperature every minute. Record the temperature as a class over time.  As the demonstration continues, ask the learners to make observations about what the water looks like. They should see bubbles forming in the water.  *What is causing the bubbles?*  Keep recording the temperature as the water boils and show the temperature stays steady at a certain point. At this boiling point, the water is hot enough to transform the liquid water into gas in the body of the water, not just at the surface. The bubbles are made of water vapour.  The learners can draw a line graph of the results. Once the line graphs have been constructed ask learners to explain what is happening in the graph.  Explain that all liquids have a boiling point, and for some it is a very high temperature, while for others it is lower than the boiling point of water. Look at other information sources to confirm.  Show learners a kettle boiling and ask the learners to observe what is happening to the water within the kettle. *What are the bubbles made of?* It is a common misconception that the bubbles are made of air. Help the learners to understand that the bubbles are made of water vapour; the liquid water is turned into a gas which makes bubbles. You may need to explain that the water has not ‘disappeared’ but has changed into water vapour, which is invisible, and is all around us in the air.  **Scientific Enquiry activity**  In groups, learners place ice cubes in different situations (including one as near to 0 °C as possible). Discuss how the ice cubes change over time and how the ones kept below 0 °C stay frozen. Discuss how water has a melting point of 0 °C for pure water.  All solids have a melting point, some are below room temperature so we see them as liquids while some are very high so we have to heat them to melt, e.g. most metals. (Mercury is the exception. It is a metal that is liquid at room temperature, only turning to solid at, or below, its melting point of -39°C.) | Pan of water.  Heating plates or hob.  Data logger (if available) or thermometer and timer.  Graph paper.  Ruler.  Pencil.  Information sources with boiling points of different liquids.  Glass kettle/transparent kettle or search for a video of a transparent kettle.  Ice cubes.  Containers to put ice cubes in (e.g. jam jar, glass, plastic mug, saucer).  Locations of different temperatures. | Health and safety:  It is essential that this boiling water activity is done by a teacher. |
| 5Cs5  5Eo1  5Eo7 | Know that when a liquid evaporates from a solution the solid is left behind  Make relevant observations  Recognise and make predictions from patterns in data and suggest explanations using scientific knowledge and understanding | Give the learners time to explore what happens to a series of solids when they are placed in water (salt, sugar, sand, rice and dried peas).  Discuss what happened when each of the solids was added to water. Some of them can no longer be seen while some of them could are still visible. Remind learners that when the solid ‘disappears’ in the water, it has dissolved and a solution has been formed. This can be confirmed by weighing the water and solid before adding them together and then weighing the solution. Solids that dissolve are ‘soluble’. *But what happens when the liquid in the solution evaporates? Does the solid ‘come back’?*  Revise prior learning about evaporation. In small groups, learners discuss: *What will happen when a solution is allowed to evaporate?*  **Science Enquiry activity**  Learners make a solution by adding a solid to hot water a little at a time. They should stop adding the solid when no more will dissolve (i.e. when crystals are left). The solutions should be left to evaporate in a sunny place (e.g. a windowsill). The evaporation can be done in a saucer, or the learners can hang some wool or string from a pencil so it dangles in a glass jar. The jar must be very clean or the crystals will form on the edge of the jar rather than on the string. Learners then monitor, and record, what happens to the solution over time.  Demonstrate to the learners how to make sugar crystals from sugar solutions:   * Bring a pan of water to the boil and then add sugar until it no longer dissolves. Explain that sometimes we need to make things hot to make a solution. * Pour the solution into some clean glass jars (baby food jars are ideal). * Tie a piece of string (or wool) around a pencil and allow it to hang into the solution without touching the sides. * Place in a sunny place.   Ask the learners to predict what will happen as the water evaporates from the jars.  The learners can then take a daily photograph of the glass jars and watch as sugar crystals are made.  *How have the crystals been formed?*  *What process has taken place?*  The learners create a photo diary including a description of how to make sugar crystals and an explanation of why they form.  **Extension activity**  Learners could plan an investigation to find out which conditions make the biggest crystals. | Cold water (e.g. that has been kept in a fridge).  Variety of solids (e.g. salt, sugar, rice and dried peas).  Weighing scales.  Transparent, waterproof containers (e.g. jam jar, glass, clear plastic cup).  Sugar or salt (to dissolve).  Hot water.  Spoon or stick for stirring.  Pan and source of heat.  Sugar.  Water.  Clean glass jards.  String of wool.  Spoon or stick for stirring.  Camera. | Health and safety:  This activity must be done as a teacher demonstration because of the hot sugar solution. |

**Unit 5.3 The life cycle of a flowering plant**

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

In this unit, learners:

* study the anatomy of flowers
* find out about the different stages in the life cycle of a flowering plant and the processes involved
* are introduced to the importance of reproduction in preserving a species.

Scientific Enquiry work focuses on:

* making relevant observations.

Recommended vocabulary for this unit:

* flower, petal, pollen, male organ, female organ, ovum, ova, stamen, carpel
* pollination, pollinator, fertilisation, fuse, germination, offspring
* seed, fruit, seed dispersal, animal, insect, wind, explosion, water
* dissect.

| Framework code | Learning objective | Suggested activities to choose from | Resources | Comments |
| --- | --- | --- | --- | --- |
| 5Bp2  5Eo1 | Know that plants reproduce  Make relevant observations | *Why is it important for plants to make seeds?*  Establish that seeds are important as the plant needs to reproduce (create offspring to ensure the species survives).  Begin the unit by the learners planting seeds of vegetables and fruits. These can be grown in a series of raised beds or containers. Learners can be responsible for watering the plants regularly. They can take photographs as they grow. For fast-growing vegetables, the learners can taste their crop when they are ready. | Fruit and/or vegetable seeds (e.g. lettuce, peas, herbs, beans, apple pips, peach stones).  Place to grow plants (e.g. raised beds, area of soil in the school grounds or containers).  Small containers can be made from food packaging (e.g. yoghurt pots, plastic bottles with the top section cut off, margarine tubs). Large food containers can be requested from cafes/restaurants etc. Bins, sinks and baths make suitable large containers for growing plants.  Compost.  Gardening equipment (e.g. a water bottle with a sports cap can be used as a simple watering can for small containers). | Seeds may be planted and grown one or two weeks before this unit is begun.  Instructions on growing a variety of plants can be found at:  <http://www.greatgrubclub.com/grow-it#.VMYSztKsXeA>  and  <https://schoolgardening.rhs.org.uk/resources>  Be aware of learners with allergies to particular seeds/plants (e.g. peanut allergies) |
| 5Bp6  5Eo1 | Observe that plants produce flowers which have male and female organs; seeds are formed when pollen from the male organ fertilises the ovum (female)  Make relevant observations | Show the learners pictures of a non-flowering plant and a flowering plant. Ask them to identify the differences. Ensure that learners can name the main parts of the plant (e.g. flower, petal, stem, leaves, roots).  Ask the learners what the role of the flower is in a flowering plant. Explain that the flowers attract bees and insects and, eventually, part of the flower becomes the fruit of the plant containing the seeds.  Demonstrate to the learners how to dissect a large flower. As you dissect the flower, stick each part onto a piece of paper and add a label with the name of the part and its function.  Show learners the male organ (stamen), the female organ (carpel) of the flower and the location of the pollen and ova.  Working in small groups, learners dissect a flower in the same way as the teacher.  The dissected plant with labels can be photographed as evidence of learners’ work.  Individually, learners draw a sketch of the flowering plant. They then add name labels, and an explanation of the function, of each part.  As a class, learners play an interactive dissection game. | Pictures of a non-flowering plant (e.g. a fern) and a flowering plant (e.g. poppy).  Large flower (e.g. rhododendron, lily, tulip) with clearly visible carpel and stamen.  Plate.  Sharp scissors, tweezers.  Glue, Paper.  Large flowers (one per group).  Sharp scissors, tweezers.  Plate.  Glue, paper.  Camera.  <http://www.bbc.co.uk/bitesize/ks2/science/living_things/life_cycles/play/> | The pollen from lilies can stain.  Health and safety:  Make sure you discuss the health and safety implications about working with sharp scissors. |
| 5Bp5  5Bp6  5Eo1 | Know that insects pollinate some flowers  Observe that plants produce flowers which have male and female organs; seeds are formed when pollen from the male organ fertilises the ovum (female)  Make relevant observations | Pollination  Explain that in order for the flower to turn into a fruit it needs to be fertilised and that means pollination must take place. Pollination is when pollen moves from the male part of the flower to the female part.  *How can pollen get to the female part of a flower? How can pollen get from one flower to another flower? Can anyone name an animal that is involved in the pollination process?*  Most learners should be able to identify the bee; some may suggest other insects. Explain that a wide range of insects, and some birds, are involved in this process as they travel from plant to plant. Explain that you will look at how this happens during pollination later in the unit.  *How do you think plants attract animals for pollination?*  Show the learners some pictures of plants that are pollinated by insects or birds. *What things do they have in common?*  Discuss the different ways insect-pollinated plants have adapted (e.g. brightly-coloured petals, scents, production of nectar, sticky pollen).  **Extension activity**  Show learners photographs of flowers taken using UV light to show how the petals look to a pollinator (such as a bee). | Pictures of insect-pollinated and bird-pollinated plants.  UV photographs of flowers. |  |
| 5Bp6 | Observe that plants produce flowers which have male and female organs; seeds are formed when pollen from the male organ fertilises the ovum (female) | Fertilisation  Revise the parts of the plant and their functions with the class. Check learners can recall, which parts of the flower are male, which parts are female and describe what happens during pollination.  *What happens to the pollen once it has reached the female part of the flower?*  Show learners a picture of a dissected flower. Explain that after pollination, the pollen travels down a tube into the ovary (another female part). In the ovary, a pollen grain fuses with an ovum. This is called ‘fertilisation’. The fertilised ovum becomes a seed.  Make sure learners are aware of the distinction between the processes of pollination and fertilisation.  Learners can draw their own version of a dissected flower and identify where the different stages of pollination and fertilisation occur.  Learners can make a cartoon strip showing the processes of pollination and fertilisation. | Picture of a dissected flower. |  |
| 5Bp3  5Eo1 | Observe how seeds can be dispersed in a variety of ways  Make relevant observations | Show the learners a picture of a large tree. *What would happen to a seed that dropped directly underneath it?*   * Discuss why the seed probably would not grow at all or it would not grow well. Explain that there would be too much competition with the large tree (especially for light and water). * Therefore, it is important that seeds are dispersed away from both the parent plant and from each other.   Use a range of activities to introduce the four ways that seeds can be dispersed (i.e. animal, wind, explosion, water):  Animal   * Ask the learners who likes to eat fruit. Explain that by eating fruit they are in fact demonstrating one method of seed dispersal, i.e. animals. Discuss the two methods by which animals disperse seeds: eating and by the seed clinging onto fur. (You may need to remind learners that birds are animals.)   Wind   * Show learners a picture of a dandelion clock being blown. Ask the learners to describe the features of a dandelion and how they think the seeds are dispersed. Explain that the seeds are very light and are dispersed by wind.   Explosion   * Show learners a video of a slowed-down version of a seed pod exploding. The seeds are literally thrown away from the pod when the casing explodes. Use a pea pod to demonstrate dispersal by explosion.   Water   * Show the learners a coconut. What method is used to disperse this seed? Learners will probably suggest animal. Place the coconut in a bucket of water and demonstrate that it floats. Explain that the final method of seed dispersal is water. These seed casings are either spongy or fibrous, which allow them to float on water.   Show learners a picture of a desert island. *What did the palms grow from? How did they get to the island?*  Learners can research different seeds, using a seed catalogue or the internet, and find examples of different methods of seed dispersion. They then draw each seed and label the features which make it suitable for that method of dispersal.  Show learners a collection of pictures of different fruits and seeds. Learners take it in turns to pick a fruit/seed and explain which method of dispersal it uses and how they know this. They can then group the pictures of the fruits/seeds by their methods of dispersal. | Pictures of seeds that are dispersed by animals.  Picture of a dandelion clock being blown.  <https://www.youtube.com/watch?v=jw_ySsU-u8w>  Pea pod.  Coconut.  Bucket of water.  Picture of a desert island.  Seed catalogue.  Secondary sources (e.g. books, internet).  Pictures of fruits and seeds with different dispersal mechanisms. |  |
| 5Bp7 | Recognise that flowering plants have a life cycle including pollination, fertilisation, seed production, seed dispersal and germination | Recap all the scientific knowledge and understanding from this unit, asking questions to ensure understanding.  *What methods of seed dispersal are there?*  *How is this plant pollinated?*  *What is fertilisation?*  Emphasise the correct vocabulary and definitions; ensure that all learners fully understand these.  Demonstrate how the processes of germination, pollination, fertilisation and seed dispersal all form a life cycle.  *Why is it called a life cycle?*  Learners draw and label a life cycle.  Allow the learners access to secondary sources (e.g. books, internet) to research the life cycles of different plants. Learners draw labelled life-cycle drawings of the selected plants; they identify similarities and differences between them.  **Extension Activity**: Learners can investigate the preferred habitat and conditions for healthy growth required by each plant.  Show the learners a picture of a tropical, unfamiliar plant. *How is it pollinated? How are its seeds dispersed?* (For example, the “Yellow Trumpetbush” is pollinated by hummingbirds.) | Pictures of a dissected plant, wind-pollinated plant, insect-pollinated plant, different types of fruit and seed.  Picture of a plant life cycle.  Access to secondary sources (e.g. books/internet).  Drawing equipment.  Picture of a Yellow Trumpetbush. |  |

**Unit 5.4 Investigating plant growth**

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

In this unit, learners:

* are introduced to photosynthesis
* understand what seeds need to germinate
* understand what plants need to grow healthily.

Scientific Enquiry work focuses on:

* using observation and measurement to test predictions and make links
* making predictions of what will happen based on scientific knowledge and understanding, and suggesting and communicating how to test these
* using knowledge and understanding to plan how to carry out a fair test
* collecting sufficient evidence to test an idea
* identifying factors that need to be taken into account in different contexts
* discussing the need for repeated observations and measurements
* deciding whether results support predictions
* beginning to evaluate repeated results
* interpreting data and thinking about whether it is sufficient to draw conclusions.

Recommended vocabulary for this unit:

* photosynthesis, light, water, carbon dioxide, oxygen
* producer
* germination
* variable, valid.

| Framework code | Learning objective | Suggested activities to choose from | Resources | Comments |
| --- | --- | --- | --- | --- |
| 5Bp4  5Ep2  5Ep3  5Ep4  5Ep5  5Ep6  5Eo3  5Eo5  5Eo6 | Investigate how seeds need water and warmth for germination, but not light  Use observation and measurement to test predictions and make links  Make predictions of what will happen based on scientific knowledge and understanding, and suggest and communicate how to test these  Use knowledge and understanding to plan how to carry out a fair test  Collect sufficient evidence to test an idea  Identify factors that need to be taken into account in different contexts  Discuss the need for repeated observations and measurements  Decide whether results support predictions  Begin to evaluate repeated results | Revise learners’ knowledge and understanding about the life cycle of a plant.  *What is germination?*  *What do seeds need to germinate?*  **Scientific Enquiry activity**  Ask the learners to plan an investigation to provide evidence to determine if seeds need light to germinate.  In small groups, learners plan an investigation identifying factors that need to be considered. They make predictions about what will happen.  Learners place a piece of filter paper soaked in water (or alternative) at the bottom of a small container and then put the seed on top. If the container is transparent then it can be wrapped in aluminium foil to make it opaque. Plastic wrap can be used to provide a transparent cover for the seed that is to be left in the light.  After a set amount of time, learners open the containers and record findings. Discuss the results and help to establish a conclusion that seeds do not need light to germinate. Photograph results.  *Can you give me a reason why they do not need light to germinate?*  *Where do seeds normally start to germinate?*  Explain that seeds start to germinate in soil with no light. Light is only required when the seed becomes a plant.  Discuss whether the conclusions matched their predictions. Learners can then write up the findings of their investigation.  **Extension activity**  Learners take observations for a longer period of time to investigate the effect of light and dark on plant growth. Learners can measure the height of the plant with a ruler and record the colour of the leaves as they form. Photograph results.  **Scientific Enquiry activity**  Ask learners to plan and set up an investigation to find out if any liquid will cause a seed to germinate or just water.  Use a similar method to the previous investigation. Make the test as fair as possible by using the same volume of liquid and having all the seeds in either the dark or the light. Learners should check the seeds for germination, make observations and add more liquid when needed.  In their groups, learners collect all their samples and look at what has happened to the seeds. Photograph the results.  *Which seeds have germinated?*  *Which have not?*  *Is there anything you were not expecting?*  If some of the seeds have not germinated despite having ideal conditions, discuss why this may have happened. Explain that the seed may have been faulty and discuss why it is important to set up repeated investigations to ensure reliability of results.  **Scientific Enquiry activity**  Learners plan a third investigation to find out if seeds need warmth to germinate.  Use a similar method to the previous investigation. Make the test as fair as possible by using the same volume of water and having all the seeds in the dark (because the inside of a fridge is dark). Learners should check the seeds for germination, make observations and add more water when needed.  As a class discuss the results of all of the germination experiments. *Based on your results, which of the following do seeds need for germination - water, warmth and/or light*?  Learners can then use their photographs and discussion work to write a report about their investigations.  *Have you enough results to make a conclusion?*  *How could you have made your investigation better?*  Check learners’ understanding by asking:  *Why do plants in temperate regions germinate in Spring?*  *Why do plants in dry regions germinate after it rains?* | Seeds that germinate quickly e.g. cress, mustard or beans.  Filter paper (e.g. a coffee filter) or cotton wool or cotton pads for makeup removal).  Water.  Small containers (e.g. baby food jars or film canisters if they are available), aluminium foil (only required if the container is transparent), plastic wrap.  Ruler.  Camera.  Seeds that germinate quickly e.g. cress, mustard or beans.  Filter paper (e.g. a coffee filter) or cotton wool or cotton pads for makeup removal).  Small containers (e.g. film canisters or baby food jars).  A variety of liquids such as water, orange juice, oil, fizzy drink, milk.  Camera for photograph diaries of the seed growth.  Seeds that germinate quickly e.g. cress, mustard or beans.  Filter paper (e.g. a coffee filter) or cotton wool or cotton pads for makeup removal).  Small containers (e.g. film canisters or baby food jars).  A cold place to keep half of the seeds (e.g. a fridge).  A warm place to keep half of the seeds (e.g. a cupboard).  Seeds growing in the light and the dark from earlier experiments. | The teacher should set up extra seeds growing in the light. These will be needed for investigations later in the unit.  Learners need to keep their seeds watered after their investigation so that they continue to grow in the light or the dark. These seedlings will be looked at again later in the unit. |
| 5Bp1  5Ep3  5Ep4  5Ep6  5Eo3  5Eo5  5Eo8 | Know that plants need energy from light for growth  Make predictions of what will happen based on scientific knowledge and understanding, and suggest and communicate how to test these  Use knowledge and understanding to plan how to carry out a fair test  Identify factors that need to be taken into account in different contexts  Discuss the need for repeated observations and measurements  Decide whether results support predictions  Interpret data and think about whether it is sufficient to draw  conclusions | Ask the learners what they do when they need some energy. Animals need to eat food to get energy to move or grow.  *What do plants eat to make energy to grow?*  Explain that plants can make their own food through a process called photosynthesis. We call green plants “producers”.  Show the learners a picture of a plant. Draw three boxes with arrows to the picture.  *What three things are needed for photosynthesis?*  Explain that the plant needs light, air (carbon dioxide) and water. This can only happen in the green parts of a plant.  Draw two boxes with arrows pointing away from the green plant. *What two things are produced during photosynthesis?*  Explain that during photosynthesis the plant makes sugar. This is what the plant will use for food. Oxygen is made as a byproduct of the process.  Learners then draw a diagram of the process of photosynthesis.  **Scientific Enquiry activity**  Learners can finish taking observations of the plants produced from seeds that have been growing in the light and the dark. The plants that have been growing in the light should have green leaves and be showing healthy growth. The plants growing in the dark are likely to be long, thin, weak and have yellow leaves; the longer stems are an adaptation to trying to find the light the plant needs.  *Which plant has been able to make its own food by photosynthesis?*  *Which plant is healthier?*  *Did the seeds need light to germinate?*  *Do the plants need light to grow?*  *Why is there a difference between what the plants need to germinate and to grow?*  **Scientific Enquiry activity**  Learners can transplant the plants produced from seeds that have been growing in the light into small containers containing compost. These can be used for the investigations in the next lessons.  Set up an investigation that the learners can monitor over the next four weeks. Take two green plants of the same species and as similar as possible in size and health. Remove all the leaves from one of the plants.  Place the two plants in the same conditions and ask learners to predict what will happen to the two plants over the next few weeks.  Allow learners to observe what happens to the plants over the next few weeks. Carry out a full investigation.  **Scientific Enquiry activity**  Learners plan an investigation to find out the conditions needed to help plants grow well. Identify different variables they could investigate.  *What variable will you change?*  *What will you measure?*  Make a list of the different variables on the board (e.g. light, water) and talk about how an investigation could be set up to monitor plant growth under these different conditions.  Allow learners to set up a series of plants growing in different conditions, e.g. dry and dark, dry and light, damp and dark, damp and light.  Introduce learners to the idea of a control. Explain that it is a way of making sure the variable being tested is actually having an effect on the results.  *Which of the plants is our control?*  *What do you expect will happen to each of the different plants?*  Learners can take a photograph of their experiment.  Ask the learners to compare the results from the plants that were grown in light/dark, dry/damp conditions.  *What is the difference between plants grown in the light and plants grown in the dark?*  *What is the difference between plants grown with water and plants grown without water?*  *What are the best conditions for growing plants?*  *Were any of the results surprising?*  *Do you need to check the validity of any of your results?*  *Do you have sufficient data to draw conclusions?*  *If not, why not?*  Learners can write a report based on their results, answering the questions discussed. | Picture of a plant.  Plants grown in previous activities.  Camera.  Small containers (e.g. yoghurt pots).  Compost.  Plants with and without leaves.  Plants.  Other equipment as necessary.  Camera. | Misconception alert: It is a common misconception that plants ‘eat’ soil. Keep reinforcing that plants make their own food from the air (carbon dioxide) and water, using light.  This is an extended investigation that needs to be scheduled to allow for school holidays. Learners can monitor the plants every few days, not necessarily only during science lessons. |

**Unit 5.5 Earth’s movements**

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

In this unit, learners:

* build on their knowledge about day and night
* learn how the movements of the Earth create day and night and year length
* research famous space scientists.

## Scientific Enquiry work focuses on:

* Making relevant observations and comparisons in a variety of contexts
* Linking evidence to scientific knowledge and understanding in some contexts.

## Recommended vocabulary for this unit:

* Sun, Earth, Moon
* day, night, year, hours
* spin, axis, orbit
* variable, validity, control, sufficient.

| **Framework code** | **Learning objective** | **Suggested activities to choose from** | **Resources** | **Comments** |
| --- | --- | --- | --- | --- |
| 5Pb1  5Pb2  5Eo1 | Explore, through modelling, that the Sun does not move; its *apparent* movement is caused by the Earth spinning on its axis  Know that the Earth spins on its axis once in every 24 hours  Make relevant observations | Introduce the unit title and ask learners to show you their understanding of what they have learned in previous years by drawing an annotated diagram of the Earth, Sun and Moon that shows where they are in relation to each other.  Put the diagrams on display at the front of the classroom and discuss as a class, correcting any misconceptions.  *What direction does the Sun rise in?*  *What direction does it set in?*  Explain that these were trick questions and that, although it looks as though the Sun moves across the sky during the day, it actually stays in the same place in space.  *So, if the Sun isn’t moving, what must be?*  Explain to the learners that we are going to track the apparent movement of the Sun and that the learners are going to be responsible for recording this.  Put a card with a hole onto a window in the classroom. A bright spot will appear on the opposite wall, mark this spot using a sticker. Repeat this every hour for the rest of the day and ask the learners to:   * describe the pattern in their results * explain why the spot is in different places on the wall at different times.   *Does the Sun appear to move in a set pattern?*  A classroom calendar can be created by repeating this daily for several weeks. The learners can begin to predict how the sticker will move the next day or the next week.  Explain that this apparent movement of the Sun is because the Earth spins on its axis; demonstrate this using a globe, pointing out where the Earth’s axis is.  Repeat the experiment on a smaller scale by making a small ‘classroom in a box’ and then shining a torch in through a hole in the side. Learners move the torch to see if it creates the same effect as the sunlight. Learners then keep the torch still and move the box. Elicit the idea that both movements have the same effect.  *Do you know how long it takes for the Earth to spin on its axis once?*  *What scientific evidence have we discovered that could help you answer?*  Explain to the learners that the Earth spins on its axis once every 24 hours.  Demonstrate this using a large globe and a torch. Attach a toy person onto a globe and ask the learners to observe what happens to the person as the globe is rotated. This model can be used to explain why the Sun appears to rise in the East and set in the West and to explain the difference in the length and directions of shadows during a day. There is an example of this demonstration shown on this website.  Working in small groups, allow the learners to research and plan their own way to explain these phenomena to one another.  Each group presents their explanations to the class; the audience discusses how effective the presentations were. | Drawing equipment.  A card with a hole in.  Stickers.  Small box, torches .  Globe.  Torch.  Toy figure.  Sticky tack.  <https://www.bbc.co.uk/education/clips/z9fpyrd>  Information resources. | Misconception alert: Be aware some learners think that the Sun moves across the sky in one direction one day and then moves back across it the next day. |
| 5Pb3 | Know the Earth takes a year to orbit the Sun, spinning as it goes | Show learners a calendar or diary for the following year. *Why do we measure time in years?* Discuss answers.  Ask the learners why we measure a day as 24 hours and remind them that this is the time it takes for the Earth to spin once on its axis.  *What do you think takes one year?*  Explain that it takes the Earth one year to orbit the Sun. There are several ways to model this including:   * One learner represents the Earth and should spin while they orbit another learner who represents the ‘Sun’. * One person (learner or teacher) holds a football (representing the Sun) in one hand. In the other hand they hold a marble (representing the Earth) and show it orbiting the Sun in a large circle.   Learners can then draw an annotated diagram explaining how the Earth moves and/or write an explanation of why we measure time using years.  Extension activity: Learners who require more challenge can also explain leap years in terms of the movement of the planets. | Calendar or diary.  Football.  Marble.  Drawing equipment.  Information sources. | Misconception alert: Learners may struggle to understand they are moving all the time, in space, even when standing ‘still’. This is due to the scale of the Earth and how we are ‘inside’ the system – if we could observe it from the outside we would see the movement. Show images from the international space station and satellites images to show the movement of Earth. |
| 5Pb4 | Research the lives and discoveries of scientists that explored the solar system and stars | Show learners the image of the day from the NASA website.  Explain that it has only since 1959 that we have been able to access direct evidence that the Earth is round and orbits the Sun. *Why was it not possible before then?* Establish that people were not able to go into space earlier.  Tell the learners that, before this, scientists had to use indirect evidence to explain phenomena. Share some examples such as Galileo Galilei.  Allow the learners time to research the life and discoveries of the scientists who explored the solar system and the stars. These can include Copernicus, Galileo, Newton, Hawking, Halley and Hubble.  Learners present their information to the rest of the class and explain the discoveries these scientists made. | <http://www.nasa.gov/>  Secondary sources Internet/books/CDROMs |  |

**Unit 5.6 Shadows**

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

In this unit, learners:

* build on work on light and the movement of the Earth
* understand more about how shadows are formed
* investigate changing shadows and track shadows created by the Sun.

## Scientific Enquiry work focuses on:

* using observations and measurement to test predictions and make links
* making predictions of what will happen based on scientific knowledge and understanding, and suggesting and communicating how to test these
* using knowledge and understanding to plan how to carry out a fair test
* collecting sufficient evidence to test an idea
* identifying factors that need to be taken into account in different contexts
* making relevant observations
* measuring volume, temperature, time, length and force
* discussing the need for repeated observations and measurements
* presenting results in bar charts and line graphs
* interpreting data and think about whether it is sufficient to draw conclusions.

## Recommended vocabulary for this unit:

* Sun, Earth, day, night, spin, axis, orbit
* light, dark, shadow, light intensity
* opaque, transparent, translucent.

| **Framework code** | **Learning objective** | **Suggested activities to choose from** | **Resources** | **Comments** |
| --- | --- | --- | --- | --- |
| 5Pl1  5Eo1 | Observe that shadows are formed when light travelling from a source is blocked  Make relevant observations | Show the learners a series of animal shadows with your hands. *What animal is this?*  Revise with the learners why shadows are formed.  Light travels in straight lines from a light source; the light enters the eye and the light source can be seen.   * Model this by throwing a ball (representing light) in a straight line at a hoop (representing an eye).   An object can block the light; opaque objects block the light completely.   * Model this by bouncing a ball off a surface into a hoop and discuss how the object can be seen because the light bounced off it into the eye. Show that the light neither goes through the object nor bounces off the surface ‘behind’ the object. No light means darkness/shadow.   Allow the learners some time to explore making their own shadows with their hands using torches. Learners can share some of their better attempts with the rest of the class. Learners explain to each other why the shadow takes the shape of the outline of their hand and not the exact position or detail, e.g. no fingernails.  Discuss with the learners how we can still see objects in shadows, e.g. a pencil in the shadow of a book. Discuss why we can still see the pencil if the book is blocking light. Model how light can be coming from all directions, unless in a dark room using a torch, and some light reflects off objects multiple times before getting to our eye. This means there is *some* light reflecting from where the shadow is, but not as much as elsewhere. This is why we can see objects in a shadow but were cannot see objects if it is pitch black. | Source of light.  Torch, ball, hoop.  Torch, surface (to represent an opaque object), ball, hoop. |  |
| 5Pl5  5Ep2  5Ep3  5Ep4  5Eo1 | Explore how opaque materials do not let light through and transparent materials let a lot of light through  Use observation and measurement to test predictions and make links  Make predictions of what will happen based on scientific knowledge and understanding, and suggest and communicate how to test these  Use knowledge and understanding to plan how to carry out a fair test  Make relevant observations | **Science Enquiry activity**  Remind the learners of the work they did in ‘The way we see things’ (Unit 5.1). Revise how light travels by repeating the shining of a torch on the wall and blocking some of the beam with a piece of card.  Explain to the learners that they are going to explore a series of objects and investigate whether they make shadows.  In small groups, the learners plan their investigation and design a table to record their results. Before testing each object, they should predict whether a shadow will be formed; they record the predictions in their table.  Once the learners have investigated a range of objects, discuss the learners’ results. *Did your results support their predictions?*  *What can you conclude about which types of objects cause a shadow?*  Revise the terms opaque*,* transparent and translucent. Ask the learners to define each word, discussing responses and refining where necessary. | Torch.  Piece of card.  Variety of light sources.  Selection of opaque/transparent solids. |  |
| 5Pl5  5PI1  5Ep3  5Eo1 | Explore how opaque materials do not let light through and transparent materials let a lot of light through  Observe that shadows are formed when light travelling from a source is blocked  Make predictions of what will happen based on scientific knowledge and understanding, and suggest and communicate how to test these  Make relevant observations | **Science Enquiry activity**  Ask the learners to predict whether a translucent object will form a shadow and, if so, how the shadow will compare to those formed by an opaque object.  Allow the learners to investigate by comparing the shadows formed by opaque and translucent objects.  *What did you find out?* Establish that translucent objects will form a shadow but it is not as dark as the shadow formed by an opaque object.  *Can you explain why this happens?*  *What is a shadow?*  Help learners to develop a detailed definition of a shadow. For example: ‘A shadow is formed when light from a source is blocked. An opaque object will block all the light, forming a dark shadow, while a translucent object will block some of the light forming a lighter shadow. A transparent object allows all the light through and therefore cannot form a shadow.’  The learners can write a report including annotated diagrams of what they have discovered. | Torches  A selection of opaque and translucent objects (e.g. tracing paper, sunglasses, frosted glass, baking paper, coloured plastic). |  |
| 5PI2  5Ep2  5Ep4  5Ep5  5Ep6  5Eo2  5Eo4  5Eo8 | Investigate how the size of a shadow is affected by the position of the object  Use observation and measurement to test predictions and make links  Use knowledge and understanding to plan how to carry out a fair test  Collect sufficient evidence to test an idea  Identify factors that need to be taken into account in different contexts  Measure volume, temperature, time, length and force  Present results in bar charts and line graphs  Interpret data and think about whether it is sufficient to draw conclusions | **Science Enquiry activity**  Learners to investigate what variables will affect a shadow.  *What can change the size of a shadow?*  Create a list of variables that could possibly influence the size of a shadow, e.g. size of object, distance of object from the torch, distance of wall from the torch.  Tell the class that they are going to investigate how the distance of an object from the light source affects the size of the shadow. Discuss how to conduct the investigation.  In small groups, the learners plan an investigation in which only this variable will be changed and the other variables will stay the same. Remind learners that this is important for a fair test.  Learners carry out the investigation. They record their results in a table. They should repeat their measurements at least three times for each distance.  Learners who require more support can be helped to use a suitable method. For example, place an opaque object (e.g. a glue stick, a cup) a certain distance from a torch. They then measure the size of the shadow, recording both pieces of information in a table. They move the object further away from the torch and measure the new size of the shadow. The learners repeat this several times.  Share the group results with the rest of the class; create a class average for the shadow size at each distance. Remind the learners that this will help ensure greater reliability of results.  Learners can then draw a line graph of the class results.  *What conclusion can be drawn about the impact the distance from the light source has on the size of the shadow? How confident are you that your conclusion is correct?* | Torch (one per group).  Opaque objects (e.g. glue sticks, cups).  Rulers.  Graph paper. |  |
| 5PI3  5Eo1  5Eo2  5Eo4  5Eo8 | Observe that shadows change in length and position throughout the day  Make relevant observations  Measure volume, temperature, time, length and force  Present results in bar charts and line graphs  Interpret data and think about whether it is sufficient to draw conclusions | **Science Enquiry activity**  Learners to investigate shadows changing in length and position during the day.  *How does the size and position of a shadow change throughout the day?*  Choose a part of the school grounds that is exposed to the Sun all day and set up a large stick that produces a shadow.  Ask one learner to draw around the shadow using the chalk, another measures the length and a third uses the compass to find the direction in which the shadow is pointing.  Repeat this at hourly intervals throughout the school day to create a table of results. Take a photo of the collection of outlines on the ground.  Learners use these results can to create a line graph to show the length of the shadows; they can write an explanation of what the evidence in the photograph shows.  Show learners some pictures of sundials and explain that they have been used to tell the time since the time of the Ancient Greeks. Relate this back to the learning from this activity. | Shadow sticks – one per group.  Chalk.  Cameras.  Graph paper.  Pictures if sundials. |  |
| 5PI4  5Eo3  5Eo4 | Know that light intensity can be measured  Discuss the need for repeated observations and measurements  Present results in bar charts and line graphs | **Scientific Enquiry activity**  Discuss how the light changes around school.  *Which are the darkest parts of the school? Which are the brightest? Which areas would be most suitable for small animals, e.g. insects that like the dark?*  Ask the learners how they know for certain that one area is brighter than the other. Remind learners of equipment that they have previously used to measure the intensity of light sources (e.g. light meter, data logger, phone app).  Working in small groups the learners will visit different areas in the school and use these devices to measure the light intensity (or lux). Discuss the importance of repeat observations/results because the result may be affected over a short time by various things, e.g. cloud cover, blinds open or shut.  Learners can present these results in the form of a bar chart, which can be linked to a map of the school.  *Were any of the results surprising?*  *Do you need to check the validity of any of your results?*  **Extension activity**  Ask learners which professions would need to know the light intensity and how this information is important in everyday life. | Light meter, data logger or phone app that can measure the light intensity.  Graph paper  Map of the school grounds |  |