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Organisation of
Eastern Caribbean States

OHPC GRADE 5 SCIENCE

Introduction

The study of science encompasses knowledge, processes and values. Scientifically literate persons will foster an attitude of caring not only for themselves, but as responsible citizens, for the world around them. Their decision-making will be enhanced by a systematic study of the structure and behaviour of the physical and natural world through observation and experiment. In learning science, learners benefit from leveraging and evaluating available technological tools to study and therefore understand the world and their relationship to it.

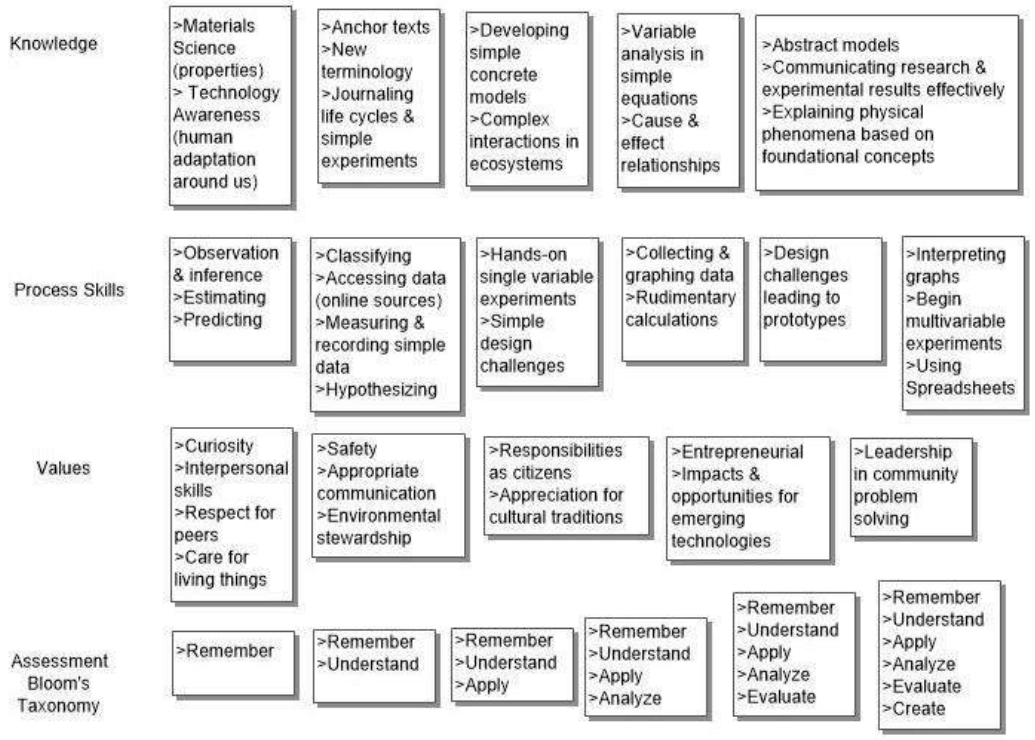
The following Innovation Configuration Map is designed to assist teachers as they continue to develop the pedagogy that supports the curriculum. It illustrates the key features of research informed best practices that might serve as a guide to teachers as they seek to engage with the curriculum with the goal of having *"Every Learner Succeed"*.

The Teacher's Developmental Sequence

Growth Area	No Implementation	Beginning Implementation	Moderate Implementation	Strong Implementation
Constructivist Pedagogy	Teacher-centred delivery of lessons	Evidence of hands-on activities	Evidence of teacher-scaffolder investigations that necessarily involve teacher-learner & learner-learner discussions. Minds-on learning.	Active lessons that begin with questions about the world (and inherent discussions) that are socially relevant & invoke cultural perspectives.
Building Process Skills	Lessons that rely solely on the recall of knowledge	Learners are involved in experiments	The processes of science & 21st century skills are highlighted in learner-centred activities. (e.g., observing, inferring, hypothesizing, measuring, graphing etc. & researching, critical thinking, communicating)	Evidence that the lesson, within active authentic learning contexts (real world questions) involves tracking & evaluating learner growth in the processes of science & 21st century skills.
Integrating Subjects	Attention to subject focused topics rather than learner outcomes	Reading about science topics & collecting/tabulating data.	Emphasizing **literacy** (Reading anchor texts, researching, listening, writing & communicating). Emphasizing science studies that invoke **social** concern & discussion. Emphasizing the collection, interpretation & communication of **numbers** as an account of science investigation	Science Investigations that begin with socially relevant questions that require numerical analysis &, in communication of results, invoke quality discussions that develop literacy skills.
Empowering learning with	No technology tools evident. Teacher-led instruction accessing	Use of simple technologies to motivate learners. These may or may not activate new ways of learning.	Use of technologies to access enhanced types of learning that place the learner at the centre of	Use of digital pictures, video, simulations & probes to pose authentic real world

Growth Area	No Implementation	Beginning Implementation	Moderate Implementation	Strong Implementation
Instructional Technology	traditional resources; primarily textbook-based instruction		constructing knowledge. (e.g. learner-led simulation activities, use of computer probes to collect data, logic exercises with coding)	questions as a basis for discussions & developing process skills.
Integrating Technology as "a way of adapting"	No evidence of problem solving in any context	Simple activities that challenge learners to think about the problem solving that has led to human adaptation in the world. This necessarily involves developing an awareness of technology around us	Activities that emphasize design challenges that rely on careful planning, prototyping & testing.	Lessons that invoke problem solving to design solutions in response to community problems.

Progression of Learners' Knowledge Skills & Values P-6



Grade Level Expectations for Skills and Attitudes[1]:

SKILLS – A Summary of Skills to be Demonstrated by the end of Grade 5

In the development of inquiry; problem identification, design and solution; learners should demonstrate the following:

Observing	Identify differences and similarities between objects and events.
Measuring	Use simple measuring instruments to identify sequence in events.
Manipulating	Handle simple equipment skillfully and effectively to investigate objects and to find solutions to environmental challenges.
Recording	Use pictures, charts and graphs to report results of investigations.
Classifying	Sort objects into groups or classes using a variety of criteria.
Communicating	Use appropriate vocabulary to describe the procedure for and results from investigations.
Inferring	Provide explanations or interpretations that follow from observation.
Interpreting data	Discuss what they find out in experiments in response to questions from their peers.
Experimenting	Formulate problems to be investigated and discuss them freely.
Predicting	From a set of events, predict future events.
Hypothesizing	Suggesting an idea or 'theory' even before an investigation.
Problem Solving	Suggest several solutions to simple problems.
Designing	Construct models or gadgets either by following given instructions or by using self-made designs.

[1]The skills and attitudes have been taken verbatim from the OECS Primary Grades' Learning Standards

ATTITUDES – Summary of Attitudes to be Developed by Grade 5 Learners

In the activities throughout Grade 5, learners are encouraged to develop the attitudes required for positively interacting with scientific and technological ideas and concepts. At the end of the Grade, these are some of the attitudes that should be evident:

Curiosity	Ask questions about objects, events and likely investigations.
Inventiveness	Suggest new (or maybe strange) ways of doing things.
Respect for Evidence	Listen for evidence in other children's results and explanations.
Persistence	Persist at tasks even though challenges or even failure loom.
Respect for Living Things	Demonstrate to others some of the ways in which living things must be treated and respected.
Cooperation	Work individually and with others on a task.
Respect for Safety	Insistence on following safety instructions, and encourage others so to do.

Structure and Properties of Matter

Introduction to the Subject: The study of science encompasses knowledge, processes and values. Scientifically literate persons will foster an attitude of caring not only for themselves, but as responsible citizens, for the world around them. Their decision making will be enhanced by a systematic study of the structure and behaviour of the physical and natural world through observation and experiment. In learning science, learners benefit from leveraging and evaluating available technological tools to study and therefore understand the world and their relationship to it.

Essential Learning Outcome 1: Develop a model to describe that matter is made of particles too small to be seen.

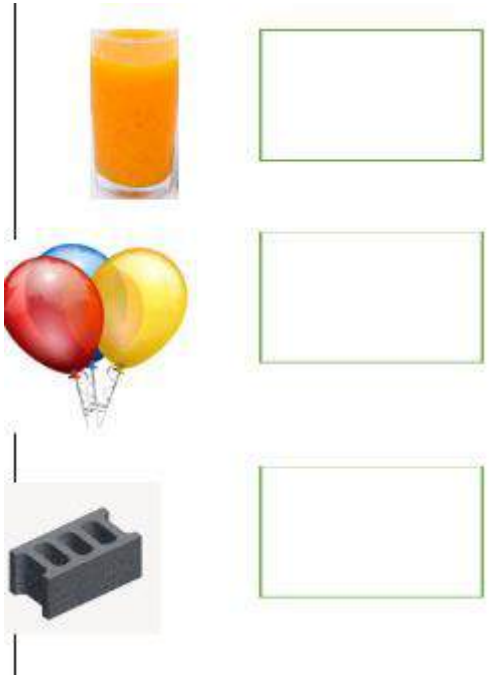
Clarification Statement: Examples of evidence supporting a model could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.

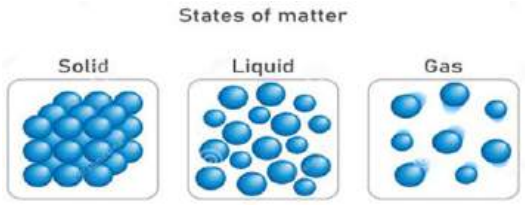
Assessment Boundary: Assessment does not include the atomic-scale mechanism of evaporation and condensation ordered from defining the unseen particles.

Grade Level Expectations: Refer to grade level expectations at the beginning of this curriculum document.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies

Learners are expected to:
 	
<u>Knowledge</u>
 	
• **Define the terms:**
 	
  • matter
  • compression
  • surface tension
  • particles
	1. For each of the objects shown below, draw in the box provided, the arrangement of the particles in this object/substance.	Learners, in earlier grades, you met the term matter. Do you remember what **matter** is? *(Matter is anything that has mass and takes up space.)* Matter is all around us in different forms, from the air we breathe, which is a gas, to the water we drink, which is a liquid, and the ice in our freezers, which is a solid.
		
		What are the three states of matter you just heard about? *(gas, liquid and solid)* Yes, those are the three states of matter that we are going to explore today.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
• melting • freezing • heating • boiling • condensation • evaporation • thermal expansion and contraction • hydraulics • Demonstrate an understanding that matter is made up of particles too small to be seen. • Understand that air is a mixture of different gases, including water vapour • Identify the properties of air and discuss the importance of air to people. (ST 3 ESS ER 7) • Define surface tension and suggest ways that it can be broken. (ST 5 LS ECS 9) • Describe the effect of detergent on surface tension. • Give examples of surface tension in everyday life and in nature. • Describe some characteristic properties of the different states of matter. • Use the arrangement of particles in solids, liquids, and gases to explain observations made in different activities.	 **Retrieved from:** Orange juice in a glass close-up on a white. Isolated | Waist Away - The Chantel Ray Way https://commons.wikimedia.org/wiki/File:Balloons-aj.svg https://www.rawpixel.com/image/7371446/psd-public-domain-illustrations-construction 2. Read each statement carefully, then write TRUE or FALSE next to each statement in the space provided.	Matter has different characteristics or properties you know very well I am sure from objects around you. In the pictures below we see a block that has a definite shape and volume. If you guessed it was a solid, that would be a good guess and you probably made that guess because of the properties you recognized. The second picture shows a liquid in a glass. We know the same liquid can occupy space in another container (like a long tube) but it will always have the same volume. Finally, we see a balloon filled by someone blowing in a gas (our breath). The gas-filled balloon can be squeezed and compressed, a special property. Why is that possible. We are going to discover why!  **Retrieved from:** https://pixabay.com/illustrations/brick-building-toy-design-plastic-685013/ https://pxhere.com/en/photo/1600418#google_vignette https://www.rawpixel.com/image/7376000/image-balloon-public-domain-celebration **<u>How are the particles in different states of matter arranged?</u>** Matter is made up of **particles** that are too small to be seen. Particles are the atoms, molecules or ions that make up matter. In each group of matter, these particles are arranged in a particular manner.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
• Distinguish between the different states of matter. • Compare different states of matter in terms of the arrangement and movement of their particles. • Describe each state of matter in terms of the arrangement of its particles. • Describe the three phases of matter (solid, liquid, or gas) and give examples of each. • Identify solids, liquids and gases based on their characteristics. • Demonstrate the effects of heating and cooling on solids, liquids, and gases. • Give examples of the effects of heating and cooling on solids, liquids, and gases. • Describe phase changes in terms of heat gain or heat loss. • Identify change of states of matter focusing on liquid changing to a solid. • Use the terms melting, evaporating, condensing and freezing to describe phase changes • Identify the processes (heating, melting, evaporation, condensation and freezing) that	a. The particles in a gas are very far apart compared to the particles in a solid or liquid. _____ b. Mass is NOT a state of matter? _____ c. Heating makes a liquid turn into a solid. _____ d. Mass is the measurement of the amount of matter. _____ e. Matter is anything that has mass and takes up space. _____ f. The amount of matter in an object is its mass. _____ g. Cooling makes a solid turn into a liquid. _____ h. In a gas, the particles have very little attraction to each other. _____ i. The amount of space an object takes up is called its volume. _____ j. In a liquid, the particles are attracted to each other but not as much as they are in a solid. _____ True: a, b, d, e, f, h, i, j False: c, g, *3.* Why does the perfume smell at one end of a classroom move so quickly throughout the classroom? (*gas particles gain energy from their surroundings, collide and spread out quickly)* 4. State two ways in which a solid is different from a gas. (*solid has shape and is non-compressible*) 5. A form of matter does not have a fixed shape nor a fixed volume. An example of this form of matter is:	I will now draw three diagrams on the board, see if you can tell me which represents a solid, a liquid and a gas.  **Retrieved from:** https://thumbs.dreamstime.com/z/states-matter-vector-circles-infographic-illustration-structure-atoms-solid-liquid-gas-221988077.jpg Explain what each diagram shows about the arrangement of particles in each state of matter. The arrangement of these particles gives each state of matter special characteristics. Let us discuss some of these characteristics. Teacher, demonstrate with your fists that solids have close particles, liquid particles are further apart and that gas particles move around in the air (waving fists). **Activity** Learners will now test their knowledge about matter by behaving like particles of matter themselves. This activity can be done in groups of 6-8 learners or as a whole class, depending on the size of the class and the space available.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
bring about a change of state of matter • Describe the effects of compressing a gas. • Explain why it is easier to compress a gas than a liquid in terms of the arrangement of their particles • Explain how the dissolving substances in water supports the theory that matter is made up of particles too small to be seen. **<u>Skills</u>** • Use the model developed, describe the differences in attraction among the particles of a solid, liquid, and gas. • Label drawings of different phases of matter by its properties of shape and volume. • Observe and describe phenomena involving gases and use these to create a model of a gas. • Develop a model to describe that matter is made up of tiny particles, too small to be seen. • Use a model to describe the salt dissolving salt in water.	a. Air X b. Cardboard c. Juice d. Metal rod 6. Which of the following states of matter has a definite volume? (*liquid and solid*)  **Retrieved from:** https://pixabay.com/photos/orange-juice-juice-vitamins-drink-67556/  **Retrieved from:** https://pixabay.com/photos/mathematics-colorful-game-color-1282319/ 	Learners will act out the three phases of matter as follows: • **Solids**: Learners form several lines linked closely together in regular rows like lattice work with arms linked tightly. The teacher in moving one part of the learner group notes they all move as single unit-no flexibility as solids are rigid with constant shape. • **Liquids**: Learners form a bigger lattice but with only hands loosely clasped. As the teacher moves one part of the lattice, other parts are flexible and the whole group can flex slightly or be pushed closer together slightly. • **Gas**: Learners-shoulder to shoulder, begin vibrating such that each collision with a neighbouring learner causes them to occupy more space until the group has moved outward to fill the entire room. Begin by calling out a phase: solid, liquid or gas. Ensure that the learners perform the correct actions associated with each phase. These are some questions that learners could be asked while they are doing the activity: 1. What are the characteristics of solids? *(shape, volume, expand on heating, non-compressible)* 2. What are the characteristics of liquids? (*volume, no shape, can be poured, can be compressed slightly*) 3. What are the characteristics of gases? *(expands easily with heat, no shape, compressible*) *4.* What can you say about how close you stand when you are pretending to be a solid, compared to how close you stand while you are pretending to be a liquid or a gas. (*solid>liquid>gas we get further apart)*

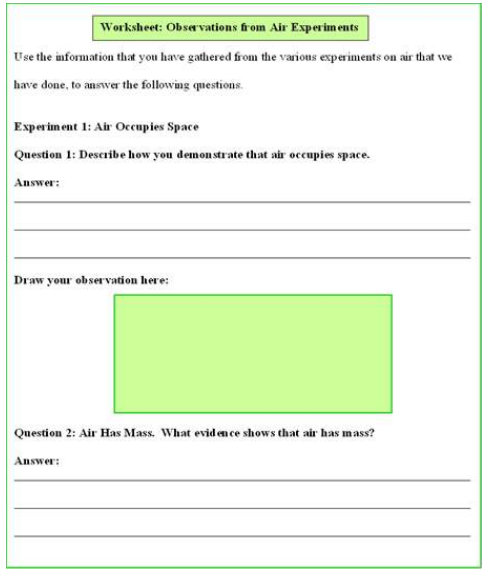
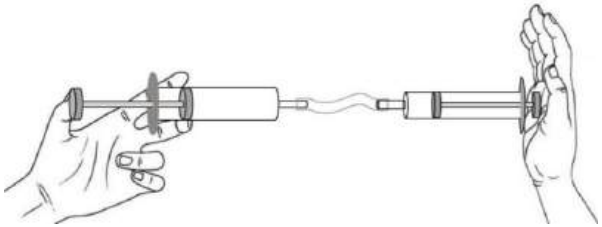
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
• Use a model to describe the evaporation of water from a solution to produce salt crystals • Use models to demonstrate the behaviour of particles in different states of matter • Conduct experiments to observe changes in matter (e.g., dissolving sugar, compressing air). • Label drawings of different phases of matter by its properties of shape and volume. • Observe changes in matter that provide evidence that matter is made up of small particles that cannot be seen • Infer how matter will change when it is either heated or cooled • Investigate the effect of heat energy on the state of matter • Classify changes in matter • Classify matter as solids, liquids or gases. • Demonstrate the effects of heating and cooling on solids, liquids, and gases, and • Give examples from daily life of the effects of heating and cooling on solids, liquids and gases.	**Retrieved from**: https://pixabay.com/photos/clouds-weather-wind-cumulus-shapes-7179673/ 7. As the chef heats the liquid coconut milk, bubbles can be seen in the pan. a. What is happening to the liquid? b. Describe what happens to the movement and arrangement of the particles during boiling. (*the particles move further apart as they gain energy and collide with one another.)* 8. Chocolate can change its state from a solid to a liquid.  **Retrieved from:** https://www.pexels.com/photo/chocolate-bars-on-white-surface-6167332/ https://www.rawpixel.com/search/chocolate%20melt?page=1&path=_topics&sort=curated a. What is the process used to change the chocolate to a liquid? *(melting)*	*IMPORTANT TEACHER NOTE: Water is atypical because it does not follow this pattern (hexagonal solid)* **Evidence that Matter is made up of Tiny Particles** As stated before, matter is made up of tiny particles that cannot be seen. However, what evidence do we have that these particles do exist? For the next few lessons, we will explore several different activities to see if these activities would provide us with the data we need to make this conclusion. **Particles in air** **Is an empty bottle empty? (This activity shows that air is made up of particles that are far apart.)** Materials • Flexible plastic soda bottle (18–20 oz.) with cap • Balloon Procedure • Learners, I have in my hand a plastic bottle. • Look at and touch the uncapped bottle.  • Do you think the bottle is completely empty? (*Yes/no)* • If you answered "no", what do you think is in the bottle?

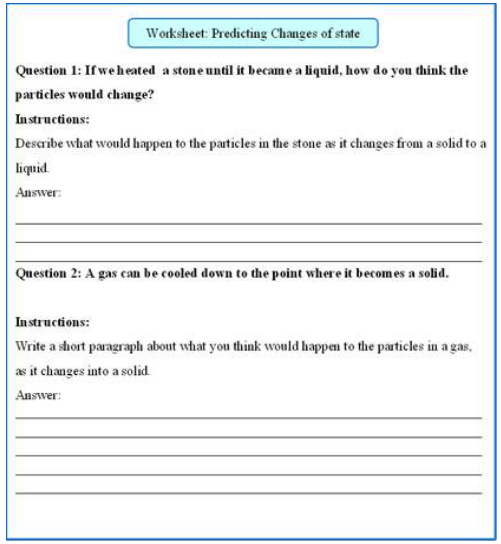
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
• Demonstrate the effects of heating and cooling on solids, liquids, and gases, and give examples from daily life • Explain how the same substance can exist as a solid, a liquid or a gas • Explain how it is possible to smell a substance • Observe the dissolving of different substances in water • Identify and explain the different phase changes that can occur to matter • Use a thermometer to measure temperature changes to matter • Hypothesize how changes to different forms of matter will change the arrangement of their particles. • Communicate data collected from the different experiments to show that matter is made up of tiny particles, too small to be seen. • Develop a model to describe that matter is made up of tiny particles, too small to be seen. • Use the model developed, describe the differences in attraction among the particles of a solid, liquid, and gas.	*b.* Explain what is happening to the particles in the chocolate that causes it to change. (*they get energy and move further apart)* *c.* How would you describe the movement of the particles as they move from a solid to a liquid*? (particles get further apart)* *d.* The melted chocolate can then be turned back into a solid**.** What is the process used to change the chocolate to a liquid? (*melting)* e. Which particles have more energy, the particles in the solid chocolate or the particles in the melted chocolate? (*melted*) 9. Condensation is a process that brings about a phase change in water. a. What is condensation? (*Water vapor cools and forms liquid water.)* *b.* Explain what is happening to the particles in the water that causes it to change. *(they move closer together than a regular gas,)* c. What process is the opposite of condensation? (*evaporation*) **Accounting for Expansion and Contraction** Because the particles that make up a metal bridge will naturally expand when heated, asphalt built upon metal bridge links should be danger. Engineers have solved this problem by creating interlocking fingers on rollers so the bridge can flex without expansion/contraction breaking it.	• If you said "yes", let us see if it is empty. • Carefully put a balloon on the top of the uncapped bottle.  **Image adapted from:** 26,822 Bottle Balloon Royalty-Free Images, Stock Photos & Pictures | Shutterstock • Hold the bottle and squeeze it until you can't squeeze it any further, then answer the questions that follow a. What happens to the balloon when you squeeze the bottle? *(The balloon expanded as the air left the bottle and entered the balloon)* b. Is the air in the balloon a solid, a liquid or a gas? *(Gas)* c. What do you think happened to the particles when you squeezed the bottle and the balloon expanded? • Now take the balloon off the bottle and put the cap on tightly. • Squeeze the bottle. 1. Were you still able to squeeze the bottle? Explain your answer in terms of the particles contained in the air in the bottle. (*the*

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
• Use models of solids, liquids and gases to explain their observations in the lesson • Observe and describe phenomena involving gases and use these to create a model of a gas • Evaluate models developed by their classmates to show that matter is made up of tiny particles, too small to be seen • Plan and conduct investigations to show that matter is made up of tiny particles, too small to be seen • Compile data from carrying out different investigations. • Analyse data from investigations to show that matter is made up of tiny particles, too small to be seen. • Interpret data to show that matter is made up of particles too small to be seen. **Attitudes/Values** • Appreciate the role that the particulate nature of matter plays in everyday life. • Appreciate the importance of phase change in everyday life.	Have learners explain why metals when heated will expand? (*particles get enough energy to increase collisions and move further apart- to sometimes resemble a liquid)*  **Retrieved from**: https://www.mageba-group.com/au/en/1026/Infrastructure/Expansion-joints/TENSA-FINGER-RSFD/Detail.htm **Another example: Applying Your Knowledge** Often in road construction there are spaces left between concrete sections of the road. Learners, based on the bridge example above, please account for the rationale for designing concrete roads this way. **(***the space is helpful to avoid concrete damage with the expansion and contraction of the concrete in different temperatures)* **Worksheets** The following are several worksheets that can be either printed for learners or downloaded on their devices or projected onto a white board.	*bottle could only be compressed a small amount because the gas particles can't be forced any closer together*) *Formative Assessment*: Draw a square in your notebook. In the square, draw circles to represent the particles of a gas. Write below the square the arrangement of the particles. That is, are the particles very **close** to each other, somewhat close, or **not close** to each other. Using your hand, you can't change the shape of a solid substance like metal or rock by squeezing. So what is it about the molecules of a gas that invites you to force it to occupy a smaller space by squeezing it? (T*he gas particles are further apart and free moving than the particles in other forms of matter).* **Experiments to investigate the properties of air** Introduction to Air: **Teacher:** Learners, what is invisible and is all around us (*Air*). Did you know air is made up of several different gases including oxygen and nitrogen? So air should behave like a gas. Tell me what you know about air. (*we need it to breath, it can be added to ballons and air mattresses to fill a space*). So it can take up space, but does it have mass? - let us investigate. **Experiment 1: Air takes up space** • Fill a container with water. Explain to learners that this experiment will prove there is air all around us and that it takes up space. Crumble a piece of paper or paper towel into a ball and push it into the bottom of a clear drinking glass. • Hold the glass vertically with the open end facing down. Push it into the water. • Lift the glass straight out of the water.

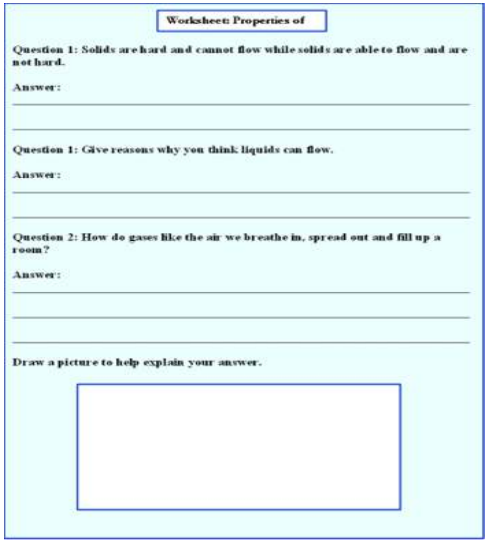
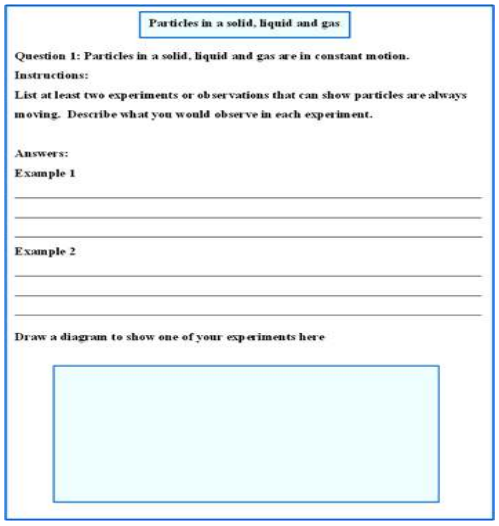
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
• Show persistence when conducting experiments to demonstrate that matter is made up of tiny particles. • Demonstrate interest in finding out more about matter and the behaviour of the particles that make up matter. • Use the inquiry approach in designing and conducting various investigations.· • Show respect for evidence obtained from investigation on the particulate nature of matter. • Work collaboratively with their group members to carry out investigations on the particulate nature of matter. • Participate actively in whole-class and group discussions on the particulate nature of matter. • Stewardship/Respect for Living Things • When conducting experiments be careful to avoid harming plants, animals or the environment. • Safety: Wash their hands after completing the activities • When conducting practical and group work, display	**States of Matter Worksheet** **Worksheet to identify states of matter** https://www.k5learning.com/worksheets/science/grade-2-states-of-matter-a.pdf **Worksheet to classify objects as solid, liquid, gas** https://www.k5learning.com/worksheets/science/grade-2-states-of-matter-b.pdf **Worksheet to identify changing states of water** https://www.k5learning.com/worksheets/science/grade-2-states-of-matter-d.pdf **The following are several worksheets exploring different concepts on matter.**	• Remove the paper and have the learners observe and record the results. (*they should observe the paper is dry*) After the completion of the demonstration, discuss the following questions and ideas with the class: 1. Why didn't it get wet? (*the air pocket between the water and top of the inverted glass prevented water from running in wetting the paper*) 2. What else was in the glass with the water that prevented the water from getting in? (*air filled some space in the glass)* **Activity 2: Does air have mass?** *(This activity shows that air has mass.)* **Materials:** • Balloon • Scale **Procedure:** • In pairs/groups of more learners, learners inflate a balloon and tie it securely. Weigh the inflated balloon on a scale and record its mass. • After recording the mass of the balloon, they then deflate the balloon completely and weigh it again and compare the two masses. • Which balloon weighed more? (*with air*) Why is that? (*air takes up space even though it is invisible)* • Write down your observations and conclusions in your notebooks. By the end of this activity, learners should conclude that air has mass.

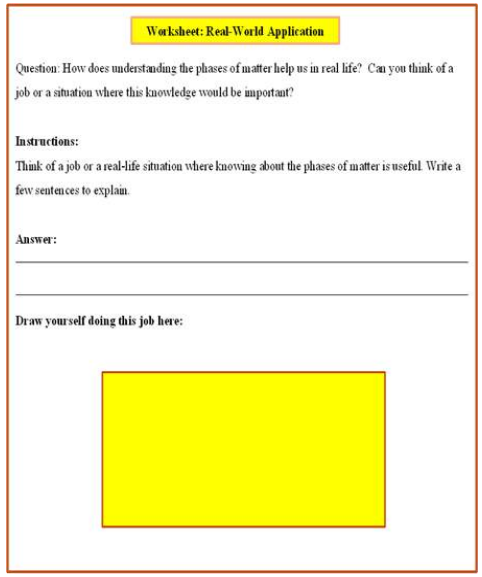
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
sensitivity to those learners who may have difficulty observing certain changes in matter.	**Worksheet: Exploring Evidence on matter** Question 1: What evidence do we have that particles exist in solids (all matter)? Instructions: Think about what you've learned about particles in matter. Write down any evidence or examples that show particles exist in solids, liquids, and gases. Draw a picture to help explain your answer. **Answer:** _____ _____ _____ **Draw your evidence here:**	**Can you force the particles of a liquid to move closer together?** **Materials** • Flexible plastic bottle (18 – 20 oz) with cap • Water  **Retrieved from:** https://pixabay.com/illustrations/water-cup-water-bottle-transparent-4998513/ Procedure • Fill a bottle with water to the very top and put the cap on securely. Squeeze the bottle. **Questions** 1. What did you observe? (*it invites a little squeezing but not very much)* 2. Were you able to squeeze the bottle filled with water as much as when there was no water in the bottle? Explain your answer in terms of particles. (*The water-filled bottle could not be squeezed as much as the air-filled bottle- the air particles as a gas are further apart and can be compressed some whereas the liquid particles closer together already can't be compressed as easily*) 3. Use your knowledge about how particles in a gas and those in a liquid are arranged to explain why you think a closed bottle of gas is easier to squeeze than a closed bottle of liquid. *The water-filled bottle could not be squeezed as much as the air-filled bottle- the air particles as a gas are further apart and can be compressed some whereas the liquid particles closer together already can't be compressed as easily*)

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		4. Draw a square in your notebook. Draw circles in the square to represent the particles of a liquid. Under the square describe how the particles are arranged. That is, are the particles very **close** to each other, somewhat close, or **not close** to each other. **Compressing Liquids vs Compressing Gases: a Practical Example** The brakes in a car operate by passing a liquid through a tube that extends from your brake pedal inside the car to a movable piston down near the brake rotor. Imagine a syringe on two ends of a plastic tube. If you press the syringe on end the syringe on the other end will move.  **Retrieved from**: http://www.mstworkbooks.co.za/technology/gr9/gr9-technology-05.html With liquids in the brake line, the movement is transferred because the liquid does not measurably compress. When you get your brakes repaired, sometimes air will get in the brake line. The result is that you press your brake and it compresses the gas in the line rather than moving the piston at the opposite end. We would say the brakes feel "spongy" because they collapse without doing the job of moving the piston at the other end. For this reason, good

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		mechanics will always "bleed" the lines inviting the gas to escape so that only liquid is in the line. This principle is used in many mechanical devices and is called **hydraulics**. Learners, where have you seen hydraulics used? (*backhoes, tractors, dump trucks, garage lifts)* **<u>Experiment to Investigate that Solids are made up of particles</u>** In my hand, I have a piece of metal (note to teacher: metal wire or ball). Is it a solid, a liquid or a gas? Either ask learners to draw two squares in their notebooks or provide learners with a worksheet with two boxes as shown below. Learners, in the square on the right, draw the metal object. Learners, in the square on the right, draw how the particles in the object are arranged. Write below the boxes, whether the particles are very close to each other, somewhat close, or not close to each other. Use your model of a solid to explain why solids cannot be squeezed like gases or liquids. You cannot squeeze solid substances like metal or rock. **Investigating how Heat affects the movement of particles** **Title: Particles on the move** I have in front of me three glasses containing hot, warm, and cold water. Let us now see if the speed of water particles are different in hot and cold water?

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	Quiz: Properties and Importance of Air **Question 1: List three properties of air.** 1. _____ 2. _____ 3. _____ **Air is very important to plants, humans and other organisms. Answer the following questions on the importance of air.** **Question 2: How does air help us hear sounds?** **Answer:** _____ _____ **Question 3: Why is air important for combustion?** **Answer:** _____ _____	I will now put two drops of food colouring in each glass (learners can help to add food colouring to the glass). Let us see what happens.  **Retrieved from:** https://pixabay.com/photos/ink-water-water-glass-liquid-drops-2427263/ 1. What do you observe in each of the glasses? (*the colour moves around quicker in the hot water)* 2. Why do you think this happened? (*The particles of water have more energy because of heat so they move around more and the dye travels with them*) 3. What did you observe about the rate at which the colouring spread in each glass? (*faster in warm water*) **Technology supplement** • See also: Skittles experiment where water temperature can make a difference in rate of diffusion https://www.youtube.com/watch?v=SGF13q4C3X0 (4:19 mins) • See also PHET Simulation here where you can add heat to a system and watch the particles move!

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	 **Worksheet: Properties of** **Question 1: Solids are hard and cannot flow while solids are able to flow and are not hard.** **Answer:** **Question 1: Give reasons why you think liquids can flow.** **Answer:** **Question 2: How do gases like the air we breathe in, spread out and fill up a room?** **Answer:** **Draw a picture to help explain your answer.**  **Particles in a solid, liquid and gas** **Question 1: Particles in a solid, liquid and gas are in constant motion.** **Instructions:** **List at least two experiments or observations that can show particles are always moving. Describe what you would observe in each experiment.** **Answers:** **Example 1** **Example 2** **Draw a diagram to show one of your experiments here**	https://phet.colorado.edu/en/simulations/gas-properties **What is that smell?** **Perfume spreading throughout the class** Produce a small, sealed bottle of perfume, vinegar or an essence.  **Retrieved from:** https://pixabay.com/photos/perfume-fragrance-luxury-glass-2721147/ Explain that you are going to open the bottle and pour some out onto a surface or on a tissue and ask the learners to raise their hands when they can smell it. You should observe a wave of hands going up as the fragrance particles spread from the tissue throughout the class. Ask learners to answer the following questions: 1. Why couldn't we smell it when the bottle was sealed? (*the molecules that make up the smell are trapped inside the bottle*) 2. Which people in the room could smell the perfume first? (*those people closest to the open bottle*) 3. Why do you think they smelled it first (*the gas molecules collided over and over and spread out from the initial site and will get to the closets person first)* 4. Where is the smell coming from? *(the gas carries the smell from the bottle)*

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		5. What do you think is happening? (*there is enough heat to give the gas molecules energy to move more quickly and expand through collisions.)*

Application: Smells in Our World

Our noses access smells that our brains process to give us recognition or memories of past experiences. The chemicals that make up those smells are distributed in the gases that make up the air around us. Because gas molecules are moving around so much and are susceptible to expanding with small temperature changes, they are very adept at moving smells around to reach our noses! Some chemicals that include sulphur (thiols) are particularly able to travel in gases to our noses; these would include the sulphur smells that come from surface cracks (volcanoes) or water springs and the smell of garlic and seaweeds like sargassum. In parts of the world, skunks emit sulphur sprays to deter attack from predators. See: https://www.youtube.com/watch?v=waTAfGeFCto (1:51 mins)

Compressing air

Can you force the particles of a gas to move closer together? *(Yes)* The action of forcing particles of matter closer together is called **compressing**. Think of the gas in a gas bottle or in a spray can. These particles have been forced closer together. What happens when the trapped gases are released? *(The gas rushes out forcefully just like a spray).*

When we spray paint out of a can it releases gas with paint particles being pulled along. Why does the can seem to cool down? What is happening? (*as the gas rushes out side the can, it needs energy to expand through a small hole in the nozzle. The energy is take from surroundings which includes the can itself. Removing heat energy means the can gets cooler.)*

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	Particles in a solid, liquid and gas **Question 1:** How do the particles in a solid compare to the particles in a liquid or gas in terms of their movement and arrangement? **Instructions:** Fill in the table below to compare the particles in solids, liquids, and gases State of Matter | Movement of Particles | Arrangement of Particles Solid Liquid Gas **Question 2:** Solids have a definite shape while liquids take the shape of the container, they are placed in. **Instructions:** Write a short explanation about why solids keep their shape and why liquids do not. **Answer:**	Let's investigate compressing air in the experiment below: • Divide the class into groups of 2 • Provide each group with a small syringe without a needle  **Retrieved from:** Best Ce ISO 50ml-200ml Disposable Irrigation Syringe with Catheter Tip Manufacturer and Factory | Teamstand (teamstandmedical.com) **Procedure**: 1. Examine the syringe carefully, pull the plunger up and down to familiarize yourself with the syringe and what it is capable of. 2. Record your observations in your notebook. 3. Pull the plunger all the way to the top. 4. Place your finger just below the tip of the syringe without touching it. 5. Press the plunger all the way down. Observe what happens. *(it seems to give off cool air like the paint can getting colder)* 6. Pull the plunger back to the top again. 7. Place one of your fingers completely over the tip of the opening tightly. 8. Try to press the plunger all the way down. Observe what happens. (*the plunger will only compress a small amount but much more than a liquid*)

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		9. Release the plunger and observe what happens. (*the plunger pressure is released as the plunger moves back upward)* 10. What happened to the volume of the syringe while you pressed the plunger? (it was reduced) 11. What happened to the volume of the syringe while you released the plunger? (*it expanded again*) 12. Draw a model to show what happens to the air in the syringe as you press and when you release the plunger. 13. Use your model to explain what happened when you pressed and released the plunger? <u>Summary</u> Although matter in the form of air cannot be seen in the syringe, it still exists. It can be detected by pressing the plunger and feeling air as it leaves the syringe. Also, when blocking the syringe, the plunger cannot go all the way down due to the air in the syringe. **<u>Inflating a ball</u>** This activity can be done as a demonstration if enough beach balls and pumps are not available. However, if enough materials are available, then it can be done in groups. **Procedure:** • Gather the following materials (beach ball and pump) for the demonstration. • Ask learners to observe the beach ball before it is inflated. 

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Retrieved from: https://www.pixelsquid.com/png/deflated-beach-ball-1216842636782999012?image=D13 • Also invite learners to feel the beach ball before and during inflation and have them record its properties in their notebook. *(is flat to begin and inflates as air enters)* • After all of the learners have felt the ball and recorded their observations, inflate the beach to fullness and close the plug, invite learners to feel the inflated beach ball, observe its properties and record their observations. (*the ball is taut and seems to be full of air)*   **Retrieved from:** **Pump:** https://openclipart.org/detail/333682/air-pump **Inflated beach ball:** https://commons.wikimedia.org/wiki/File:Beach_ball_detail.jpg <u>Questions:</u> 1. Restate the observable features that the beach ball had before and after it was inflated. *(ball begins flat with no air inside and then gets air pushed in from pump*) 2. What was the cause of the changes? (*invisible air particles entered the ball)*

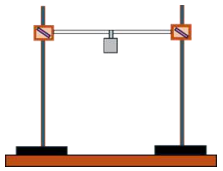
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		3. What can you say about the volume of the air in the beach ball before it was inflated and after it was inflated? (*the volume of air inside the ball increases with the action of the pump*) 4. Draw a 2-box model to show the beach ball before it was inflated and after it was completely inflated. 5. How do these two activities provide evidence that matter consists of tiny particles too small to be seen. *The air in the beach ball cannot be seen but we know that it exists because the beach ball changes shape and has different properties when air is pumped into it. The volume of the beach ball increases when air is pumped into it. Air released from the beach ball can be felt.* After learners have developed their evidence and reasonings, invite them to share their information. Confirm and restate the important content about the task to help them understand the idea of matter existing in particles too small to be seen. ***Application***: Why does our tyre go flat on a bicycle or car? (*the air somehow escapes the inside of the tyre through a hole in the rubber or leak around the rim*). How do we remedy this? (*we patch the tyre, clean the rim and reassemble the tyre*) After it is assembled, what do we usually do next? (*the garage often has something called a* ***compressor*** *which will deliver volumes of air to the inside of our tyre to the correct pressure.)* ***Teacher note:*** ***Extension – Temperature change***: after the bicycle pump has been used for inflating the ball, learners should feel the side of the pump. They will detect that it is warm. Ask them why the pump get swarm as pumping continues? (the air particles get compressed over and over. When they are brought together in collision

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		repeatedly, they actually give off heat energy. This is the opposite of the energy loss as a gas expands leaving a spray can. <u>Effects of heating and cooling on matter</u> Let us recall that particles in all states of matter are in constant motion as follows: • The particles in solids cannot move freely; instead particles in a solid vibrate in a fixed position. • Particles in a liquid vibrate and move about sliding past each other. • Particles in a gas vibrate and move freely at high speeds. Do you think an increase in temperature would increase the kinetic energy and speed of particles in matter? (*Yes*) Heat is the energy possessed by an object due to the vibration of the molecules that make up the object. When matter is heated, its particles get further apart, it expands, its overall temperature increases and it sometimes changes state. On the other hand, when matter is cooled, heat is removed, particles slow, it contracts, its temperature decreases and it may even change state. Today, we will conduct some exciting experiments to explore the effects of heat on different types of matter. By the end of our activities, you will see all of these phenomena. Let's dive in and discover the power of heat! Before conducting the experiments, engage learners in a brief discussion about what heat is and how it can change matter. Use examples like melting butter on toast or boiling water for tea. Ask

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		learners to share their experiences with heat changing matter at home. Expansion and contraction When heat is added to any substance, it expands as its particles move further apart. This is called **thermal expansion**. With thermal expansion, gases expand more than liquids and liquids expand more than solids. **Air expansion** Materials needed • Balloon • Empty soda bottle • 2 containers • Cold water • Hot water • Thermometer Procedure: • Stretch the balloon over the opening of the bottle. • Place cold-water in a container and a hot-water in another container. Ensure that the water level is about 15 cm high. • Encourage the learners to take the temperature of the water in each container, to determine the difference in temperature between the two.  • Put the bottle in the container with the hot water and push it down so the water rises up around the sides of the bottle. Hold it for a minute or so.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		• Ask learners to observe the balloon and record their observations. (*the balloon begins to inflate*) • Ask learners to draw a diagram (model), to show how the heat caused the gas particles to gain energy and expand to fill the balloon • Repeat the above steps this time, placing the bottle in the container with the cold water. Hold it for a minute or so. Observe how the balloon begins to deflate as the particles begin to slow at the lower temperature. • Ask learners to draw a diagram (model), to show how the absence of heat (cooling) caused the gas particles to contract or get closer to each other and in the process the balloon is reduced in size.  • What is inside of the bottle? (air) Can the air escape? (no) • What happens to the air in the bottle when you put the bottle in hot water? (*the particles moved quicker colliding and getting further apart filling the balloon with air.* • What happens to the air in the bottle when you put the bottle in cold water? (*the particles slow down and with fewer collisions there is less pressure exerted by the gas.)* • What do you predict will happen if we leave the bottle in the hot water for half an hour? (*it may expand the balloon so large it will burst)*

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Learners, see if you can explain what is happening in each example. *When you stretch the balloon over the opening of the bottle, all of the air is trapped inside. Putting the bottle in hot water provides the air particles with more energy, causes them to heat up and move further apart, taking up more space (thermal expansion), causing air to enter the balloon and inflate it.* When the bottle was moved into the cold water, the heat was reduced and the air molecules cooled down moving closer together, taking up less space than when in the hot water **(thermal contraction)**. Examples of how thermal expansion and contraction are used in everyday life: 1. If the tin lid of a bottle is struck on too tightly, we often dip it in warm water to help open the bottle. 2. If two metal bowls are struck, one inside the other, we usually place them in hot water. This helps to separate the two bowls easily. **Using a Simulation for Particle Behaviour** Use the PHET site found below, to design an activity that has them investigating what happens when gas particles are compressed. (https://phet.colorado.edu/en/simulations/gas-properties Expansion of solids: Heating metal wire Suspend a metre length of resistance wire between two supports and hang a weight from the centre as shown in the diagram below. Note the position of the weight and then heat the wire. Record the new position of the weight, to see if the wire expanded. Observe the wire as it cools.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		 Diagram by: Amaala Muhammad, St. Vincent and the Grenadines *When metal wire is heated it expands. That is, its length increases. If a lightweight object is placed on the wire its position changes as the wire droops. If we stop heating the wire it cools down, contracts and goes back to its original length. The object will also return to its original position Thus, we see that solids expand when heated and contract when cooled* <u>Heating liquids</u> 1. Heat a certain amount of water using a stove/Bunsen burner/candle 2. What happens to the water as it heats up? (*It starts moving.*) 3. What effect does this have on the volume of the water in the beaker/pot? (*The volume increases as the liquid expands.* 4. Your mother asked you to put a pot of water to boil but told you not to fill the pot to the brim. What is the reason for this? (*water expands and may overflow the pot)*  **Retrieved from:** https://timelessmoon.getarchive.net/media/pot-steaming-hot-food-drink-b52222 When water boils, it not only expands, it also evaporates. As the water evaporates, ask learners the following questions.

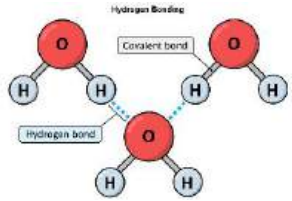
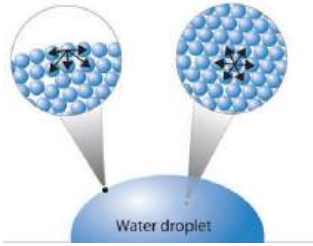
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		1. What happened to the water in the heated beaker/pot? *(It changed into an invisible gas.)* 2. What happens to the water when it evaporates? *(It disperses into the surrounding air.)* 3. What is different about the water after it evaporates? *(It is gas instead of liquid.)* **Change of state:** A **phase change** is a change of matter from one state to another. Phase changes are only possible when matter loses or gains heat. For a substance to undergo a change of state, heat must either be given to it or taken away from it. Each phase change has its own special name. 1. **Melting** - solid to liquid *(heat gain)* 2. **Evaporating/Boiling** – liquid to gas *(heat gain)* 3. **Condensation** – gas to liquid *(heat loss)* 4. **Freezing** – liquid to gas *(heat loss)* Let's observe some of these phase changes: **Condensation:**. Fill a glass or beaker with cold water. Leave it undisturbed for a few minutes. As water vapour condenses on the beaker, ask learners the following 

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Photo credit: Amaala Muhammad, St. Vincent and the Grenadines 1. Where does the water come from on the outside of the beaker? Explain your thinking. *(It must come out of the surrounding air.)* 2. Has the amount of water changed inside the beaker? *(no)* 3. How could you investigate this phenomenon to explain your answer? *(weigh the beaker several times during the process)* The following is another activity that can be done to demonstrate condensation. Heat some water until it begins to boil. As the steam is given off, hold a metal spoon over the steam and watch droplets form on the spoon as the steam cools and condenses (change) back into water. Discuss how cooling causes the gas to change back into a liquid. Think about where you have seen phase change before. **<u>Melting: A change from a solid to a liquid</u>** 1. Have you ever had ice-cream on a hot day? What happened to the ice cream if you did not eat it very quickly? *(it melted)*  **Retrieved from:** https://pixabay.com/photos/ice-cream-melted-dessert-sweet-2200436/

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		2. What happens to puddles when the Sun comes out after it rains? (*the puddle evaporates- no more water)* 3. Where have you seen the following? *a.* A liquid turning to a gas (*rubbing alcohol on my hand)* b. A gas turns to a liquid. (*condensation on the outside of a window*) c. Will ice cream melt if it is left in the freezer? (*not if the temperature is below freezing temperature*) **<u>Dissolving salt in water and evaporating the water to get back the salt</u>** **<u>Explore the Salt:</u>** • Divide the class into groups of two. Provide each with a teaspoon of salt on a small piece of black construction paper/Bristol board.  **Photo credit**: Amaala Muhammad, St. Vincent and the Grenadines Ask learners to use the magnifying glass to observe the salt then record what they observe. Also ask them to draw what they see. (*tiny cubic crystals*) • Ask learners to write a hypothesis in their notebook about what they think will happen if the salt is added to the water. *(it will fall to the bottom & slowly dissolve)*

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		• Ask them to pour the salt into the water and stir the water. What do you observe class? (*the salt is disappearing as it dissolves in the water-stirring and heating accelerates the dissolving process)* <u>Questions:</u> 1. Could you see the salt in the water after you stirred it? (*no disappeared*)- 2. Is it still there or has it disappeared? *3.* What is one way you can tell that the salt is still in the water? (*taste it? Evaporate the water)* 4. You have just established that you can't see salt when it is dissolved in water but you know that it is there. 5. Can you think of other examples of matter that you know is there but can't see it? (Hint: think about sugar, food colouring, or a fire) 6. How does this activity help you to understand that matter is too small to be seen. (*dissolving solids is a very small process*) *7.* What do you think will happen if you evaporate the water from the glass? (*will get salt crystals back)* <u>Evaporate the water</u> **Evaporate the water using a Bunsen burner** Put the salt water on a metal cover or beaker and heat on a Bunsen burner/stove or candle until the water evaporates. What is left behind? (*salt crystals)* **Evaporate the water using the Sun** Place the samples on a windowsill or somewhere there is direct sunlight. • Let the water evaporate naturally; this may take days to weeks, depending on the amount of water used. • Revisit the cups regularly to observe the progress of evaporation, until all of the water evaporates.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Teacher Note: Experiment can also be conducted using sugar. ***Summary*** Considering all the demonstrations, done in this section, do your observations support the statement that matter is made of smaller particles and that these are too small to be seen individually. **Surface tension** Have you ever noticed that when you slap the surface of water it feels as though the water is resisting or fighting back? *(Yes/No?)* That's because of **surface tension.** Surface tension is a force which is caused when all of the molecules on top of water are pulled tightly together and behave like an elastic skin. Learners, watch as I demonstrate surface tension using the following experiment: • Fill a glass with water slowly just to the point where the glass is full and the top of the water is above the glass.  **Retrieved from**: https://www.flickr.com/photos/andredoreto/4429208363/in/photostream/ Even though we can't see them, water molecules like to stick to each other by weak negative-positive attractions we call **hydrogen bonding**

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		 **Retrieved from**: https://ib.bioninja.com.au/hydrogen-bonds/ Because of the relatively high attraction of water molecules to each other through a web of hydrogen bonds, water has a higher surface tension than most other liquids. The internal molecules are tightly surrounded but the surface molecules tend to pull inward and form a surface skin.  **Retrieved from**: https://saylordotorg.github.io/text_general-chemistry-principles-patterns-and-applications-v1.0/s15-03-unique-properties-of-liquids.html • Carefully place a razor or pin on the surface of the water, to show learners that the water will support the razor/pin. • Carefully add a few drops of detergent to the water and observe the razor or pin falling to the bottom. Ask learners why they think the surface tension was broken? (*the detergent gets in the way of the hydrogen bonding to break the surface tension*)

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		• Place a few drops of water on a sheet of wax paper. Ask learners to observe and record what they see. *(it forms a round droplet)* • Carefully add a few drops of detergent to the water on the sheet of wax paper. Ask learners to observe and record what they see. (*the droplet flattens out)* • Ask learners why they think this happened? *(the surface tension of the droplet was broken because the detergent interrupted the hydrogen bonding.)* • **Applications:** o ***Washing Clothes*:** by adding detergent to our wash water for cleaning clothes, the surface tension of droplets of water is broken such that the water is better able to enter the crevices of textiles and do a better job cleaning. The detergent serves a second purpose of bonding weakly to oil-like dirt and water at the same time**.** o ***Mosquito Control*:** farmers have been known to add detergent or natural oils to stagnant bodies of water. These both interrupt the surface tension film caused by hydrogen bonding. Developing mosquito larvae happen to breath through tubes that rely on string surface tension. The clever farmer can limit the number of mature mosquitos by reducing surface tension thereby suffocating the developing mosquitos. This may sound like a negative intervention but mosquitos can carry dangerous diseases, so control of the population is actually a positive measure! Have learners research

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		the diseases that mosquitos typically carry and have them report back to their classmates.

Additional Resources and Materials

Experiment: Don't spill the water! (*This experiment shows air can exert pressure.)*

Materials:

- A plastic bottle/jar
- Water
- Piece of cardboard/cardstock

Procedure:

- Learners fill an empty plastic bottle or jar with a little water.
- They then place a piece of cardboard wide enough to cover the opening and invert the bottle/jar.

Learners should observe that the water does not fall out. Learners share why they think the water does not fall out? (*The simple explanation is that the outside air pressure is approx. 14.7 pounds per square inch (varies with temperature and altitude) in all directions. The pressure from the water is much less (approx. 0.3psi or weight divided by area of jar rim). So, the air pressure pushing up exceeds water pressure down, holding the card in place.)*

Additional Useful Content Knowledge for the Teacher

Disciplinary Core Ideas to be attained by the end of grade 5. Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means (e.g., by weighing or by its effects on other objects). For example, a model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon; the effects of air on larger particles or objects (e.g., leaves in wind, dust suspended in air); and the appearance of visible scale water droplets in condensation, fog, and, by extension, also in clouds or the contrails of a jet.
National Academies of Sciences, Engineering, and Medicine. 2012. A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas. Washington, DC: The National Academies Press. https://doi.org/10.17226/13165.

Opportunities for Subject Integration

Mathematics: Record data from different experiments.
Language Arts:
Ask learners to read and summarize the main points, enhancing their reading comprehension skills.
Learners write a story or a poem about the journey of an air molecule through different phases and environments, integrating creative writing with scientific concepts.
Social Studies: Learners can investigate the effects of phenomena such as the Saharan Dust.
Art: Learners can create models using clay or other materials to represent different phases of matter.
Physical Education: Breathing Exercises: Teach learners about the role of air in respiration through breathing exercises and activities that highlight how air enters and leaves the lungs. Breathing also helps in maintaining calm and reducing stress.
Music: Sound and Vibration: Explore how air acts as a medium for sound. Conduct experiments to show how sound travels through air and have learners create simple musical instruments to observe these effects.
Health and Family Life Education: Respiration and Health: Discuss the importance of clean air for healthy lungs and overall well-being. Include topics on how to protect the respiratory system and the impact of smoking and pollution.

Elements from Local Culture, Technology, TVET, Environment that are integrated

Elements from Local Culture

- Outside cooking on firewood and coal pot. Oxygen (air) is very important to this combustion process. Notably, air and technology have evolved in the cooking process through gas and electric stoves.
- Balloon blowing competition is a Nine Mornings activity.
- Jumbie from folklore are wind/air spirits.
- The smell of local foods spread; persons can recognize these foods by their smell.
- The fact that matter can change state, is used in local cuisine.
- Inflated balls are used in many different sports.
- Inflated balloons are used as decorations.
- The entertainment industry also utilises a number of gases in musical shows and sporting activities.
- Swimmers can cut through water to swim.
- Change of state is used to produce many local foods such as ice cream.

Environment

- Air masses and air pressure systems greatly influence the Caribbean weather. We have a known hurricane season because of this.

Technology

- Use digital tools and apps to simulate experiments or visualise air particles. Interactive simulations can help students understand abstract concepts.
- Many technologies are developed for the detection and removal of particles in the air that are too small to be seen, detect matter dissolved in blood stream, water bodies, foods etc. as these are too small to be seen.
- Some gases are transported under pressure as a liquid instead of as a gas.

TVET

- Many TVET activities release a lot of dust and chemicals into the atmosphere.
- Many of the food products made in TVET centres are results of matter changing from one state to another

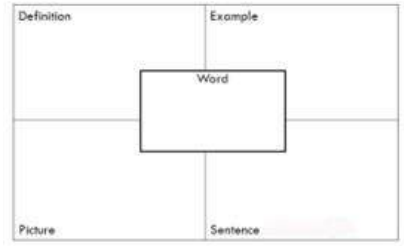
Agriculture

- A number of chemicals are applied in an aerosol manner. These chemicals can spread to areas and cause harm to other animals and plants.
- The sources of air pollution be field and orchard operations, unpaved roads, farm equipment exhaust, agricultural burning, processing and handling facilities, pesticides, livestock, and windblown dust

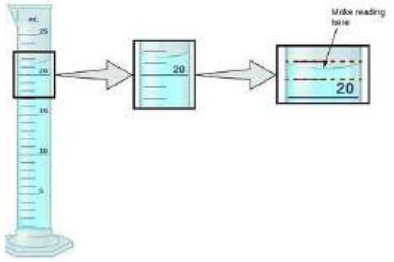
Essential Learning Outcome 2: Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.

Clarification Statement: Examples of reactions or changes could include phase changes, dissolving, and mixing that form new substances.
Assessment Boundary: Assessment does not include distinguishing mass and weight.
Grade Level Expectations: Refer to grade level expectations at the beginning of this curriculum document.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Learners are expected to: **<u>Knowledge</u>** Define terms: • Mass • Grams • Kilograms • Reliability • Change of state • Chemical change • Mixture • Solution • Homogeneous mixture • Heterogeneous mixture • Soluble/insoluble • Precipitate • Conservation of mass and Conservation of matter	**<u>Experimental Design</u>** Have learners recall an experiment that shows: a) Conservation of mass for a change of state b) Conservation of mass for dissolving a solid in a liquid with no chemical reaction c) Conservation of mass for a chemical reaction in a closed system d) Indication of a chemical change rather than a simple physical state change. **<u>Mixing Substances</u>** 1) If we mix sand and water we have a **mixture.** Would you predict the starting materials would have the same mass as the combined materials? (*yes*) 2) If we mix table salt and water, we can see that the salt slowly dissolves. We say this is a special homogeneous mixture called a **solution**. Would you predict the starting	**<u>Scenario</u>** Mary and John were twins who got two boxes of wax crayons each for their birthday. John's crayons were smaller as he preferred them for fine drawings. Mary's crayons were slightly larger which preferred for making posters. Unfortunately, on a recent car trip they each left them loose in a separate pile under the back window of the car. You guessed it…they melted in the hot sun- what a mess! Neither could remember which side of the car they left them on but their parents wanted them cleaned up right away. Now that the crayons were cool again each of two messes was just a mass of colours all mixed together. But which mess was there's to clean up?? Do you think if they weighed their other packages of intact crayons and the solidified wax messes, they could determine whose was whose to clean up? Let see if we could help them decide if that was possible.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
• Changing states of matter: particularly- melting and freezing • Open and closed systems • Variable • Controls or controlled variables • List some physical properties of matter. (ST 3 PS MM 1) Identify and explain different ways by which materials can be changed. (ST 5 PS MM 1) Understand that the mass of water remains constant when water changes from solid to liquid. (ST 6 PS MM1) **Skills** Hypothesize why the total mass of the products may appear to change when performing experiments in an open system. Identify different phase changes of matter e.g. liquid changing to a solid, solid to liquid	materials would have the same mass as the combined materials? (*yes*) **Comprehension of Vocabulary** Place the words ***Conservation of Mass*** in the centre of this Frayer square and ask learners to fill in the 4 quadrants with the appropriate information. Frayer Model (Four Square) Reinforcing Vocabulary  **Manipulation and Measurement Skills** ***Note to teacher:*** Assess each learner's use of measuring/weighing devices (scale and or measuring cylinder/ measuring spoons/ measuring cups)	**Note to teacher:** Conservation of mass is a critical concept that is developed over time; therefore, learners need multiple opportunities to investigate this phenomenon. **What is Mass?** As you would have learnt before, matter is anything that has *mass* and takes up space, but what is mass? **Mass** is the measure of how much matter is in an object. Mass can be measured in **grams or kilograms**. How would you find the mass of an object? *(Weigh the object on a scale)* As a review the teacher may find it useful to view the following video: https://www.youtube.com/watch?v=BJJOZ5QQpmc (1:03 mins) In particular watch Timestamp: 0-0:28s **Investigating Conservation of Mass - Nothing is Lost** From experiments we have done and from your own experiences, you are aware that the state of matter can be changed. For example, solid butter can be melted to form liquid butter, liquid water can be frozen to form solid water (ice) and solid sugar can be mixed with water until it dissolves. Now, let us think about what happens to the mass of matter when the state changes? Let's conduct a few investigations to determine if changing the state matter also changes the mass. Let us first start by investigating what happens when matter changes state. **Below are a series of investigations on how changing the state affects the mass of matter.** Retrieved from:

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Identify the conservation of mass with phase change. Use measurements and calculations to show that regardless of the reaction or changes mass is conserved. Conduct an experiment to observe what happens when salt is dissolved in water. Describe their observations of water evaporating and the salt crystals re-forming. Select and use the appropriate tools to observe and measure matter. Record and organize observations in chart form. Investigate the effect of heat energy on the state of matter Have an understanding that heating and cooling matter can bring about phase changes from solid to liquid to gas.	**Suggested Mark Scheme:** Observe each learner using the apparatus and award one mark for each skill the learner can perform. **Electronic Scale:** 1. He/she uses the TARE (zero) button appropriately. 2. Handles scale with care 3. Minimises spilling materials on the scale or if needed he/she removes any spilled materials from the scale before weighing 4. Invites reading to stabilise before recording it. **Measuring Cylinder/Measuring Cup:** 1. Pours liquid carefully to avoid spills 2. Places cylinder on a flat surface before reading 3. Reads device at eye-level 4. Reads the bottom of the meniscus.	https://teaching.betterlesson.com/lesson/604577/changing-matter-is-weight-the-same-or-different?from=search **Notes to teacher:** Using at least three types of matter (butter, ice, chocolate, candle, candy) that melt and/ or freeze quickly, have learners measure the mass of them and record them on an observation sheet. Now, heat the solids so that they change state and measure the mass again. After measuring, have learners place the liquids in a freezer (optional) to change back to solids and measure the mass. Have learners plot a bar graph for each substance showing the three measurements. N.B. The mass should remain the same. Before using the scale, instruct learners on how to use the electronic scale. See the following video for guidance https://youtu.be/cu4byDWQxKk?si=vq2GTkxT5Ly7-nRc (1:34 mins)  **Retrieved from** https://publicdomainvectors.org/en/free-clipart/Digital-weighing-scale/85434.html Discuss with learners the possible errors that could occur to result in them not having the same measurement in all three cases e.g. spilling the substances, reading balance inaccurately, etc. Scientists call consistency of measurement **reliability.**

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Recognize that when substances combine, they may lose their individual properties. Demonstrate that changes of state are reversible through the addition or removal of heat. Determine if the mass of a substance changes when it changes state Determine if the mass of two or more substances change when they are mixed Take measurements showing that whether the process is a change of state, dissolving, or a chemical reaction, the total mass of the substances does not change. Understand that the same substance can change state and be a liquid, a solid, or a gas Apply the Law of Conservation of Mass to the mixing of two separate states of matter.	**Diagram Showing How to read the bottom of the meniscus**  https://www.collegesidekick.com/study-guides/introductorychemistry/measurement-uncertainty-accuracy-and-precision **Measuring Spoons:** 1. Careful to avoid spills 2. Make certain to fill or level the measuring spoon as needed. 3. Transfer all of the material from the spoon into the vessel. In addition to awarding marks for use of apparatus, the teacher may also mark: 1. How well learners work with their team and if he/she shows regard for others. 2. How they maintain their work station (i.e. Do they keep it clean and tidy and clean up after the experiment?)	**Experiment using Water and Ice** **Materials:** • Beaker/cup/tin/soda bottle) • Water • Scale • Measuring cup/cylinder ***Note to teacher***: select a container and volume of water that will minimise water loss during the freezing and thawing processes. **Procedure**: • Place the container on a scale, find its mass, add 250 ml (1 measuring cup) of water to the container and record the mass of the water and the container. • Place the container with the water in a freezer. When the water is completely frozen, remove from the freezer and weigh the frozen water (ice) again and record its mass. • Predict what will happen to the mass of the ice after it melts. Will it change or stay the same? • Leave the ice to melt completely, then reweigh the container with the water. • Record the mass of the water from the melted ice. • Draw a bar graph of your results.

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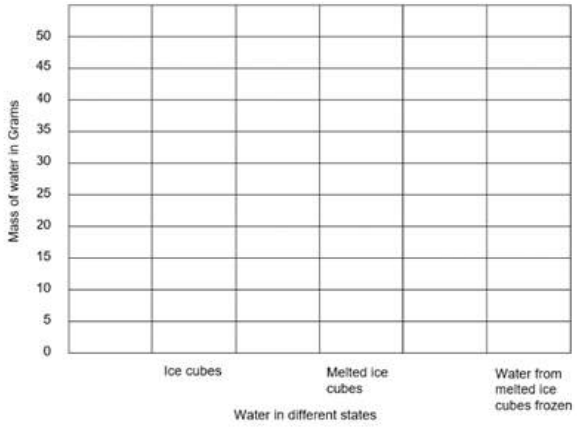
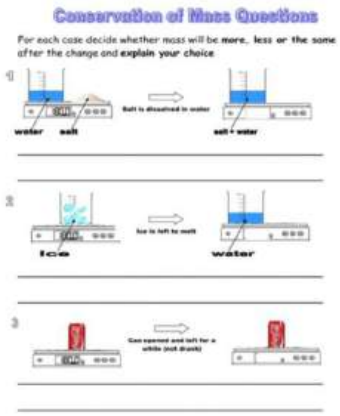
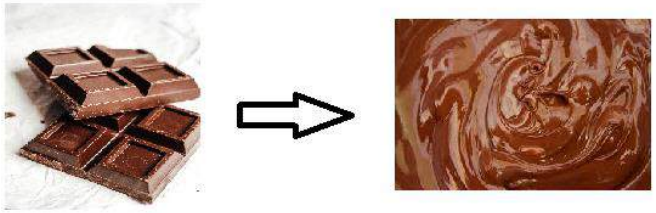
Explain how, when different states of matter are mixed, some properties change while others remain the same. Describe how matter is transported into, out of, and within systems. Describe the changes in properties they observe during and/or after heating, cooling, or mixing substances. Describe the effect of cooling and heating on different states of matter. Measure and graph quantities to provide evidence that regardless of the type of change that occurs when substances are heated, cooled, or mixed, the total weight is conserved. Develop skills in using a balance to measure mass. Investigate whether the mass of two or more substances change when they are mixed. Infer that the mass of water remains the same when water changes from solid to liquid.	**Make a Simple Lab Report** ***Note to teacher:*** For this aspect of the assessment learners should have an opportunity to write/present a simple lab report after conducting at least one of the experiments. In addition to the date title, aim, list of apparatus/materials and procedure, below are some of the key areas which should be included in a report and some suggestions on how to mark those areas: **Observations** 1. Uses appropriate section to record observations 2. Correctly records before and after observations. **Recording Results/Data gathered** **Table:** 1. Table has an appropriate title 2. Neatly draws/constructs the table with headings, units and all the relevant sections shown? 3. Uses the sections of the table appropriately. 4. Correctly records the data gathered?	**Bar Graph Template**  **Diagram credit:** Amaala Muhammad **Questions:** 1. Did the mass of the water change after it turned into ice? Why or why not? (*no it did not- only change of state*) 2. How does your prediction compare with the actual results? *(I expected it to change*) 3. What happens to the mass when the ice melted into water? *(no change*) 4. What do you predict will happen to the mass of the water when it is frozen again? *(return to original mass*) 5. Compare the starting weight of the water in the container with the mass of the water from the melted ice. *6.* Did the mass of the water change when it turned into ice? Why or why not? (*no change- only a change of state)*

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Conduct an investigation to produce data that can serve as the basis for evidence, using fair tests Identify with examples, physical change in everyday living (ST 3 PS MM 2) Classify substances as soluble or insoluble by their ability to dissolve in water. (ST 4 ESS ER 9) Measure volume and mass of materials. (ST 4 PS MM 1) Investigate using a variety of ways and measurements to compare physical properties of certain materials. (ST 4 PS MM 2) **<u>Attitudes/Values</u>** Appreciate the importance of the conservation of mass. Show persistence when conducting experiments that demonstrate the conservation of mass.	**Graph:** 1. Graph has an appropriate title. 2. It is neatly drawn/constructed. 3. Axes and sections are labelled appropriately. 4. Correctly plots each bar of the graph. **Analysis of Data:** Assess is learners can correctly calculate the difference between the total weight of the substances (using standard units) before and after they are heated, cooled, and/or mixed. **Discussion:** Give relevant background information. Explain observations/results. **Conclusion:** Have learners make conclusions based on the aim of the experiment and their experimental findings and reward a mark for every correct conclusion. ***Note to teacher*:** For a simplified version of the lab report the teacher may prefill certain sections of a lab report and leave spaces in the report for learners to complete.	7. Did moving from one state to another affect the mass of the water? Support your answer with evidence from your graph. (*no it did not- graph shows equivalent mass*) 8. How did moving from one state to another affect the water? Support your answer with evidence from your graph. (*the water changed state but no mass change*) ***Note to Teacher*:** Repeat the experiment using two other substances that melt or freeze quickly such chocolate, butter, candle, candy as shown below: **<u>Experiment Using Butter</u>** Weigh a certain amount of butter and the container it is in. Record the mass on your worksheet. Heat the butter until it melts completely then weigh the butter and the container again and record the mass. Place the butter in the refrigerator until it returns to its solid state, weigh it one more time and record the mass of the butter and the container.   **Retrieved from:** https://pixabay.com/photos/food-butter-table-milk-3179853/ & https://pixabay.com/photos/liquid-butter-butter-sauce-stove-792696/

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Use the inquiry approach in conducting investigations on the conservation of mass Show respect for evidence obtained from investigation on the conservation of mass Show care for the environment by appropriately disposing of the chemicals used. Demonstrate work habits during the lab activities that ensure personal safety, the safety of others, as well as consideration of others and the environment. Follow rules for safe and appropriate use of scientific tools and chemicals. Display sensitivity to those learners who may have difficulty using certain tools or identifying certain changes when conducting practical and group work. Participate actively in whole- class and group discussions on the conservation of mass.	**Using Experimental Findings** Learners can make correct predictions on the weight of substances after heating, cooling or mixing in a closed system. Learners can correctly distinguish between physical and chemical changes by indicating when a new substance has been formed. **Graph Construction /Analysis** Provide learners with data and have them construct a graph or give learners a graph and have them analyse it. **Conservation of Mass Worksheet**  Conservation of Mass Questions For each case decide whether mass will be more, less or the same after the change and explain your choice	Have learners plot a bar graph for each substance, showing the three measurements. **Note to teacher:** Repeat the experiment using another substance such as chocolate.  **Retrieved from:** https://www.pexels.com/photo/chocolate-bars-on-white-surface-6167332/ & https://www.rawpixel.com/search/chocolate%20melt?page=1&path=_topics&sort=curated Learners from these three experiments, what can you conclude about the mass of a substance when it changes from one state to another? (*The mass remains the same)* Learners, **when matter changes from one state to another, the mass does not change.** **So: what could we tell Mary & John?** If we weigh one of their intact sets of crayons it should have the same mass as one of the melted messes! Then we know whose mess each pile is to clean up 😊

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Communicate the results from the various investigations to the class and teacher. Work collaboratively with their group members to carry out the activities on the conservation of mass.	**Retrieved from:** https://www.tes.com/teaching-resource/conservation-of-mass-worksheet-6062980	**Introducing the Law of Conservation of Matter** The **Law of Conservation of Matter** states that the amount of matter stays the same even when it changes state. This simply means that when matter changes state, nothing is lost. We saw this in the previous experiments when the mass remained the same even though the states had changed. Now, let's do a few more experiments to investigate this but this time, let's see what happens when we **mix** substances. **Mixing** is the act of combining two or more different substances. A **mixture** is a combination of two substances. Here the components do not react chemically but are mixed physically. Depending on the type of components, mixtures are classified as **homogeneous** and **heterogeneous**. A **solution** is a type of homogeneous mixture where two or more components are dissolved such that you cannot see them as separate substances any longer. Some examples of substances that are mixed are: • **Sand and pebbles (heterogeneous)**  **Retrieved from:** https://www.publicdomainpictures.net/pictures/150000/velka/pebble-beach-1455121574J7E.jpg

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		• **Sugar and water** **(homogeneous mixture-solution)**  **Retrieved from:** https://www.wikidoc.org/images/8/89/SaltInWaterSolutionLiquid.jpg • **A Tossed Salad** **(heterogeneous mixture)**  **Retrieved from:** https://ndsalud.blogspot.com/2013/08/como-preparar-una-ensalada-correctamente.html Let's investigate what happens to the mass of the substances when they are mixed. **Investigating what happens to the mass when substances are mixed** **Note to teacher:** As learners compare the data, they should recognize that when two or more substances are mixed, the mass of the resulting substance equals the sum of the masses of the original substances. In other words, regardless of the changes that occur when mixing substances, the total mass of matter is conserved. It should be noted that some substances, such as the sugar in the sugar and water mixture disappear when mixed. This process is called **dissolving** and the substance that is dissolved is known as a **soluble** substance. On the other hand, a substance

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		which does not dissolve is referred to as an **insoluble** substance. For example, sand does not dissolve in water. Let's do an experiment. **Materials for each group:** ● 1 clear plastic cup (or beaker) ● Water ● Sugar ● Stirring rod (or spoon) ● electronic balance(s) **Procedure:** *Precautions: Be sure to avoid spilling any of the substances during this experiment.* 1. Weigh 20 grams of sugar. 2. In an empty cup, weigh 100 grams of water (i.e. zero an empty cup then add water until the reading is 100g) 3. Add the 20 grams of sugar to the water. 4. Weigh the cup with the water and sugar mixture and record the mass. 5. Stir the mixture until the sugar dissolves and weigh the mixture again. **Question:** Learners from this experiment, what can you conclude about the masses of the substance when they were mixed? Did the masses change? *(No. The masses remained the same.)*

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Plot a bar graph for each substance showing the measurements before the substance dissolved and after the substance dissolved. Use your graph to answer the following questions: 1. Why was the weight of sugar and water the same before and after mixing? *(Nothing was lost or gained during mixing)* 2. Why was it so important to avoid spills during this experiment? *(To avoid loss of material)* 3. Would the mass of the weighing dish of sugar and water be the same, more or less, after it was left on a table for two days. Explain your answer. *(Less- evaporation would lead to loss of water and formation of crystals)* ***Teacher note**: It is important to remind the learners that evaporation of the water gives us back the sugar crystal so we know that there was no chemical change only the dissolving process (dissolution)..* A video resource showing the experiment https://www.youtube.com/watch?v=4O0PFJQW9SI (1:21 mins) **Activity One – Mixing Sodium carbonate (Washing soda) and Magnesium sulphate (Epsom salt)** We have seen that when matter changes from one state to another, the mass does not change, that is, it is **conserved**. We have also seen that when we mix certain substances without an indication of **chemical change** (heat, gas, light, precipitate), the total mass does not change (sugar dissolved in water). Suppose we were to mix two substances that undergo a chemical change to form something

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		new, would the mass of the new products be the same as the total mass of substances we mixed? In the next activity, we are going to combine two substances that will react to form something new. Do you think the total mass of the substances before the reaction took place, would be the same, more or less than the mass of the new substance formed? Make your prediction. **Materials for the demonstration** ● 2 Clear plastic cups/beakers ● Sodium carbonate (Washing soda) ● Magnesium sulphate (Epsom salt) ● Water ● Graduated cylinder/graduated measuring cup ● Teaspoon **Procedure** 1. In a clear plastic cup add 50 mL of water and add 1 teaspoon of Epsom salt (magnesium sulphate). Gently swirl the cup so that the Epsom salt dissolves. 2. Measure the combined mass of the cup with the Epsom salt solution in it. Tell learners the mass and have them record it. 3. To another cup, add 50 mL of water and add 1 teaspoon of sodium carbonate. Gently swirl the cup until the sodium carbonate dissolves.

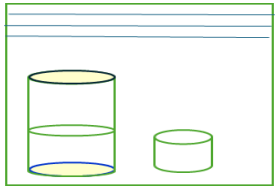
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		4. Measure the combined mass of the cup with the sodium carbonate solution in it. Tell learners the mass and have them record it. 5. Have learners add the two masses together and record and announce the sum. 6. Hold the cups up so learners can see them and then slowly and carefully add the sodium carbonate solution to the Epsom salt solution. 7. Place both cups on the scale to measure the total mass. **Expected results** A white solid will form. At first the solid may appear or look like clouds of white particles floating in the liquid, but the particles should eventually settle out to form a solid **precipitate** at the bottom of the cup. This is a new substance formed and it indicates a chemical change has occurred In chemistry it is referred to as a precipitate. The total mass should be the same as the sum of the individual masses found before the substances were mixed and the reaction took place. Even though the two substances have been changed into a new substance, all of the particles making up the two substances that were mixed, are still present in the new substance formed. Which is why the mass stays the same.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Activity Two: The chemical reaction of baking soda and vinegar  **Retrieved from:** https://www.shutterstock.com/search/bottle-balloon In the last experiment, we combined two substances that formed a new product that formed in the beaker/test tube. What if one or more of the new products formed is a gas? How would we be able to tell if the mass of the new substances remains the same as that of the substances we reacted? To study this type of reaction we can use what is referred to as a closed system. **What are open and closed systems?** **Closed systems** are systems which have no interaction with their surrounding environment. Energy may, however, move into and out of a closed system but mass cannot. This means that all mass

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		remains in the system. A sealed box is a good example of a closed system. The inside is separated from its surroundings. **Open systems** are systems that interact with their environment. Energy and mass can move into and out of an open system. To make the comparison between the reaction in a closed system and an open system, it must be done as a fair test. A fair test compares two or more things. Fair tests invite one to compare one factor while keeping all others the same. The factor that is being tested is called a **variable**. You keep everything else exactly the same. All of these things that are the same are called **controls**, or **controlled variables**. This means that in order to be fair, a test must include measurement with scientific tools. In this two-part activity, you will be comparing a reaction between baking soda and vinegar/lime juice in an open system and in a closed system. **Activity Two Part A - The Mixing baking soda and vinegar in a closed system**  **Retrieved from:** https://www.shutterstock.com/search/bottle-balloon

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Materials needed: Baking Soda, vinegar/lemon juice, empty soda bottles, balloons, measuring spoons, funnel **Procedure:** 1. Weigh and record the weight of the bottle (empty) on the scale. Leave the bottle on the scale. 2. Measure out 20 mL of vinegar/lemon juice using a measuring cylinder. Pour the vinegar/lemon juice into the bottle using the funnel. 3. Use the measurements of the empty bottle and bottle with the vinegar/lemon juice to calculate the mass of the vinegar/lemon juice. Take the bottle with the vinegar/lemon juice off the scale. 4. Weigh and record the mass of two teaspoons of baking soda. 5. Blow up the balloon a bit to stretch it out a bit and use the funnel and teaspoon to carefully add baking soda to it. 6. When baking soda has been added to the balloons, of all the groups, carefully attach your balloon to the soda bottle, making sure you have a good seal. 7. Predict what will happen to the mass of the substances after they have been added together. Will it change or stay the same? 8. Now, on the count of three, lift up your balloon to tip the baking soda into the bottle with the vinegar/lime juice.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		9. Observe the balloon to see what changes are taking place. Also, look at the mixture in the bottle, to see what is happening. 10. Record what you observed when you added the baking soda to the vinegar/lemon juice in the bottle. 11. When the reaction stops, place the bottle with the balloon still attached on the scale and weigh them. 12. Record the mass of the bottle and its contents. **Question:** This experiment is said to be taking place in a closed system. Why do you think it is called a closed system? *(Nothing from the environment can get in or out of the system)* When the two substances mix, a gas called carbon dioxide is produced. As the gas leaves the plastic bottle, it goes up into the balloon. However, due to the tight seal you have created it cannot escape. The gas has nowhere else to go and it pushes against the balloon and blows it up, making it larger. Therefore, all of the products stayed in the system and therefore the mass is the same. 

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Retrieved from: https://www.shutterstock.com/search/bottle-balloon **Note to teacher:** Invite learners to perform the vinegar/lemon juice and baking soda reaction again for a closer observation of the reaction taking place. This reaction can also be done in a sealed Ziploc bag, where the vinegar/lemon juice is placed in a glass or jar and the baking soda is placed in a cap or very small medicine cup. What type of system does that make? (*a closed system*)  The baking soda is poured into the cup and the reaction observed. As learners take the mass of the system with its contents at the end of the experiment, they will find that the total mass remains the same, proving that the mass of substances before and after a chemical change remains the same. We will now repeat this experiment using the same amount of substances used in part A and the same method. This time however, we will not be placing a balloon over the bottle, before adding the baking soda to the vinegar/lemon juice in the bottle.

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		Predict what will happen to the mass of the substances after they have been added together. Will it change or stay the same? After completing part B of the activity, respond to the following: 1. Describe the difference between the total mass and the mass of the bottle with its contents after the mixing of the substances. (*the mass afterwards is less)* 2. Why is this system called an open system? Explain. (*The gas that is produced can escape with the container open)* 3. Draw the system made up of the bottle, baking soda and vinegar/lemon juice. Use labels and arrows to show the movement of matter and energy in the system. 4. Graph the masses before and after mixing the two substances. 5. Compare the results obtained for the open and closed systems. 6. Last time you mixed baking soda and vinegar, what type of system was that? *(a closed system)* 7. What made it that type of system? *(The gas from the chemical change could not escape from the system.)* In this activity, learners compared the mass before and after a reaction. The learner will find that this time the mass is different. Ask learners to explain the difference found.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Explain and provide learners with a definition of the Law of Conservation of Mass (write the definition on the overhead/from board). **<u>Observing the popping of a bag of microwave popping corn</u>**  **Retrieved from:** https://www.flickr.com/photos/armydre2008/4012916832 Weigh the bag of microwavable popping corn. Place the bag in a microwave for the period of time stated in the instructions on the bag. After the corn has popped, Weigh the bag again. Compare the two masses. Is there a difference in the masses? (*yes mass afterwards is less)* How can you account for this difference observed? (*water vapour gas that has escaped the corn kernel is lost into the atmosphere so the mass should be less afterwards)* Now you get to eat the popcorn! Plot a bar graph showing the masses before and after the experiment. In this activity, learners compared the mass before and after a reaction.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		The learner will find that this time the mass is different. Ask learners to explain the difference found. Explain and provide learners with a definition of the Law of Conservation of Mass (write the definition on the overhead/from board).

Additional Resources and Materials

Fifth Grade Lesson 4.1 Conservation of Mass Time: 7:12 mins

Additional Useful Content Knowledge for the Teacher

Disciplinary Core Ideas:

1. The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish (e.g., sugar in solution, evaporation in a closed container).
2. No matter what reaction or change in properties occurs, the total weight of the substances does not change. (Boundary: Mass and weight are not distinguished at this grade level.)

National Academies of Sciences, Engineering, and Medicine. 2012. A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas. Washington, DC: The National Academies Press. https://doi.org/10.17226/13165.

Opportunities for Subject Integration

Mathematics: calculations of mass which involve finding the difference.
Language Arts: Learners can write descriptive pieces to record their observations. Introduction to new vocabulary such as "conservation", "melting", "boiling", "freezing".
Social Studies: Principles of conservation, the need for sustainability in the environment, Resources, Pollution, Wants and needs, Culture and materials and kind of space.

Elements from Local Culture, Technology, TVET, Environment that are integrated

- Using a scale to measure luggage mass at airports to ensure that correct weight allowance is maintained
- The use of scales, measuring cups, and measuring spoons in domestic kitchens, restaurants, and guest houses
- The use of measuring instruments to administer the correct dosages of medicines
- Making local coconut oils, hair products, candles, and confectioneries.
- Use of 3D printers to change the shape and form of matter
- Law of Conservation of matter/mass may be linked to sustainability, the effects of various forms of matter which may change from one form to another and impact the environment in the process (for example solid/liquid chemicals that change into gases that pollute the environment.
- Did you know there was a time when people weighed objects in the palm of their hands?

Items of Inspiration

Life is like a jar of many important and not so important things- be careful how you fill the jar.
See: https://kenosha.extension.wisc.edu/files/2010/10/21-Lifeisajarofgolfballsstory.pdf

Essential Learning Outcome 3: Make observations and measurements to identify materials based on their properties.

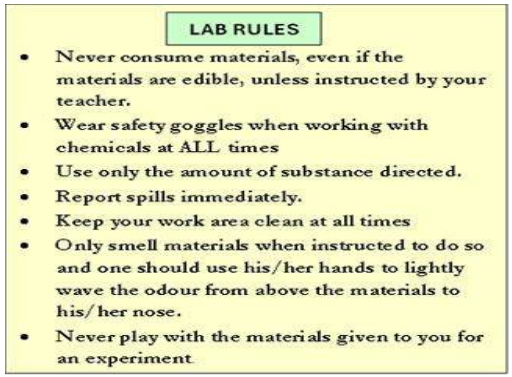
Clarification Statement: Examples of materials to be identified could include baking soda and other powders, metals, minerals, and liquids. Examples of properties could include colour, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility; density is not intended as an identifiable property.
Assessment Boundary: Assessment does not include density or distinguishing mass and weight.
Grade Level Expectations: Refer to grade level expectations at the beginning of this curriculum document.

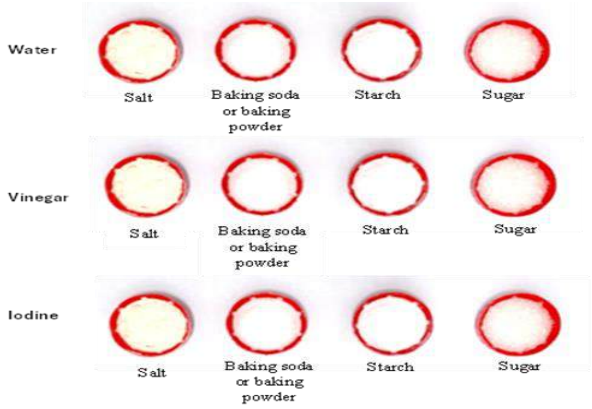
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Learners are expected to: **<u>Knowledge</u>** **Define the terms** ● Soluble ● Insoluble ● Transparent ● Translucent ● Opaque ● Magnetism ● Electrical conductivity ● Density ● Buoyancy ● Elasticity ● Solubility ● Thermal conductivity	1. Matter and materials have different properties that can be used to identify them. a. What does the word property mean when discussing matter and materials? b. List three physical properties that a material may have. c. State three physical characteristics that can be gathered through measuring with certain tools. 2. A learner has three jars of powdered chemicals that are not labelled. One is salt, one is sugar, and the last one is baking soda. To figure out which is which, the learner pours vinegar over each of them. One of the powders started to bubble. a. Which of the three substances reacted with the vinegar? (*baking soda*)	**<u>Properties of Matter</u>** **<u>How can I describe an item or material?</u>** Welcome, young scientists! Today, we're going to dive into the fascinating world of the properties of matter. In my hand I have a stick of chalk, it is the same as the stick of chalk that you and your partner have. How would you describe it? Guide learners by asking questions such as: ● What colour is it? ● Does it feel hard or soft? ● Is it easy or difficult to break? ● Does it have a scent? ● How long is it? ● What shape is it?

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Identify materials/ objects which can be attracted to magnets. Realise that even though some materials may have the same properties, they may not be magnetic. Locate the North and South poles of a bar magnet. Determine if a magnetic material has a high or low level of magnetism. Describe what happens when like poles or opposite poles of magnets interact. Explain what determines the strength of the magnetic force between a magnet and the object that is attracted to it. State the basic observable properties of materials (colour, texture, shape, size, weight, hardness). Use a variety of ways and measurements to compare the physical properties of materials	b. What can she do to find out which is salt and which is the sugar? *(iodine will react with sugar*) 3. The block gold bar shown below will sink if placed in water, while the wooden raft will float.   **Photos retrieved from:** https://pixabay.com/photos/gold-bullion-wealth-finance-2801876/ https://commons.wikimedia.org/wiki/File:Turtle-raft-muenster-zoo-germany.jpg a. State three factors that affects an object's ability to float on water (*shape, mass, size*) b. What property does the wood that the raft is made from have, that invites it to float? (*anything that has air pockets is likely to help it float because the particles of the entire object are further spaced- less dense and we know by experiment that objects with less densely packed particles tend to float on water*) c. What property of the gold bar prevents it from floating? (*the particles are packed closely*	Record their ideas on the board. Let learners know that there is not one set of correct answers for this activity. Remind learners not to smell the chalk or any other substance they may be given, without being told to do so. Demonstrate to learners how to gently fan air from materials to detect odours. Tell learners that what they are doing is observing and describing the chalk by what are called its properties. Properties or characteristics enable us to distinguish one substance/item from another. Some of these properties can be observed and some of them have to be measured. Different types of matter have different They describe how a substance looks and behaves. There are two types of properties: physical and chemical properties. During this unit of study, you will observe and identify materials based on their properties. You will be given the opportunity to observe, describe and measure a variety of physical properties. You will also be given the opportunity to see how some substances react to certain chemicals. These observations and measurements will produce evidence that can be used to identify materials. **Activity** In this activity, each learner will test four white substances. The substances are similar in colour and form, representing the fact that some types of matter share some properties that are immediately identifiable, such as colour or shape. Learners will soon find that each powder has other properties that are unique. The magnifying lens invites learners to visually inspect the shape, colour and texture of the powder**s.**

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Identify objects that float or sink when placed in water State the properties that objects that float have in common. Give reasons why certain objects float and others do not. List factors that determine if an object will float or sink when placed in water. Determine which properties of materials can be used to distinguish them from other materials. Identify materials based on their properties. List some physical properties of matter. (ST 3 PS MM 1) Identify some physical properties of materials. Identify some chemical properties of materials.	*together making it more dense causing it to sink in water*) 4. Water can exist as a solid, a gas or a gas. Use this information to answer the following questions. *a.* Which two properties identify water vapour as a gas? (*no shape, no volume)* *b. If a learner compares an ice* cube to liquid water. What are two observations you think that the learner would make? (*volume & shape)* 5. Which of the following are physical characteristics that can be gathered by simple observation? a. Colour X b. Mass c. Volume d. Texture X 5. Anthony drops a drinking glass on the floor. The glass breaks into several pieces. 	1. Divide the class into groups of about 3 – 4 learners. 2. Distribute 4 Ziploc bags or clear plastic bags labelled A, B, C and D to each group, containing one of the following: salt, baking soda/baking powder, cornstarch/arrowroot starch and sugar. Each bag must contain the same amount of substance. 3. Invite learners time to study each substance, discuss some of the properties of the substances and create a list of these properties. 4. Ask learners to feel the texture of each substance by pinching a small amount between two fingers, keeping it all in the bag and taking note of the grain (crystal) size, or if it is powdery. They can also use the hand lens provided. Learners, here are some questions to guide you: ● What do you notice about the appearance of each powder? ● How does the texture of each powder feel between your fingers? ● Can you describe the colour of each substance? ● How is powder A different from powder B? What about powder C and D? ● Are there any powders that look or feel similar? What are those similarities? ● Based on what you see and feel, what do you think powder A might be? Why?

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Distinguish between different materials based on their observable properties Describe different types of materials based on their observable properties. State the basic observable properties for materials (colour, texture, shape, size, weight, hardness). Distinguish between physical properties and chemical properties of substances. Cite ways of making hard water soft and soft water hard, identifying situations where hard or soft water is required. (ST 6 LS ECS 10) Demonstrate they understand an object can have many properties. Recognize that the state of matter is a physical property Account for differences observed between the properties of different materials.	**Retrieved from:** https://pixabay.com/photos/water-glass-isolated-transparent-3155018/ a. Which property of the glass caused it to break into pieces? (*brittle solid*) *b.* State two other properties that glass has. (*shape & mass)* c. Name another object that has the same properties as the drinking glass. (*tea cup*) 6. What property do the following items have in common? (*elasticity)*    **Photos retrieved from:** https://pixabay.com/photos/sock-socks-colors-colours-colorful-4330279/ https://pixabay.com/photos/rubber-band-elastic-fastener-2476/ https://pixabay.com/photos/balloon-pretty-colorful-1565746/	• Do you think any of these powders are something you've used at home? Which ones and why? *(N.B. Here teacher circulates and listens to conversations while groups discuss the properties and make the list)* 5. Invite groups to share their list of properties (E.g. white, powdery, and solid). 6. Learners can use the information they observe to complete column 1 and 2 of the table below. ***N.B. Here teacher will review the term physical properties*** A **physical property** is a characteristic of matter that is not associated with a change in its chemical composition. Familiar examples of physical properties include colour, hardness and electrical *conductivity*. Some of these qualities can be measured using different kinds of equipment, such as scales, rulers, etc. | Substance	Colour	Crystaline/ powdery	Reaction to water	Reaction to vinegar	Reaction to iodine
---	---	---	---	---	---
Baking soda					
Sugar					
Salt					
Starch						 *During this process, circulate to ensure that learners are observing accurately and are not making a mess or removing any of the substances from the bags.*

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Explain the importance of knowing the physical properties of a given material. Explain the importance of knowing the chemical properties of a given material. Give an advantage and one disadvantage of a given material with an identified physical or chemical property Give examples of materials with given properties. Describe with examples, materials that are opaque transparent, translucent and opaque. (ST 4 PS MM 5) Identify and describe electrical conductors and insulators Determine the observable properties to be observed in their investigations Distinguish between conductors and insulators	7. Which property do these three objects have in common? *(solids with shape)*  **Retrieved from:** https://pixabay.com/photos/mirror-frame-frame-mirrors-isolated-2407289/ https://pixabay.com/photos/tin-aluminum-canned-big-1528316/ https://pixabay.com/photos/kettle-copper-kitchen-water-shiny-365501/ 8. Light cannot pass through a certain material. What property does the material have? (*Opacity)* 9. In a laboratory experiment, you are given a beaker of liquid and asked to determine what it is. You observe that: • The liquid is clear • The liquid has a distinct smell a. Which of the following do you think this liquid is? Pepsi, water or bleach. Give	From their observations, learners should realise that powders are similar in colour and form, so explain to learners that when physical properties are the same for a substance, scientists need to rely on chemical properties to help them identify the substance. The ability to change from one type of matter into another is a **chemical property**. Examples of chemical properties include, toxicity, acidity and many other types of reactivity. *Ask learners to make a list of chemical properties e.g. changes colour, fizzes or bubbles.* Before you start the next part of the investigation, review the following laboratory rules to follow when working with chemicals. Examples of some rules which can be discussed are shown below: 

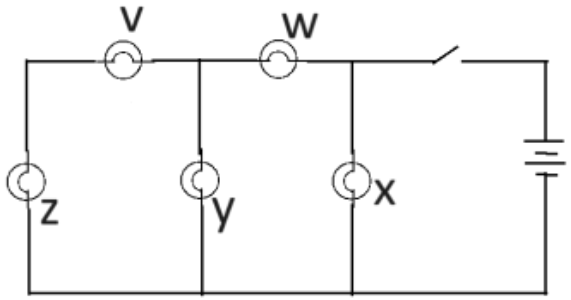
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Skills Classify materials as magnetic or non-magnetic Classify a variety of materials as insulators or conductors Investigate using a variety of ways and measurements to compare physical properties of certain materials. (ST 4 PS MM 2) Investigate the strength of a variety of common materials and recommend ways of strengthening materials to make them more force resistant. (ST 5 PS FMS 7) Predict whether an object/material will be attracted to a magnet. Predict which objects will sink and which will float. Predict which objects are conductors of electricity and which are insulators.	reason for your answer. (*colour and smell-bleach*) 10. Susan tells James that she has an item behind her back. She gives James a list of properties of the item. The list is as follows: ● The item is a solid ● The item is shiny ● The item can be bent with her hand a. Give two examples of everyday items that this mystery item could be. (*tin foil plate, foil wrap*) 11. Read each of the following sentences, decide if it is **TRUE** or **FALSE** then write the answer on the line near to it. a. Copper is used for electrical wiring. _____ (T) b. Absorbent is the opposite of waterproof. _____ (T) c. Plasticine can be easily moulded or squashed into different shapes. _____ (T) d. Colour is a physical property that is determined through observation. _____(T) e. The physical properties of matter can only be gathered through observation. _____(F)	**Looking at the chemical properties of substances** 1. Recollect the Ziploc/plastic bags from each group and distribute the following materials to each group. ● Four small cups labelled with each of the following (salt, baking soda/baking powder, flour, cornstarch/ arrowroot starch, sugar ● Hand lens ● Dropper ● Teaspoon ● A sheet of construction paper with three rows and five columns of circles or bottle caps that learners can arrange similar to the circles on the construction paper. 2. Point out the first row of circles using a diagram on the board. Tell the groups that they will need to place one teaspoon of each powder in the circle on the construction paper or the bottle caps. 

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Compare the physical properties of different materials. Compare the chemical properties of different materials. Measure, observe, and document physical properties of two or three substances Collect and record data on the properties of matter. Select and use tools to observe and measure different physical properties of materials. Communicate the results from the various investigations to the class and teacher Plan and conduct an investigation to classify different kinds of materials by their observable properties Construct simple circuits and explain how they work in terms of the flow of current.	12. A bolt is shown below.  *a.* What are two properties of this object? (*shiny , heavy, has a shape)* b. In relation to its use, why is it important that it has these properties? (*shape and mass make it strong to fasten items)* **Retrieved from:** https://pixabay.com/photos/hex-bolt-bolt-screw-1613931/ 13. Some materials conduct electricity. That is, they invite electricity to pass through them. a. Which of the following materials would you expect to invite electricity to pass through them? i. Wood ii. Paper iii. Water X iv. Metal X v. Glass vi. Plastic	**Photo credited to:** Amaala Muhammad 3. Model this by placing one teaspoon of salt on the first circle for group one. Point out to the learners that it should be a level teaspoon of each substance. 4. Give groups a minute to get each substance out on the correct circle or bottle cap. 5. Explain to learners that when physical properties are the same for a substance, scientists need to rely on chemical properties to help them identify the substance. Explain to learners the term "chemical properties" 6. Ask learners to make a list of chemical properties e.g., changes in colour, fizzing or the production of bubbles, changes in temperature, acidity, etc. 7. After learners have placed all of the chemicals in the correct bottle caps or out on the construction paper, present the liquids to the learners. in unidentified cups. Ensure that each learner makes observations about each liquid—colour, odour, etc.—to show that properties help to identify it. 8. Tell them that their first reaction test will be with the water. They should take turns adding a couple of drops of water with a dropper to each substance, in the first row one at a time and observing what happens. NB. The hand lens will be used if they need to look at the reactions more closely. Things to watch for are: dissolving, clumping together, changing in appearance, or bubbling.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Conduct test to classify objects as electrical conductors or insulators Observe the attraction and repulsion of magnetic poles. Explain how an object's ability to return to its original shape after being stretched (elasticity) affects the height to which it bounces. Explain the relationship between the speed at which an object returns to its original shape and the height to which it bounces. Produce drawings of what an object looks like at the exact moment it hits a surface. **Attitudes/Values** Show an appreciation for the fact that different materials exist and that these materials have different properties. Show persistence when conducting experiments on the properties of materials.	*b.* If you were to test these materials using an electrical circuit, how would you know if they conduct electricity? (*illuminate a light in the circuit)* 14. You have three different rods, one is made from wood, one is made from plastic and the third one is made from metal. Describe a simple experiment you can use to find out which rod is the best conductor of heat  **Photo credit:** Amaala Muhammad 14. Mr. Smith wants to buy a plastic sheet to put over a sign, to protect it from the weather. However, he wants the word school to be seen properly. 	NB. Teacher circulates while learners test, observe, and record their observations in the investigation log/chart. 9. Repeat using the vinegar, then the iodine. The water and vinegar are added to the powders to show different ways the powders react when mixed with other substances. 10. Give learners time to record their observations after the addition of each liquid in the remaining row of their worksheet. | Substance	Colour	Crystaline/ powdery	Reaction to water	Reaction to vinegar	Reaction to iodine
---	---	---	---	---	---
Baking soda					
Sugar					
Salt					
Starch						 11. Invite learners to clear their tables and then pass out the four bags of white substances labelled A, B, C, D and a new piece of construction paper with circles labelled with those letters or new bottle caps and tape. *N.B. The powders in the Ziploc bags/clear plastic bags are the same powders the learners tested, but they do not know which powder is which.* 12. Tell learners that their task is to identify each of the unknown substances (A, B, C and D) in the four bags, using the properties of the substances they just tested to help them. Invite learners to complete the investigation in their

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Demonstrate interest in designing simple experiments on the properties of materials Use the inquiry approach in conducting various investigations on the on the properties of materials Show respect for evidence obtained from investigation on the on the properties of materials Follow rules for safe and appropriate use of scientific tools. Follow lab rules during the activities that ensure personal safety and the safety of others. Participate in investigations to identify materials based on physical properties that can be observed or measured. Work collaboratively with group members to carry out activities on the properties of materials Stewardship/Respect for Living Things	  a. Which of the three sheets shown above would you recommend to Mr. Smith? (*sign 3*) b. Which of the sheets is the most opaque? *(sign 1)* c. Is an opaque windshield a good idea? (*no can't see*) 15. In the following worksheet, circle the objects that light can pass through.	groups. Ask them to begin with the grain size and then check the reaction of each substance to each of the liquids. 13. Create a List: Write down the properties you observe for each substance. This list will help you figure out what each mystery powder might be. 14. After learners have observed the four substances and have looked at the grain size, ask learners to predict what each substance is. As groups begin testing, circulate to observe, listen to the science talk that is occurring and ask questions. Ask groups to hold up their findings. NB. The order of results would be based on what the teacher placed in each bag. 15. At the end of the activity ask learners why they had to identify the substances after they already explored their properties. (*Learners may say that if they had stopped after testing each powder originally, they would not have had the opportunity to use the properties for identification purposes*). **Follow-Up Questions** After the activity, teacher asks: 1. **<u>Concluding Questions:</u>** a. What did you learn about the different properties of matter from this activity? b. How did your group work together to make observations and conclusions?

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
When conducting practical and group work, display sensitivity to those learners who may have hearing difficulty or who may be visually impaired or colour blind.	 https://pixabay.com/photos/wine-wine-glass-glass-chic-drink-224039/ https://pixabay.com/photos/hamburg-shopping-architecture-3130629/ https://pixabay.com/photos/a-book-embossing-leather-book-cover-3088775/ https://pixabay.com/photos/brick-wall-red-structure-masonry-1916752/ https://pixabay.com/photos/juice-carrot-juice-drinking-food-595699/ https://pixabay.com/illustrations/cardboard-box-cardboard-box-carton-220256/ https://pixabay.com/photos/teddy-bear-toy-soft-animal-colour-2142/ https://pixabay.com/photos/purse-handbag-	**2. <u>Extension Questions:</u>** a. How do you think these powders would behave if we heated them up or cooled them down? b. What other experiments could we do to learn more about these substances? **<u>More Physical properties of materials</u>** Demonstrate the following properties for the class using the experimental demos below: Hardness, magnetism, electrical conductivity, opacity, buoyancy, elasticity, solubility, reflectivity and thermal conductivity NB. *With each demonstration, encourage the learners to question and subsequently explain what they are seeing and how it informs their understanding of the property of matter being demonstrated.* **<u>Inspecting the hardness of different objects</u>** Hardness is a property that is often used in science to identify and/or categorize materials such as minerals. Some materials are hard and others are soft. This activity invites learners to compare the hardness of various materials.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	fashion-bag-female-883112/ https://pixabay.com/illustrations/bottle-dropper-container-glass-5947443/ Can pass through the glass or the empty bottle Conductivity  If lamp Z is broken, when the switch is turned on which lamps will light? Which lamps will not light? Which lamp(s) will continue to light if W is broken? Which lamp is not affected if W is broken?	• Learners scrape the nail against the penny, a piece of chalk, a piece of wood and a rock to see what happens when each is scraped with the nail. • What are we looking for? When each material is tested the nail will leave a different type of impression on it. Each material will also leave some sort of colour on the nail. • Review the evidence learners have gathered in their investigation. Ask the following questions: 1. How were the scratch marks different in the demonstration? (*They were different colours, and the nail left scratches on them.*) 2. What evidence does this provide about the materials? (*It provides evidence that they have different hardnesses.*) 3. How is this information useful? **<u>Thermal conductivity</u>** Objects can transfer their heat energy to other objects through a phenomenon known as thermal conductivity. Different kinds of matter conduct heat differently. The following is a simple investigation to test the thermal conductivity of several substances and determine whether each substance is a thermal conductor or an insulator. Demonstrate the properties of thermal conductivity as this requires the use of a hotplate or a Bunsen burner. Put some water in a beaker or pot on the hot plate or burner to boil. While

<table>
<tr><th>Specific Curriculum Outcomes</th><th>Inclusive Assessment Strategies</th><th>Inclusive Learning Strategies</th></tr>
<tr>
<td></td>
<td>
Opacity

Tick the cell to indicate whether these things are transparent, translucent or opaque

<table>
<tr><th></th><th>Transparent</th><th>Translucent</th><th>Opaque</th></tr>
<tr><td>Clear plastic</td><td></td><td></td><td></td></tr>
<tr><td>Cardboard</td><td></td><td></td><td></td></tr>
<tr><td>Wood</td><td></td><td></td><td></td></tr>
<tr><td>Cloth</td><td></td><td></td><td></td></tr>
<tr><td>Aluminium wire</td><td></td><td></td><td></td></tr>
<tr><td>Metal paper clip</td><td></td><td></td><td></td></tr>
<tr><td>25c coin</td><td></td><td></td><td></td></tr>
<tr><td>5c coin</td><td></td><td></td><td></td></tr>
<tr><td>Thumb tack</td><td></td><td></td><td></td></tr>
</table>

Conductivity

Use the tester to test if these objects are conductors or insulators of electricity. Write your answer in the table below
</td>
<td>
the water is heating, attach a small button to the end of three different spoons: one metal, one plastic and one wooden, using melted candle wax. Invite the candle wax to cool and harden. Vaseline can be used instead of the candle wax.

When the water has boiled, place the three spoons into the water, wax side up. Observe the spoons to see which spoon melts the wax or Vaseline® fastest.

1. What does this say about the thermal conductivity of each material?
2. Ensure that learners understand that the material that melts the wax fastest has the highest thermal conductivity.

<u>Opacity</u>

● Hold up a block of wood and a piece of paper.
● Do you think light could pass through the block or the piece of paper?
● Darken the classroom by turning off the classroom lights or closing all of the windows.
● Hold up a block a few inches from the chalk board or wall. (NB. A dark room can be created using black garbage/plastic bags, boxes, etc.)
● Hold the flashlight up to the side of the block that faces away from the wall. Point the flashlight towards the wall.
● Have the learners predict what will happen when you turn on the flashlight.
● Turn the flashlight on and discuss what they see.
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</table>

<table>
<tr><th>Specific Curriculum Outcomes</th><th>Inclusive Assessment Strategies</th><th>Inclusive Learning Strategies</th></tr>
<tr><td></td><td>
<table>
<tr><td>Object</td><td>Conductor</td><td>Insulator</td></tr>
<tr><td>nail</td><td></td><td></td></tr>
<tr><td>pencil eraser</td><td></td><td></td></tr>
<tr><td>pen</td><td></td><td></td></tr>
<tr><td>coin</td><td></td><td></td></tr>
<tr><td>cloth</td><td></td><td></td></tr>
<tr><td>key</td><td></td><td></td></tr>
<tr><td>spoon</td><td></td><td></td></tr>
</table>
A learner connected an electrical tester to the points V, W, X, and Y on a circuit board. The results are shown below.
</td><td>
i. Why doesn't light go through the block to the wall?
ii. Explain that the ability of a material to resist energy such as light from moving through it is known as opacity. The block is opaque because it doesn't invite light to move through it to the other side.
iii. Is the block totally opaque.
iv. Can they see some light going through part of the wood?

Do the same demonstration with the piece of paper, showing that light can move through the paper onto the wall on the other side. It is less opaque than the wood, but do they think there is material even less opaque than paper?
What about clear plastic or glass?

Knowing what materials block or transmit light comes in handy

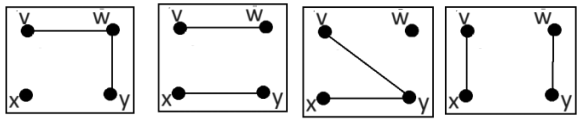
<u>OR</u>

To begin this activity, you will need a piece of clear glass, a piece of cardboard and a torch.

1. Hold up the clear glass and ask a learner to look at the lighted torch through it. Can you see the light from the bulb of the torch through the glass? Yes, you can see the light because it invites the light to pass through it, hence it is said to be transparent.
</td></tr>
</table>

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies

POINTS	LIGHTED BULB
V - W	yes
V - X	yes
V - Y	no
W - X	yes
W - Y	no
X - Y	no



Which diagram is likely showing the circuit board?

2. Now try to look at the light of the torch through the piece of cardboard. You cannot see the light because the cardboard does invite light to pass through it. Hence, it is opaque. The objects that do not invite any light rays to travel through them are opaque objects.
3. Repeat the experiment using a piece of paper, a piece of fabric, a piece of wax paper, aluminium foil, etc.
4. Classify the materials used as transparent or opaque.

Examples of opaque objects are bricks, walls, books, tables, clothes, and trees.

Homework

1. What are some other objects or materials that we would not be able to see through?
2. Give four examples in the home where opaque materials are used and four examples in the home where transparent materials are used,
3. Give one reason why the material is used in each example given.

Buoyancy

Have you ever wondered how boats are able to float in water and not sink? The reason for this is due to the fact that they are buoyant. Buoyancy refers to the ability of an object to stay afloat. Boats are buoyant because they are able to float on the surface of a body of water without sinking. We say that a piece of Styrofoam is buoyant because it floats on top of water.

<table>
<tr><th>Specific Curriculum Outcomes</th><th>Inclusive Assessment Strategies</th><th>Inclusive Learning Strategies</th></tr>
<tr><td></td><td>Elasticity

John collects data on the rebound of several objects when dropped from a height of 100cm.

<table>
<tr><td>Type of ball</td><td>Rebound height</td></tr>
<tr><td>Tennis ball</td><td>20 cm</td></tr>
<tr><td>marble</td><td>3 cm</td></tr>
<tr><td>Ping pong ball</td><td>15 cm</td></tr>
<tr><td>Football</td><td>10 cm</td></tr>
</table>

Which object has the greatest elasticity? (tennis ball)

Which object has the least elasticity? (marble)</td><td> 

Retrieved from:
https://www.flickr.com/photos/wonderlane/4083805329

There are several factors that determine if an object is buoyant or not. What do you think some of these are?

The material an object is made from, its shape, its mass and its size). How can you tell whether an object is buoyant? To do so, we see if they float or sink in water.

Divide the class into groups of three or four learners. Provide learners with the following items: A cork, a ball of plasticine, Styrofoam and a marshmallow.

<u>Retrieved from:</u>
https://pixabay.com/photos/cork-stuff-closure-lid-wine-corks-3397658/
https://pixabay.com/photos/marshminvites-jumbo-fruit-flavor-788771/</td></tr>
</table>

<table>
<tr><th>Specific Curriculum Outcomes</th><th>Inclusive Assessment Strategies</th><th>Inclusive Learning Strategies</th></tr>
<tr><td></td><td></td><td>https://media.istockphoto.com/id/1461554434/photo/plasticine-balls-isolated-modeling-clay-creativity-modelling-material-plasticine-on-white.jpg?s=1024x1024&w=is&k=20&c=yMVjVl7nFHmmyjOimCys9NVYEGQK2kz0w9T3mVtwBgM=

https://media.istockphoto.com/id/1278094194/photo/styrofoam-blocks.jpg?s=1024x1024&w=is&k=20&c=0EdE-4wCzR6E0sb8rDrwhbRIirdSyPb2dXMv46ajZEY=

• Place the item, one at a time in the water and observe whether it floats or sinks.
• Record your observations in the table below.
• After learners finish placing each item in the water.
• Cut each item in half and ask learners to observe the cut items and state what they notice about the inside of the cork, the Styrofoam and the marshmallow. (air pockets). Now ask them to state what they observe about the inside of the plasticine ball? (uniform packing of clay- no air bubbles)

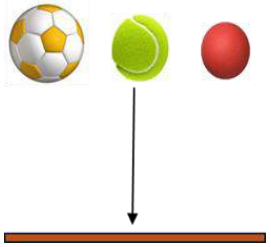
<table><tr><th>Item</th><th>Sink or float</th><th>What was observed with the cut halves</th></tr><tr><td>A cork</td><td></td><td></td></tr><tr><td>A ball of plasticine</td><td></td><td></td></tr><tr><td>A piece of Styrofoam</td><td></td><td></td></tr><tr><td>A marshmallow</td><td></td><td></td></tr></table></td></tr>
</table>

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Since these items floated and the plasticine sank, this tells us that items/materials with air pockets tend to make things float. Based on this information, do you think that metal would float? Why or why not? (*no, it is uniform packing*). Do you think that wood might float? Have a cross-section of a stick and show learners the pores inside- the air pockets will make it float. Therefore, densely packed items or materials tend to sink whereas things that have air space in them are more likely to float. Ask learners why a boat might float? (*because it has a large air space inside the boat.)* Repeat the experiment with five other items. Before learners place them in the water, have them predict whether they will sink or float. Record results in the table below. Item | Prediction | Sink or float Provide learners with a variety of materials to build boats. Once the boats are done, have learners float them in a plastic swimming pool or large sink. ● Which boats floated, which sank? ● Give reasons for each result.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Elasticity 1. Divide the class into groups of three. 2. Provide each group with a rubber band and a ruler. 3. Ask each group to measure the length of the rubber band and to record the length of the band in the table below. 4. After each group has recorded the length of their rubber band, ask each group to stretch the rubber band as far as they can. Learners then record this length. 5. They must then stretch the rubber band twenty times to the length they stretched it the first time. After stretching the rubber band twenty times. 6. Measure the rubber band again to see what effect the stretching had on it. **Video - Elasticity**  https://www.youtube.com/watch?v=9INtOjAIytk (2:53 mins)

Object	Measurement before pulling the object	Measurement after the object if pulled for the first time	Measurement of the object after it was pulled 20 times
Rubber band			
Balloon			

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		• Discuss the learners' observations. Introduce the term elasticity and explain why the rubber band is able to return to its original length. • Repeat this activity using a balloon instead of the rubber band. • Hold up several items found in the classroom such as pencils, pens, stapler, etc. and ask learners which ones they think are elastic. • Ask learners to try to bend the items to see which one they could bend and if those items they could bend, return to their original shape. • After they try to bend each item, ask them the following questions. a. How much could you bend it? b. Did it return to its original shape or did it form a new shape? c. What do you think will happen if it bent or stretched past that point? d. Ask learners to describe each item in terms of its elasticity, how it compares to the rubber band and how they compare to each other. e. Ask learners to rank the items in terms of their elasticity from the least elastic to the most elastic. **<u>The bounce of balls and elasticity</u>** In the next activity, we are going to find out if there is a relationship between the elasticity of a ball and the height to which it bounces when dropped from a height.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		• Take the soccer ball, rubber/bouncy ball and flannel/tennis ball. • Drop each one individually from a predetermined height and record the height to which it bounces in the table below.  **Credited to:** Amaala Muhammad 1. Ask learners to analyse the data collected to determine if there is a relationship between the height to which a ball bounces when dropped and its elasticity. 2. How are bounciness and elasticity related?

	Flannel ball	Bouncy ball	Soccer ball
It is used to play			
It is made from			
Height it is dropped from.			
Height, it bounces to.			

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Explain to learners that an object's ability to return to its original shape after being stretched (elasticity) is what causes it to bounce. The faster and more completely an object returns to its original shape, the better the object will bounce. Have the learners come to the board and draw what they think the soccer ball, rubber ball, and tennis ball look like at the exact moment these balls hit the ground. 1. Which ball's shape would change the most as it hits the ground? What would it look like? 2. Which do you think returns to its original shape the fastest? **Solubility** ● Learners you have in front of you, five different substances Examples of materials to be identified could include: Baking soda, salt, sugar, corn starch, powders, etc. ● Now observe each substance and write down its colour. Next use your fingers to feel each substance to determine their relative hardness. Please wash your hands after this test.. ● After all the substances have been tested, ask learners to see if they can identify the substances. Write the names of the substances on the board as you explain what each substance is. ● Do you think the information you have is enough to differentiate the substances from each other?

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<tr><th>Specific Curriculum Outcomes</th><th>Inclusive Assessment Strategies</th><th>Inclusive Learning Strategies</th></tr>
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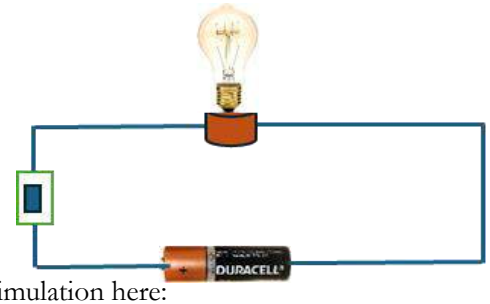
One more test we will do on these substances is to find out if they are soluble in water.
You now have five cups of water and five different spoons. Take a level spoon of each substance and add them individually to each of the cups of water. Stir each cup for one minute, put the glass down and check to see how much of the substance dissolved.

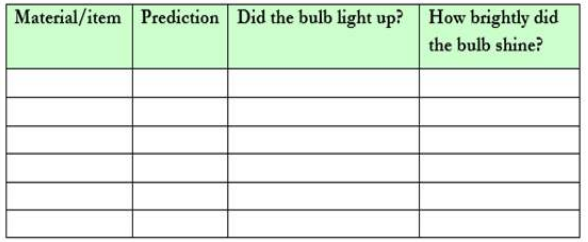
<table>
<tr><th>Substance</th><th>Prediction</th><th>Soluble</th><th>Insoluble</th></tr>
<tr><td>Sugar</td><td></td><td></td><td></td></tr>
<tr><td>Salt</td><td></td><td></td><td></td></tr>
<tr><td>Baking powder</td><td></td><td></td><td></td></tr>
<tr><td>Epsom salt</td><td></td><td></td><td></td></tr>
<tr><td>Flour</td><td></td><td></td><td></td></tr>
</table>

What properties did the substances that dissolve have compared to those that did not dissolve?
Which substance dissolved fastest?
Now rank the substances from 1-5 in terms of their solubility, I being the most soluble and 5 being the least soluble.
Suppose you had two bags, one containing sugar and one containing salt. Describe how you could use your results to determine which is which.
Give the learners some sugar, some salt and some alum. Based on the amount of each substance that dissolved,

</td></tr>
</table>

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		which do you think was the sugar, salt and the new substance? **<u>Electrical conductivity</u>** Another property of matter is their ability to conduct electricity. Electrical conductivity is how well a material conducts electricity (invites electricity to pass through it). An object that is a ***conductor*** invites electricity to flow through it and complete the circuit. If the item is not a conductor, the circuit will be broken and the current will not flow. We call those items or materials that do not conduct electricity insulators. In this experiment, we will be using a simple circuit where electricity flows through the wires to light up the lamp in the circuit, once the circuit is complete. If the circuit is broken, the electricity cannot get to the light bulb. The lamp will shine brightly for solutions/materials that strongly conduct electricity, less brightly for solutions that weakly conduct electricity and not at all for solutions/ materials that do not conduct electricity **Note to teacher**: Prepare circuits ahead of time. *The circuits for this investigation can be made using circuit components of the micro science kit.*

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		 Phet simulation here: https://phet.colorado.edu/sims/html/circuit-construction-kit-dc-virtual-lab/latest/circuit-construction-kit-dc-virtual-lab_en.html • Demonstrate to the learners using an insulator such as a pencil to show that the current will not flow. We call the pencil an **insulator** because it insulates or stops the flow of electricity. • Ask learners to identify where the circuit is broken (*at the pencil*). • Then demonstrate to the learners using a nail that is a conductor. When the light turns on explain that it's because the electricity flows through the nail. The nail is a conductor. • After the demonstration, provide learners with a variety of materials to test their electrical conductivity. Before each item/material is tested, ask learners to predict if it is a conductor or an insulator. • Before learners test the items/materials, ask them to predict whether or not the item/material will cause the bulb to light up. Learners can record their observations in the table below.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		

Material/item	Prediction	Did the bulb light up?	How brightly did the bulb shine?

- Explain that most metals make good conductors. Solutions like salt water will also conduct electricity.
- Ask learners to classify the items/materials as conductors and insulators. Also ask learners to rank the materials from highest conductivity to lowest using the brightness of the bulb.

(Natural fibres like paper, wood and cotton are not conductors. Synthetic materials like plastics, rubber and polyester fabric are not conductors. Grains and food items are not conductors

Response to magnetic forces

Magnetism is a property of matter that can be used to identify materials. Certain materials are attracted to magnets and other materials are not. Magnetic materials are those which are attracted to a magnet. Examples of such materials include iron, nickel, and cobalt, etc. whereas materials like plastic and wood are non-magnetic. Certain objects may look similar but have different magnetic properties. The force of magnetism acts on certain types

<table>
<tr><th>Specific Curriculum Outcomes</th><th>Inclusive Assessment Strategies</th><th>Inclusive Learning Strategies</th></tr>
<tr><td></td><td></td><td>of materials, such as the paper clips but not others, such as the aluminium wire.

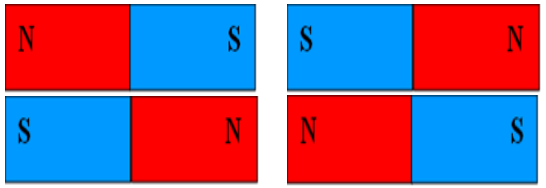
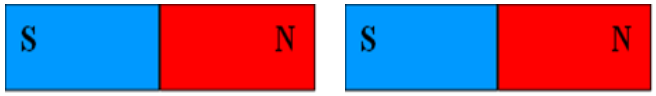
In this activity, learners test different materials to see which ones are magnetic and which are not.

● Hold a magnet to a piece of paper, showing that the paper is not magnetic because it doesn't stick to the magnet.
● Next hold the magnet to a piece of metal, showing that the metal is magnetic because it sticks to the magnet.

After the demonstration, divide the class into groups of 2 to 3 learners, provide each group with a magnet and several materials and objects. Ask learners to pass the magnet over each substance/material/object. Observe if the substance/material/object is attracted to the magnet or not. Write down your observations in the table below.

<table><tr><th>Material/item</th><th>Prediction</th><th>Was it magnetic?</th></tr><tr><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td></tr></table>
● What makes some substances magnetic and others nonmagnetic.
● What evidence does this provide about the materials? (It provides evidence that some metals are attracted to magnets but not all metals.)</td></tr>
</table>

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		• Have learners list the properties that magnetic items normally have. It should be noted that: • Natural fibres like paper, wood and cotton are not magnetic. • Synthetic materials like plastics, rubber and polyester fabric are not magnetic. • Grains and food items are not magnetic. Magnetic items are often metallic but not all metals are magnetic. **<u>Strength of magnetism</u>** • Do you think all magnetic objects have the same strength of magnetism? • Can you think of anything with weak or strong magnetism? • Do the magnets on your fridge all stick with the same strength? Let us find out! • Design a simple experiment to determine if magnetic materials have weak or strong magnetism. • Data collected from the experiment should establish that magnetic strength depends on distance between the magnet and the magnetic object. **<u>Magnets have poles</u>** Provide each group with another magnet so that they have 2 magnets to work with.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		• Tell learners that magnets have two ends or poles; one is a North Pole and the other is the South Pole. • Learners bring the magnets together with the like ends near to each other.  What do you observe? • Learners bring the magnets together so that opposite poles are near to each other.  1. What do you observe? 2. What can you conclude about the attraction of poles of a magnet? **Reflectivity** Objects have the ability to reflect light. This is known as the property of reflectivity. In this activity, learners are given five different materials: aluminium foil, cellophane, printing paper, black plastic and

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		tracing paper to experiment with. The learners compare the reflectivity of the different materials, with the aim of finding the most reflective material. Working in pairs, using a reflective tester made out of a piece of paper with a hole in it through and a torch. Ask the learners to shine the torch through the hole unto each of the materials and see if the reflection bounced back onto the paper. Ask learners to rank the materials in terms of their reflectivity, with 1 being the most reflective. They should find that the cellophane is the most reflective material

Additional Resources and Materials

Mystery Powders activity: https://letstalkscience.ca/educational-resources/lessons/mystery-powders
Properties of substances: https://byjus.com/question-answer/properties-of-solid-liquid-gas/

Additional Useful Content Knowledge for the Teacher

Hard and Soft water: Soaps & Detergents:
https://www.youtube.com/watch?v=jDgSohKVLio (2:32 mins)
https://www.youtube.com/watch?v=ei-rmud9vBU (1:25 mins)

Measurements of a variety of properties (e.g., hardness, reflectivity) can be used to identify particular materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.)
National Academies of Sciences, Engineering, and Medicine. 2012. A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas. Washington, DC: The National Academies Press. https://doi.org/10.17226/13165.

Opportunities for Subject Integration

Mathematics: Measurements and calculations
Language Arts: New vocabulary
Social Studies: How do properties of matter determine whether we consider them safe to use? (e.g. off-gassing of painted objects; leaching of plastics)

Elements from Local Culture, Technology, TVET, Environment that are integrated

The making of Sorrel beer, mauby, and other local drinks involves properties of colour, volume, and mass.
The materials used to make local arrowroot starch and coconut oil go through different states of matter and have different properties at each state/stage.
Our fisher folk making boats, fishing nets and pots must select materials that have hardness and buoyancy
Suitability of materials selected for making baskets, mats and hats.

Item of Inspiration

When speaking of teaching stepwise algorithms instead of constructivist learning: " For dividing fractions; "Ours is not to reason why just invert and multiply"

Essential Learning Outcome 4: Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

Grade Level Expectations: Refer to grade level expectations at the beginning of this curriculum document.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Learners are expected to: **<u>Knowledge</u>** Define the terms: • Mixture • Solution • Solvent • Solute • Suspension • Precipitates (e.g. curdling) • Physical changes • Chemical changes • Chemical reaction • Reversible and irreversible changes Explain the importance of mixing different substances. Describe different methods used to separate mixtures. List advantages and disadvantages of different separating methods.	1. Read each of the following statements carefully, decide if it is **TRUE** or **FALSE**, then write true or false in the space provided. a. A chemical change is easy to reverse. _____(F) b. Changes in states of matter are chemical changes. _____ (F) c. Bubbling is a sign of a chemical change. _____ (T) d. Rusting is **NOT** a physical reaction. (T) e. When an ice cube melts into water, it goes through a chemical change. _____ (F) f. Leaves changing colour is a physical change. _____(F) g. An ice cream melting is a physical change. _____(T) 2. Which of the following changes are physical changes? a. Cutting a piece of paper. b. Crushing a can c. Burning a log of wood	**Demonstration** Add boiling water dropwise to ½ cup of table salt in a jar and stir vigorously until the salt ***just barely dissolves***. Place a pencil with a 10 cm length of string tied to the centre across the top of the jar so the string dangles into the salt water. We call this solution **supersaturated.** Invite the solution to cool and slowly evaporate over coming days. You will notice crystals growing on the string. This is the salt reassuming its solid state. It proves that only a physical change occurred as the salt dissolved in the water. If it had undergone a chemical change, we wouldn't have been able to retrieve the salt crystals. Teacher note: depending on what solids are available, sugar and borax can also be used.  Retrieved from: https://www.sciencebuddies.org/science-fair-projects/project-ideas/Chem_p082/chemistry/how-to-grow-the-best-and-the-largest-crystals

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Differentiate between physical changes and chemical changes. Identify burning, rusting and decaying as changes that are irreversible Differentiate between physical and chemical changes to matter. Recognize the physical changes that are involved in forming and separating mixtures Identify reversible and irreversible changes that can be made to substances. Recognize when two or more substances have been mixed or not mixed. Explain how, when different states of matter are mixed, some properties change while others remain the same. Give examples of changes in substances, classify them as physical or chemical changes, and justify the designation. Define physical change and give examples of physical changes.	d. Dissolving sugar in water. e. Boiling an egg Answer (a, b, d) 3. A teacher mixes two liquids which are at the same temperature together in a glass. When she took the temperature of the two substances that she mixed, she noticed that it increased. What kind of change does this suggest? (*chemical*) *4.* When ice melts, is it a physical or chemical change? Explain your answer. (*change of state – can be reversed therefore a physical change* 5. What is likely type of change when steel wool turns rusty if left in the rain? (*chemical*) 6. As a candle burns it undergoes both physical and chemical changes. a. List a physical change that a candle undergoes as it burns. (*melting)* *b.* Explain why the mass of a candle decreases as it burns. (*wax is the fuel for burning that gets wicked into the burning process)* 7. Below is a list of words and phrases related to physical changes and chemical changes.	So learners, you can see we made a special mixture, let us review the different types of mixtures. **What is a Mixture?** A mixture is a combination of two substances. In mixtures, the components do not react chemically but are mixed physically. Depending on the type of components, mixtures are classified as **homogeneous** and **heterogeneous**. A **solution** is a type of mixture where two or more components are dissolved i.e., the solute (usually solid) is dissolved in a **solvent** (usually liquid) so we can no longer see separate components. E.g.. Salt dissolved in water would be a type of homogeneous mixture called a solution where salt is the solute and water is the solvent. **Mixtures versus Solutions- Distinguishing Features** **Difference Between Mixture and Solution** Mixture: In a mixture, substances are generally just mixed and are not completely dissolved. / Solution: In a solution, substances are dissolved completely and they cannot be filtered out. Mixture: The mixture comprises two or three compounds that aren't fused chemically. They have no physical interactions. / Solution: A solution contains two substances that are chemically mixed to form a new compound. Mixture: The chemical properties of all substances are retained without change. / Solution: Chemical properties usually change. Mixture: The amount of substances in a mixture can vary and amounts don't have a fixed ratio. / Solution: A solution usually has a fixed ratio or amount of substances. Mixture: Mixtures can be classified primarily into two groups, namely homogeneous mixtures and heterogeneous mixtures. / Solution: A solution is a type of homogeneous mixture.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Explain how matter can be changed in ways such as heating or cooling, cutting or tearing, bending or stretching. Identify evidence of the formation of a new substance after two or more substances are mixed. List physical properties of matter. (ST 3 PS MM1) Identify with examples, physical change in everyday living. (ST 3 PS MM 2) Understand that melting, freezing, evaporation, and condensation are changes of state that can be reversed. (ST 5 PS MM 2) Classify substances as soluble or insoluble by their ability to dissolve in water. (ST 4 ESS ER 9) Understand that melting, freezing, evaporation, and condensation are changes of state that can be reversed. (ST 5 PS MM 2)	8. Place each word or statement in one of the correct boxes that follow. Melting Burning Freezing Heat produced A gas given off Colour change Change in size Light produced Can be reversed Cannot be reversed A new substance created CHEMICAL CHANGES PHYSICAL CHANGES	Retrieved from: https://byjus.com/chemistry/difference-between-mixture-and-solution/ Formative Assessment • What is the solute in the sugar solution? *(sugar)* • What is the solvent in the sugar solution? *(water)* Water is a very common solvent because many substances can dissolve in it. Substances that can dissolve in a solvent are said to be **soluble**. Conversely, substances that cannot dissolve in a solvent are said to be **insoluble**. Below are some common solutions: **Solution** | **Solute** | **solvent** Sugar solution | sugar | water Salt solution | salt | water Rum | alcohol | water **Suspensions (heterogeneous mixtures)** Have learners add some dirt to a beaker of water, stir and then leave undisturbed for several minutes. Learners, I want you to observe what happens when you mix dirt and water together. Write or record some of the things you see. This type of mixture is called a **suspension**.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Describe with examples, the use of water as a solvent in everyday life. (ST 4 ESS ER 10) **<u>Skills</u>** Demonstrate how a mixture is made by safely combining two forms of matter into a mixture. Demonstrate a technique that will best separate these two forms of matter from a mixture. Compare different mixtures to determine degree of separation. Plan and conduct investigations to determine whether or not a new substance is made when two or more substances are mixed. Recognize that a physical change alters the characteristics of a substance without producing a new substance. Give examples of changes in substances, classify them as physical or chemical changes, and justify the designation.	9. Which of the pictures represents substances combined to create an entirely new substance? a.  b.  c.  d. 	Questions: Compare the suspension to the solution, then answer the following: 1. Does the suspension have undissolved particles? *(Yes)* 2. In which mixture can you see layers? *(suspension)* 3. Which of the two has large particles suspended in the mixture? *(suspension)* A suspension, like muddy water, is a type of mixture in which the solid particles do not dissolve but may remain suspended in the liquid and then eventually settle out if left undisturbed.  **Retrieved from:** https://commons.wikimedia.org/wiki/File:Mud_and_water_suspension_and_clear_water.JPG **Sand and Water (Heterogeneous Mixture)** Provide each group with either a test tube or a beaker with water and a small amount of sand and a spoon or stirring rod to stir the

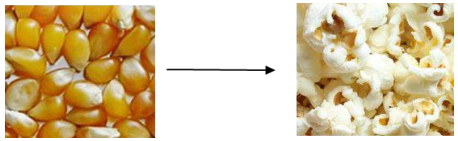
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Combine pure substances to make different mixtures. Infer how a change of different parts of a string telephone will affects its ability to transmit sound waves Classify changes as physical changes or chemical changes Hypothesize about changes that would occur when two or more substances are mixed. Compile data from carrying out different investigations physical and chemical changes. Analyse data obtained from physical and chemical changes using everyday substances Interpret data obtained from their investigations Evaluate data obtained from their investigations on physical and chemical changes. Record and interpret physical and chemical changes using everyday substances	**Fudge** https://pixabay.com/photos/walnut-fudge-candy-milk-cold-672976/ (chemical) **Pepper-spice mixture** https://pixabay.com/photos/pepper-scoop-peppercorns-spices-1914117/ (physical) **Cookies** https://pixabay.com/photos/cookies-chocolate-chip-cookies-1264263/ (chemical) **Chex mix** https://www.flickr.com/photos/epw/6506552919 (physical) **Separating mixtures** 1. The water coming through the tap is muddy. Marla's mother collects a bucket of water, leaves it to settle and then throws off the water on top. The water she throws off is less muddy than that coming through the tap. *a.* What is this method called? (*pouring off a settled suspension)* *b.* What happened when the water was left to settle? (*it separated out the solid to the bottom)*	mixture with. Ask learners to pour the sand into the water, little by little stirring after each addition. **Questions:** 1. What happens to the sand when it is first added to the water? *(The sand sinks to the bottom)* 1. What happens to the sand after the water has been stirred? (*The sand mixes with the water and the starts to fall)* 2. How does the mixture look after a few minutes? *(The sand settles to the bottom again)* *3.* What type of change was involved in the mixture? *(Physical)* 4. State whether the mixture can be reversed/ separated. *(Yes it can be separated using a method called **filtration**)* **Teacher note:** Please see the section on "Separation" for more on filtration. **Oil and water (heterogeneous mixture)** Provide each group with either a test tube or a beaker with water and a spoon or stirring rod to stir the mixture with. Ask learners to slowly pour the oil into the water, little by little stirring after each addition.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Plan and conduct investigations to determine whether or not a new substance is made when two or more substances are mixed. Compare the observable properties of two or more substances before and after they are mixed to explain whether a new substance with different properties was formed. ed. Measure volume and mass of materials. (ST 4 PS MM 1) Investigate the principle that burning, rusting and decaying are changes that are not reversible. (ST 5 PS MM 3· **Attitudes/Values** Appreciate the role that physical and chemical changes play in our daily lives. Show persistence when conducting investigations to produce data on the mixing of two or more substances. Demonstrate interest in finding out more about the mixing of two or more substances.	2. Below is a picture of a strainer. Answer the questions that follow.  a. Give an example of a mixture that can be separated into its components using a strainer. (*pasta and water)* b. If you do not have a strainer, what can you use in place? (*a filter cloth)* 3. How would you separate the following mixture? (*by hand*) 	**Questions:** 1. What happens to the oil when it is first added to the water? *(It floats on the water)* 2. What happens to the oil and water after the mixture is stirred? *(The oil combines with the water but only for a short time)* 3. What do you notice about the mixture after it was left undisturbed? *(The oil floats on the water)* 4. What can you say about the density of the oil compared to the water? *(oil is lighter than water)* 5. Why would you call this physical change? *(No new substances formed)* **Combining Substances** ➢ Marbles & water (heterogeneous mixture) easily separated ➢ Salt and water (homogeneous mixture -a solution) can only be separated by evaporation A good example is the evaporation of the Dead Sea  Retrieved from: https://www.npr.org/sections/pictureshow/2022/12/11/1139524126/photos-dead-sea-water-level-dropping-sinkholes-erosion

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Use the inquiry approach in conducting various experiments on the mixing of two or more substances Show respect for evidence obtained from investigation on the mixing of two or more substances Dispose of substances used in different experiments responsibly When conducting practical and group work, display sensitivity to those learners who may have hearing difficulty using different scientific tools and identifying changes in colour. Participate actively in whole-class and group discussions on the data obtained from their investigations. Participate in investigations to determine whether mixing two or more substances results in the formation of a new substance.	**Retrieved from**: https://pixabay.com/photos/food-eat-diet-planters-trail-mix-2202384/ 3. Samuel is making a sandcastle on the beach. To be able to mould the sand into the different shapes she wants, she mixes water with her sand. *a.* Is Samuel creating a new substance when she mixes the sand and water? Give reasons for your answer. (*no, the sand and water can be separated into components- physical change only)* 4. Explain how you would separate a mixture of sand and iron filings? (*using a magnet because iron is magnetic)* 5. A learner is given three white substances in a beaker that are not labelled. One is salt, one is sugar and the third one is baking soda. a. If vinegar is added to each of the three substances, which one do you expect to react with the vinegar? (*baking soda*) *b.* What changes would you expect to observe when vinegar is added to the substance that reacts with it?(*a gas given off)*	➢ Baking soda and vinegar (chemical change) new product as the identities of the starting components are no longer separable. **Chemical Changes** In the examples above, it is clear that the physical change in a mixture invites us to separate out the components where as a chemical change is **irreversible** (meaning we can't get back the starting materials) How can we tell if a chemical change has occurred? Review indicators of chemical change: ➢ Colour change ➢ Gas evolved ➢ Solid precipitate formed ***Teacher note***: if you have tangible samples of each of these to show learners this is useful. **Observing a Chemical Change** Below are a series of experiments to help us investigate some physical and chemical changes: **1. Burning of a candle** We have reviewed indicators of chemical change. In this experiment, a candle burns wax in a reaction called combustion. What signs do you see that a chemical change is occurring? (*smoke-gas, heat, light*)

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	c. Is a new substance formed from the reaction of this substance and the vinegar? (*yes a gas- carbon dioxide*) 6. State three things that can tell you that a chemical change has taken place. (*gas, increased temperature, light, precipitate)* 7. Mark an X in the box to identify the evidence that a chemical change has occurred. Some examples may have more than one type of evidence. 8. Give an example of a chemical change for each of the following situations: a. Heat is given off.. b. A gas is given off. c. Sound is produced	Introduce the unlit candle to the class and ask questions such as: ● What do you need for a candle to burn? (*fuel, oxygen and kindling temperature)* ● Where does the wax go when the candle is burning? (*it is the fuel; it burned)* ● What is the purpose of the wick? (*the wicked draws the melted wax up to be burned- this can be observed by placing pepper on the surface of the melted wax)* ● What happens when a candle is burning? (*it is burning carbon in wax with oxygen to form carbon dioxide)* <u>Procedure:</u> 5. Light the candle and ask learners to carefully observe the candle burning Discuss where the wax might have gone *(changed into carbon dioxide and water).* The wick of a candle burns long enough for the wax to start melting. The liquid wax is drawn up the wick to the flame where it becomes a gas. As a gas, it reacts with the oxygen in the air and creates carbon dioxide and water. This reaction releases energy in the form of heat. The carbon dioxide and water vapour produced are gases; however, the water vapour will only condense once it is away from the heat of the candle. Some wax particles create a black smear where they land Another chemical change that occurred in this demonstration is that of the match striking against the matchbook. When the

Examples	Colour change	Odour	Gas given off	Light given off	Temperature change
Baking cookies					
Glow sticks					
Lighting a match					
Bleach added to clothes					



Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	9. The popped corn shown above came from the corn kernels on the left. Look at these two pictures and answer the questions below. a. How is popped corn obtained from the corn kernels? (*heat causes the water in the kernel to expand rapidly*) *b.* Is this a chemical or a physical change? (*When popcorn is popped, liquid inside the kernel is changed to steam. Pressure from the steam builds up inside the kernel. When the pressure reached a critical stage the kernel pops turning itself inside out. This is a* ***physical change****.)* **Physical- Chemical Change Quiz** https://www.youtube.com/watch?v=MBmBknteSrQ (10:39 mins) **Teacher note:** The process of dissolving requires energy to surround solute particles and therefore you will likely see a temperature drop. This is not an indication of a chemical change just an endothermic process.	match strikes against the matchbook, it gives off an odour. Odours are also signs of chemical change. **Household Examples of a Chemical Change** Sometimes in the kitchen, a cook will purposely add vinegar to milk to thicken it or cause it to curdle. When milk is curdled it changes its properties and a new thing that is the "curd" is formed . This formed curd cannot be turned back to milk. So it's an irreversible process and that's why it is a chemical change. The new solid tell us a chemical change happened. When eggs are left in the heat for too long we sometimes begin to smell a characteristic odour of rotten eggs. When processes generate a gas or bad odour, it is a good indicator that spoilage is happening which indicates a chemical change. We add yeast to our bread recipe and we see bubbles that make the bread rise (carbon dioxide). This production of a gas tell us that a chemical reaction happened with the yeast. If you leave your bicycle in the rain you eventually see a reddish brown deposit on the steel parts especially anything that is not painted! This is the iron in the steel reacting with oxygen to make iron oxide. Rusting is a chemical reaction that affects many steel items (cars, boats, metal roofing) often weakening them. In all these examples the combination of these components cannot be reversed because new products are formed in a chemical reaction.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Separation of Mixtures Unlike chemical changes which are irreversible, we have ways to separate out the components of a mixture that represents only a physical change. These techniques prove to us that a chemical change did not occur because we can retrieve the starting materials. Mixtures that have undergone physical changes can be separated into its original components. Below is a list of some of the common methods used to separate such mixtures. **2. Evaporation** **Supplemental video resource**: https://www.youtube.com/watch?v=YgdrzYaG91A&t=3s (3:52 mins) **Evaporation** is used to separate a soluble solid (i.e. a solid that dissolves or solute) from the solvent. For example, the salt from the water in a salt solution. During evaporation, the water evaporates away leaving the solid behind. **Method:** Prepare a mixture of a small amount of Kool-Aid (or salt/sugar) and water. Place on a hotplate or a Bunsen burner and heat. As it boils, ask learners to record their observations. Ask learners the following questions to guide their observations.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		1. Notice the bubbles in the mixture. What does this tell us? *(Evaporation/Boiling is occurring)* 2. What is happening to the volume of the water? *(Decreases until it is all evaporated)* When almost all of the water has evaporated, remove the beaker from the fire and place it on the side for the remainder of the water to evaporate. What is remaining at the bottom of the beaker? *(solid Kool aid)* **3. Separation by magnets** **Supplemental video resource:** https://www.youtube.com/watch?v=VSIBzRKIWAQ&t=2s (1:07 mins) A mixture of iron filings and sand (preferably white sand) can easily be separated using a magnet. The iron filings are attracted to the magnet, but the sand is not. **Method:** Prepare a mixture of iron filings and sand. Try to pick out the iron filings individually. It would be very difficult to pick out a piece of iron without picking out sand as well. Use a magnet to pull out the iron filings, leaving the sand behind. **4. Separation by filtration** **Supplemental Video Resource:** https://www.youtube.com/watch?v=BihdNtS4BzE (1:56 mins)

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Explain the concept of a filter to the learners. A filter is a material with very small holes that invite certain things to pass through it but not others. Filters separate based on size, particles that are small pass through, while particles that are large remain behind. Ask learners to think about examples of materials that act as filters. Some examples that learners may give include: cloth, colander, coffee filter, window screen and strainer. Demonstrate how you would separate the mixtures of sand and water and the mixture of flour and water, using filter paper and a funnel.

Additional Resources and Materials

Growing crystals:
https://www.youtube.com/watch?v=RBB_M74bSFY&t=40s
https://www.fizzicseducation.com.au/150-science-experiments/kitchen-chemistry-experiments/make-your-own-crystals/

Note to teacher: Make certain learners can see a sugar and water mixture in which the sugar crystals have been completely dissolved and none are visible.

Learners, what has happened to the sugar when it was added to the water and stirred? *(It dissolved).* Now take an even closer look at the sugar and water mixture. Can you tell which part of the mixture is sugar and which is water? *(No).* That's correct, the sugar has completely dissolved in the water and cannot be seen. This mixture is an example of a **homogeneous mixture**. Homogeneous means the same - so a homogeneous mixture is the same all the way through. A homogeneous mixture is a mixture in which different substances or parts are evenly distributed (or the same) all the way through.

Questions:

1. What if we were to add some more crystals of sugar to the mixture without stirring? Would the mixture still be homogeneous? Let's try it and see.

Note to teacher: Have learners add sugar to the sugar solution without stirring and make their observations
(Answer to question - No)

2. Explain why the mixture is no longer homogeneous? *(The sugar would be seen at the bottom, hence the mixture is no longer uniform)*

Here are some other commonly known homogeneous mixtures:

Retrieved from:
https://sciencenotes.org/what-is-a-homogeneous-mixture-definition-and-examples/

Now look at the mixture in Glass B (sand and water). Can you separate the two substances in this mixture? **(YES)** . This mixture is called a **heterogeneous mixture**. A heterogeneous mixture has parts that remain separate.

Retrieved from: https://scienceinfo.com/heterogeneous-mixture-important-properties/

Making Milk curds: Divide the class into groups of four.

Provide each group with 1/4 cup milk (preferably in a transparent glass or beaker, 4 teaspoons white vinegar or lemon juice and a spoon for stirring, a strainer and some paper towels

Instruct learners to describe the milk (white, liquid, translucent, etc.). Then ask them to describe the vinegar or the lime juice (pale yellow or colourless liquid).

Pour the lime juice or vinegar slowly into the cup with the milk and stir very slowly for about one minute.

Ask learners to discuss their observations. You should notice that solid chunks called curds start to form and separate from the liquid called whey.

Pour the mixture into a strainer and press out all the liquid leaving just the solid clumps or curds behind.

Press the paper towel into the strainer to soak up any of the leftover liquid or whey and remove it.

Have learners discuss and answer the following questions

1. Can the resulting mixture be separated into its original components? - (No)
2. Can the change be reversed?
3. Has a new substance been formed?
4. Is this a physical or a chemical change? (Chemical)
5. Give reason(s) (A new substance is formed)

When old milk is added to tea or coffee it will sometimes form small lumps/solids similar to those formed when the vinegar/lime juice is added to the milk. This is called 'curdling" of the milk. Scientists often refer to these masses as "precipitates".

Curdling happens when the solids in the milk (the proteins and fats) clump together and form a new substance, which are called curds. The curdling is the result of a chemical reaction between the vinegar (acid) and the fats and proteins. This is also one way of making simple cheese from milk.

Handwarmer packets: https://cen.acs.org/articles/88/i4/Hand-Warmers.html

Physical and chemical changes

There are several other physical changes that matter can undergo, these include changing its mass, texture, volume or state, by mixing one solid with another and dissolving matter in a liquid such as water. Substances can also undergo what is called a chemical change. Let us look at the following video to see some more examples of physical and chemical changes.

Additional Useful Content Knowledge for the Teacher

The opposite of physical change is **chemical change.** If these are opposites then tell me, do you think new substances will be formed during chemical changes? *(Yes).* Chemical changes result in the formation of new substances because the substances undergo a **chemical reaction** when they are mixed. Chemical reactions lead to chemical changes. In other words, chemical changes occur when the components react with each other to form new substances. When chemical

reactions/changes occur there are usually some observable changes that also happen, such as bubbling, sudden changes in temperature, colour changes, formation of solids, etc. Tell me what were some of the clues that chemical changes occurred in each of the above reactions? *(The baking soda started to bubble when it was mixed with vinegar and in the second reaction a white solid formed when the sodium carbonate was mixed with the magnesium sulphate)* In each of these reactions something new was formed. In reaction 1, the bubbling indicated the formation of a gas called carbon dioxide and in the second reaction the white solid that formed was a new substance called magnesium carbonate.

Opportunities for Subject Integration

Art and Craft: Mixing of different colours to create new colours

Mathematics: Measurement, Mass, Volume, Fractions and Percentages (of substances/mixtures)?????

Language Arts: Vocabulary and Spelling (different terms) ,Grammar (adjectives)

Social Studies: Resources, Personal Hygiene, Pollution, The Family, Decision Making

Stretching hair by the use of a hot iron or the use of chemicals.

Elements from Local Culture, Technology, TVET, Environment that are integrated

Elements from Local Culture

- Production of beverages and other drinks by the St. Vincent Brewery, and local wine and drinks makers
- Mixing "mortar" during construction
- Desalination and bottling of water
- During the carnival paint is mixed for body painting at jouvert and other activities
- Burn sugar to make stewed meats and in pelau.
- Ginger and sugar and mauby bark and sugar to make unique local drinks.
- Bending of wire and cutting of cardboard and other materials to make costumes for carnival, local craft, etc.
- Creating steelpans through a combination of physical changes to the drum.

Technology

Many technologies are used to determine if new products are formed and to study these products..

TVET

Number of areas in TVET utilise both physical changes (e.g. sanding and painting) and chemical changes (hair dressing, dyeing, etc) in their activities.

Environment

- After rainfall mud sometimes mix with water in the river and affect our water system/reservoir
- Hard water resulting from chemicals dissolving in the water as it passes over rocks or drains through soils.
- Rusting of galvanised roofs, rails, vehicles from sea blast.

Items of Inspiration

There are many chemical reactions that occur in products for the home. The teacher has an abundance of examples at their disposal for teaching to this outcome.

Matter and Energy in Organisms and Ecosystems

Purpose of the Subject The study of science encompasses knowledge, process skills and values. Scientifically literate persons will foster an attitude of caring not only for themselves, but as responsible citizens, for the world around them. Their decision making will be enhanced by a systematic study of the structure and behaviour of the physical and natural world through observation and experiment. In learning science, learners benefit from leveraging and evaluating available technological tools to study and therefore understand the world and their relationship to it.
Strand Matter and Energy in Organisms and Ecosystems: Understanding how ecosystems rely on the exchange of matter and energy helps humans to better care for the environment including the constituent plants and animals.

Essential Learning Outcome 1: Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.

Clarification Statement: Examples of models could include diagrams and flow charts
Grade Level Expectation: Refer to grade level expectations at the beginning of this curriculum document.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Learners are expected to: **<u>Knowledge</u>** Define the terms: • balanced diet	**Practicing terminology** Have learners fill in the blanks in the following table:	**<u>Importance of Food and the Connection to the Sun</u>** **Focusing Question to Begin**

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies

- carbohydrates
- proteins
- fats
- photosynthesis
- simple sugar glucose
- cellulose
- starch
- vitamin D
- food chain
- food webs
- trophic levels
- producers
- consumers
- decomposers
- nutrients
- invasive species
- biotic and abiotic

Explain the process by which plants make their own food.

Explain how the sun provides energy for both plants and animals.

Identify the nutrients needed by the human body.

Distinguish between food chains and food webs.

Show how food chains and food webs are inter-related

Foods	Term	Use for Body
Rice, potato, pasta	(Carbohydrate)	Energy
Meat	Protein	(Repair/Growth)
Milk & Cheese	(Fat)	Warmth & Energy Storage

Food Chains/Food Web

Learners will design their own food chain / food web. Teacher will use a rubric to access the food chain/ food web.

Sample Rubric:
Retrieved from: Ministry of Education, Sustainable Development Innovation, Science, Technology and Vocational Training. (National Curriculum Revision With A Special Education Needs Focus - Primary School Grade K-6, 2023)

Grading Rubric

Components	Excellent (4)	Good (3)	Average (2)	Poor (1)
Organization of organisms	All organisms on the correct level in the food chains and food web	Most organisms are on the correct levels in the food chains and food web (2 or less organisms incorrect)	Some organisms are on the correct levels in the food chain and food web (3-4 organisms incorrect)	Most organisms are in the wrong order (5 or more organisms incorrect)
Arrangement of arrows	All arrows are in the correct direction to show the flow of energy.	Most arrows are in the correct direction to show the flow of energy. (2 or less arrows are incorrect)	Some arrows are in the correct direction to show the flow of energy. (3-4 arrows are incorrect)	Arrows are present but in the wrong direction OR No arrows are present
Explanation of Feeding Relationship	The role or purpose of all organisms in the food chain or food web is completely and correctly explained	The role or purpose of most organisms in the food chain or food web is completely and correctly explained	The role or purpose of as few organisms in the food chain or food web is completely and correctly explained	The role or purpose of none of the organisms in the food chain or food web can be explained
Presentation	Food chain/web is arranged neatly and well-spaced out. All food chains are clearly differentiated.	Food chain/web is arranged neatly and well-spaced out. Most food chains are clearly differentiated.	Food chain/web is visible but slightly cluttered. 1 to 2 food chains are clearly differentiated.	Food chain/web is visible but cluttered. Food chains are difficult to differentiate.

Each tier will create a food chain and a food web with the assigned number of organisms.
Tiers 1 and 2 has 6 organisms each
Tier 3 has 4 organisms

Look at the picture below. What does it show? (*different types of food*)

Have you ever heard someone say it is important to eat a "**balanced diet**". There must be a reason why we must balance our food intake with such a variety of foods. Learners, can you suggest a reason why a mixture of different foods would be most healthy? I will give you hint…different foods accomplish different tasks in our bodies! (*maybe energy*)

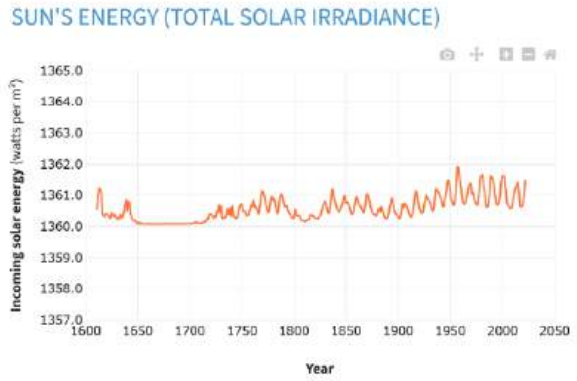
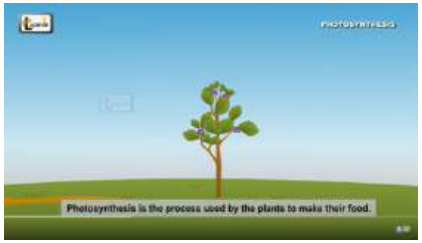
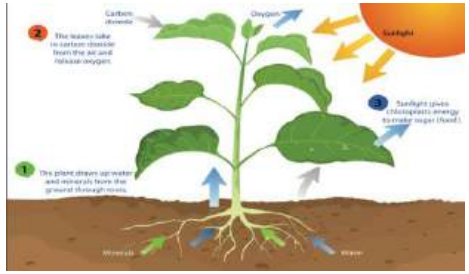
Retrieved from: https://www.pickpik.com/appetizer-summer-organic-colorful-freshness-cheese-141271

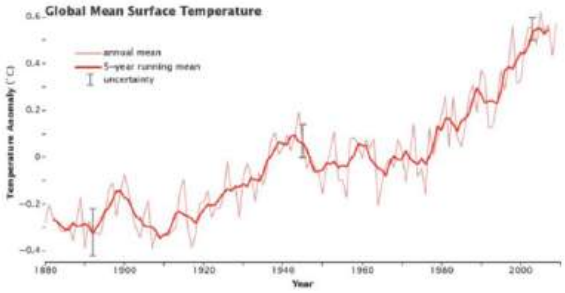
Teacher -led discussion

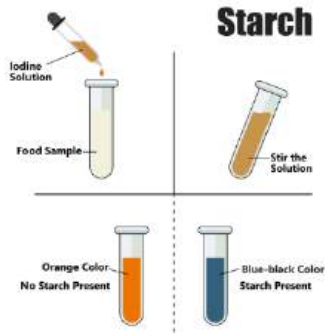
What are some examples of food we eat? (*Rice, cereal, chicken, eggs, fish, mutton, milk, cheese, vegetables, etc.)*

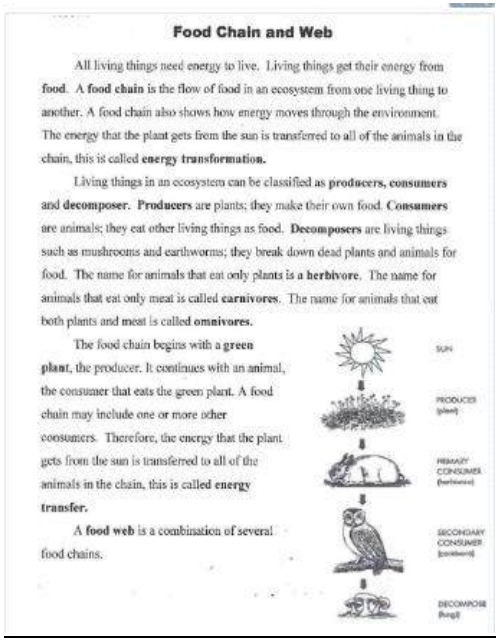
I am going to help you to understand what different groups of food can do for our bodies. You will learn some new words that you will want to write down.

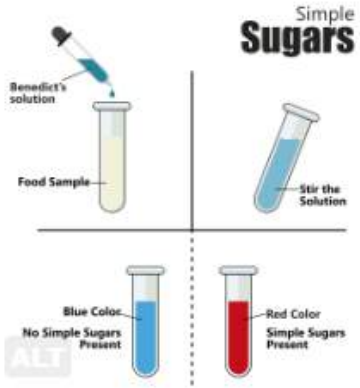
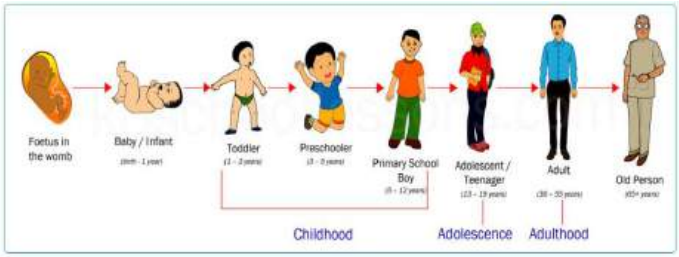
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Give examples of food chains and food webs found in various habitats. Explain the feeding relationships between animals in food chains and food webs Distinguish producers, consumers and decomposers Describe factors which adversely affect a food chain/web in the Caribbean region. **Skills** Identify and observe food chains in your community Infer that everything in our ecosystem relies on each other. Draw food chains found in various ecosystems. Draw food webs found in various ecosystems. In the context of food chains, classify animals based on their feeding	**One Page Response Paper** You have learned that the sun is a source of energy that impacts ecosystems through food chains and food webs. Write a one-page essay that answers the following questions: a) How does the sun supply the energy to the ecosystem? b) How can air pollution impact the potential for the sun to supply the energy for ecosystems? c) What initiatives can we take in our society to limit the amount of air pollution and thereby protect the delicate ecosystems? d) How does pollution lead to climate change and how might that impact species within an ecosystem? **Interpreting Energy Data** The sun gives supplies heat and light to the earth. There has been some suggestion that increased pollution will seriously impact the amount of energy that gets to plants from the un and therefore impact energy transfer to ecosystems in general. By reference to the energy output graph below, answer the following questions:	Nutrients we get from rice and cereals are starch and sugars. These are commonly referred to as **carbohydrates.** The body needs carbohydrates to provide energy for movement and work. Nutrients we get from meats, eggs, milk and cheese are commonly called **proteins** and **fats**. The body needs proteins for repair/growth and it requires fats to keep warm or to store energy for later use. Where does the food that you eat come from? (*Plants, animals*) Have you ever wondered where the energy in animals' food comes from? It may surprise you to learn that all the energy in animals' food was once energy from the sun! In this lesson, we will explore how energy from the sun is transformed into the food that animals consume and how it is used for various purposes such as body repair, growth, motion, and maintaining body warmth. Learners, we have already learned there is a process called **photosynthesis** that invites plants to gather energy from the sun but those same plants get eaten by humans or sometimes we eat the animals (cows & goats) that have eaten those plants. In that way, the energy from the sun eventually gets to us through the food we eat. Click on the link below to enjoy a short video on photosynthesis.

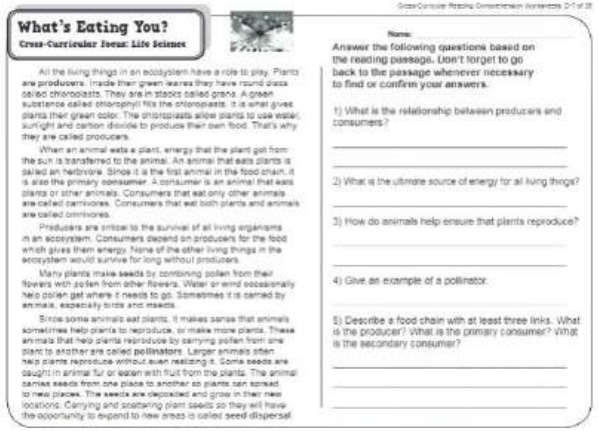
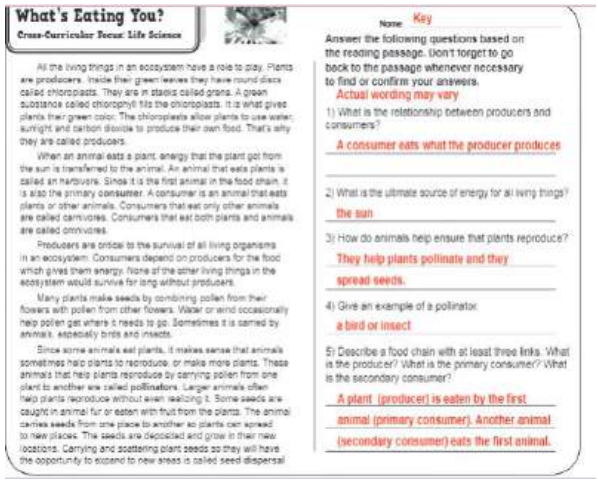
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
relationships (herbivores, carnivores and omnivores) Hypothesize the effects of various situations, activities or events that can affect food chains and food webs. Communicate effectively in class discussions on various topics. Interpret sun's energy graph Graph surface temperature data Extrapolate surface temperature data Identify biotic and abiotic factors within a food chain/food web **<u>Attitudes/Values</u>** Appreciate the importance of the sun, plants and animals to our survival. Lead initiatives to limit air pollution so as to maintain adequate sunlight for photosynthesis and energy transfer to ecosystems. Lead initiatives to limit fossil fuel consumption to protect the energy transfer in ecosystems that may be	 Retrieved from: https://www.climate.gov/news-features/understanding-climate/climate-change-incoming-sunlight# What is the approximate amount of energy given off by the sun as measured in watts per square meter? (1360-1361 watts/m².) While the earth goes through a normal cycle of average temperature change, the increase in greenhouse gases from burning excessive fossil fuels has caused temperatures to rise worldwide (greenhouse effect). These increases have the potential to kill plant species that are responsible for photosynthesis and energy transfer to ecosystems.	Retrieved from: https://www.youtube.com/watch?v=3pD68uxRLkM (4:52 min) .  Review of photosynthesis  Retrieved from: https://ssec.si.edu/stemvisions-blog/what-photosynthesis The sun is the ultimate source of energy for almost all life on Earth. Through a process called **photosynthesis**, plants and other photosynthetic organisms convert sunlight into chemical energy in the form of a **simple sugar called glucose**. Glucose serves as the primary source of energy for all living organisms, including animals.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
impacted by global warming and elimination of species. Work collaboratively with each other when completing assigned tasks or activities. Stewardship/Respect for Living Things When conducting practical and group work, display sensitivity and offer assistance to peers who may have physical or learning challenges. Participate actively in classroom discussions.	**Average Earth Surface Temperature Change by Decade** Have learners extract data from the following graph and use it to draw their own graph.  Retrieved from: https://earthobservatory.nasa.gov/features/GlobalWarming/page2.php Have learners make a data table (temperature increase per year every ten years) based on the graph from 1960-2010. Sample data e.g. Temperature increase (degrees Celsius) / Average for the year 0 change / 1960 0 change / 1970 0.1 degree increase / 1980 0.2 degree increase / 1990 0.3 degree increase / 2000 0.5 degree increase / 2010	There are other ways the sun's energy gets transformed. Today we are going to learn how that happens and how we can draw pictures that show how everything in our ecosystem relies on each other. **Photosynthesis** Background information: Plants use a process called **photosynthesis** to make food. During photosynthesis, plants trap light energy with their leaves. Plants use the energy of the sun to change water and carbon dioxide into a sugar called glucose. **Glucose** is used by plants for energy and to make other substances like cellulose and starch. **Cellulose** is used in building cell walls. **Starch** is stored in seeds and other plant parts as a food source. That's why some foods that we eat, like rice and grains, are packed with starch! In small groups, learners will test for starch. **Test for Starch & Sugars made/stored in Plants** Carbohydrates in food can take the form of sugars, starches, and fibre.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	Task a) Learners should duplicate the data in drawing their own graph b) They should extend their x axis to include up to 2030 c) They should draw a line on their own graph that follows the trend (the slope) and predict (extrapolate) what the temperature increase could be predicted for 2030. Rubric: labelled graph 5 marks/extrapolated value 5 marks **Food Chain Vocabulary** photosynthesis energy herbivores nutrients scavenger producers fungi web food omnivores humans chains  **Read the sentences below and fill in the missing words from the word bank.** 1. Every living plant and animal must have _____ to survive. 2. Animals and plants get the energy they need from their _____. 3. Plants are called _____ and animals are called consumers. 4. Plants absorb energy from sunlight through _____. 5. Animals that eat only plants are called _____ and animals that eat only animals are called carnivores. 6. _____ are animals that eat both animals and plants. 7. A _____ is an animal that eats dead animals. 8. Decomposers help put _____ back into the soil for plants to eat. 9. Worms, bacteria, and _____ are examples of decomposers. 10. There are many food _____ and most plants and animals are part of several chains. 11. _____ are at the end of the food chain. They eat both plants and animals. 12. Many food chains are joined together to form a food _____.	**How to Test for Starch in Foods** Iodine solution is used to test for starch in foods. Iodine solution is an orange or reddish-brown liquid 1. Prepare a test sample by placing small pieces or crushed food in a petri dish or drink cork (preferably white) or on a white tile. *NB. Liquid samples can be used as well.* 2. Add 2 to 3 drops of iodine solution on the food sample and observe. 3. If starch is present, the orange colour of the iodine will change to blue-black.  Retrieved from: https://everythingaboutbiotech.tumblr.com/post/688046157627310080/food-tests

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	Answers 1.nutrients 2. food 3. producers 4. photosynthesis 5. herbivores 6. omnivores 7. scavengers 8. nutrients 9. fungi 10.chains 11.humans 12. web Retrieved from: https://www.pinterest.com/pin/food-chain-vocabulary-worksheet--471048442258100231/ **Food chains and Food Webs**  **Food Chain and Web** All living things need energy to live. Living things get their energy from food. A **food chain** is the flow of food in an ecosystem from one living thing to another. A food chain also shows how energy moves through the environment. The energy that the plant gets from the sun is transferred to all of the animals in the chain, this is called **energy transformation.** Living things in an ecosystem can be classified as **producers, consumers** and **decomposer. Producers** are plants; they make their own food. **Consumers** are animals; they eat other living things as food. **Decomposers** are living things such as mushrooms and earthworms; they break down dead plants and animals for food. The name for animals that eat only plants is a **herbivore**. The name for animals that eat only meat is called **carnivores**. The name for animals that eat both plants and meat is called **omnivores.** The food chain begins with a **green plant**, the producer. It continues with an animal, the consumer that eats the green plant. A food chain may include one or more other consumers. Therefore, the energy that the plant gets from the sun is transferred to all of the animals in the chain, this is called **energy transfer.** A **food web** is a combination of several food chains. SUN PRODUCER PRIMARY CONSUMER SECONDARY CONSUMER DECOMPOSER	Teacher demonstrates the test for reducing sugar. **How to Test for Sugar in Foods** Benedict's solution is used to test for simple sugars, such as fructose or glucose. Benedict's solution doesn't identify the specific sugar in a sample, but the colour produced by the test can indicate whether a small or large quantity of sugar is present. Benedict's solution is a translucent blue liquid 1. Prepare a test sample by mixing a small amount of crushed or grated food with distilled water. 2. In a test tube, add 40 drops of the sample liquid and ten drops of Benedict's solution. 3. Warm the test tube by placing it in a hot water bath or container of hot tap water for five minutes. 4. If sugar is present, the blue colour will change to green, yellow, orange or red, depending on how much sugar is present. Green indicates a lower concentration than yellow, which is a lower concentration than red. The different colours may be used to compare the relative amounts of sugar in different foods.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	Directions: Circle the letter for the best answer for each question. 1. Your body changes food into _____. [1] A. oxygen B. sunlight C. energy 2. Food and energy move in a path called a _____. [1] A. food web B. food pyramid C. food chain D. food line 3. Most food begins with _____. [1] A. vegetable B. the sun C. meat D. water 4. What is the main idea of the text? [1] A. You need energy. B. Plants make their own food. C. Food and energy move in a path we call a food chain. D. Plants in the ocean are food for animals. 5. Write the name given to animals that live on other animals. [1] 6. The animals that other animals eat is called. [1] 7. Name TWO animals that eat other animals. [2] 8. What is the movement of energy from one animal to the next called? [2] 9. What are consumers? [1] 10. What are decomposers? [1] 11. Who are producers? [1] 12. What is a food web? [1] **Retrieved from:** https://www.liveworksheets.com/w/en/science/18811	 Retrieved from: https://everythingaboutbiotech.tumblr.com/post/688046157627310080/food-tests **The Sun Provides Energy** Picture of human growth cycle- (Class discussion or in small groups)  **Retrieved from:** https://k8schoollessons.com/human-life-cycle/

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	Reading and Comprehension  **What's Eating You?** **Cross-Curricular Focus: Life Science** All the living things in an ecosystem have a role to play. Plants are producers. Inside their green leaves they have round discs called chloroplasts. They are in stacks called grana. A green substance called chlorophyll fills the chloroplasts. It is what gives plants their green color. The chloroplasts allow plants to use water, sunlight and carbon dioxide to produce their own food. That's why they are called producers. When an animal eats a plant, energy that the plant got from the sun is transferred to the animal. An animal that eats plants is called an herbivore. Since it is the first animal in the food chain, it is also the primary consumer. A consumer is an animal that eats plants or other animals. Consumers that eat only other animals are called carnivores. Consumers that eat both plants and animals are called omnivores. Producers are critical to the survival of all living organisms in an ecosystem. Consumers depend on producers for the food which gives them energy. None of the other living things in the ecosystem would survive for long without producers. Many plants make seeds by combining pollen from their flowers with pollen from other flowers. Water or wind occasionally help pollen get where it needs to go. Sometimes it is carried by animals, especially birds and insects. Since some animals eat plants, it makes sense that animals sometimes help plants to reproduce, or make more plants. These animals that help plants reproduce by carrying pollen from one plant to another are called **pollinators**. Larger animals often help plants reproduce without even realizing it. Some seeds are caught in animal fur or eaten with fruit from the plants. The animal carries seeds from one place to another so plants can spread to new places. The seeds are deposited and grow in their new locations. Carrying and scattering plant seeds so they will have the opportunity to expand to new areas is called seed dispersal. Name: **Answer the following questions based on the reading passage. Don't forget to go back to the passage whenever necessary to find or confirm your answers.** 1) What is the relationship between producers and consumers? 2) What is the ultimate source of energy for all living things? 3) How do animals help ensure that plants reproduce? 4) Give an example of a pollinator. 5) Describe a food chain with at least three links. What is the producer? What is the primary consumer? What is the secondary consumer?  **What's Eating You?** **Cross-Curricular Focus: Life Science** All the living things in an ecosystem have a role to play. Plants are producers. Inside their green leaves they have round discs called chloroplasts. They are in stacks called grana. A green substance called chlorophyll fills the chloroplasts. It is what gives plants their green color. The chloroplasts allow plants to use water, sunlight and carbon dioxide to produce their own food. That's why they are called producers. When an animal eats a plant, energy that the plant got from the sun is transferred to the animal. An animal that eats plants is called an herbivore. Since it is the first animal in the food chain, it is also the primary consumer. 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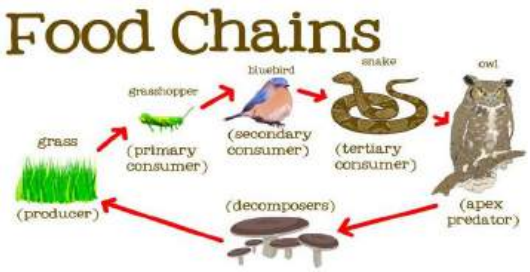
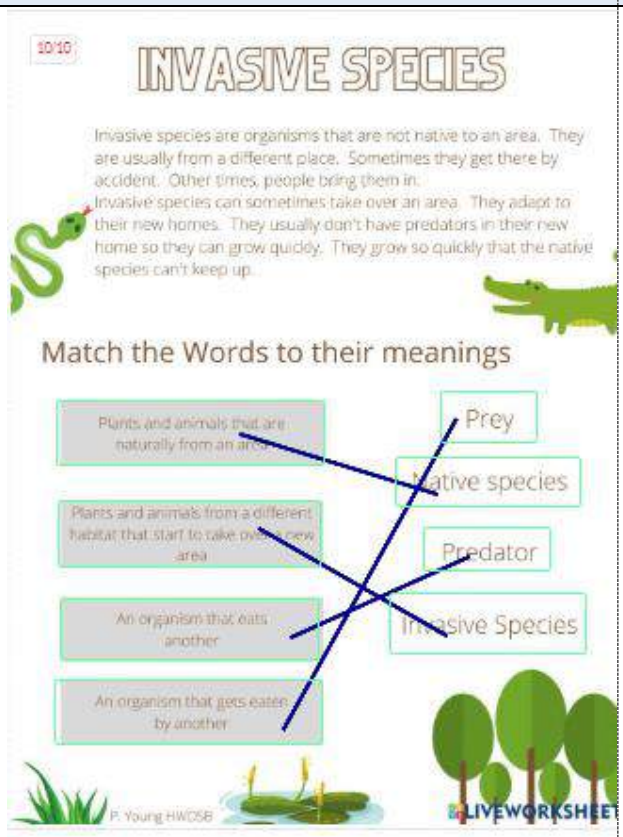
Some seeds are caught in animal fur or eaten with fruit from the plants. The animal carries seeds from one place to another so plants can spread to new places. The seeds are deposited and grow in their new locations. Carrying and scattering plant seeds so they will have the opportunity to expand to new areas is called seed dispersal. Name: Key **Answer the following questions based on the reading passage. Don't forget to go back to the passage whenever necessary to find or confirm your answers.** Actual wording may vary 1) What is the relationship between producers and consumers? A consumer eats what the producer produces 2) What is the ultimate source of energy for all living things? the sun 3) How do animals help ensure that plants reproduce? They help plants pollinate and they spread seeds. 4) Give an example of a pollinator. a bird or insect 5) Describe a food chain with at least three links. What is the producer? What is the primary consumer? What is the secondary consumer? A plant (producer) is eaten by the first animal (primary consumer). Another animal (secondary consumer) eats the first animal.	**Questions to ask during guided discussion.** Have learners answer questions (in small groups or as individuals in a whole class discussion), e.g. - What is the picture showing us? (*How a baby grew/ develop and how he moved)* - What does he need to move and grow? *(Energy*) - What does our heart, hands, etc. require to work? *(Energy*) - Where do we get our energy from in order for us to grow, move and have our body function properly? (*We get our energy from the food we eat.)* - Where does the food we eat come from? *(The food we eat comes from plants and animals)* - We know that plants need water, soil to grow. What else is needed for plants to grow? (*sunlight*). So energy from the sun grows the plants which we eat and then we get the energy when we eat the plants. Its like a cycle isn't it? Lets' draw a picture of that process. - Have you ever heard that humans gain vitamin D from exposure to the sunlight? (*When your skin is exposed to sunlight, it makes vitamin D from cholesterol. The sun's ultraviolet B (UVB) rays hit cholesterol in the skin cells, providing the energy for vitamin D synthesis to occur.)*

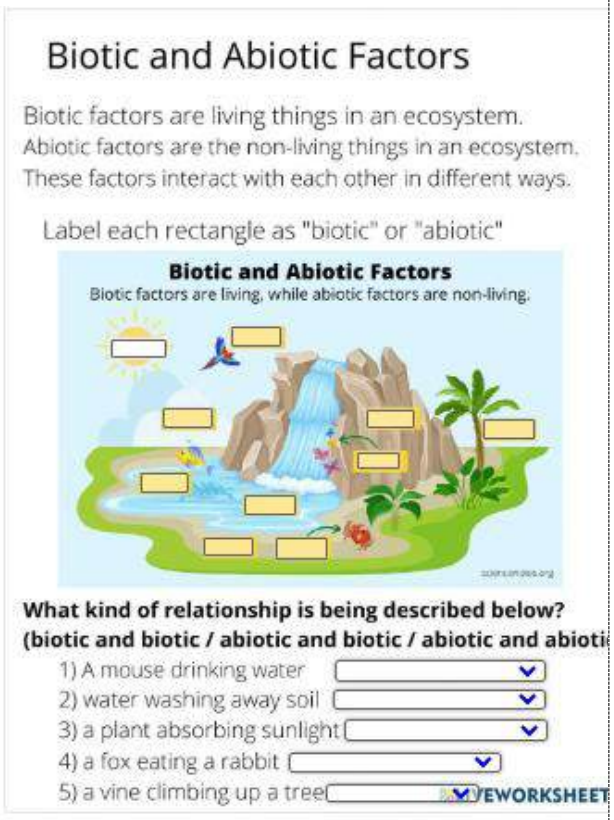
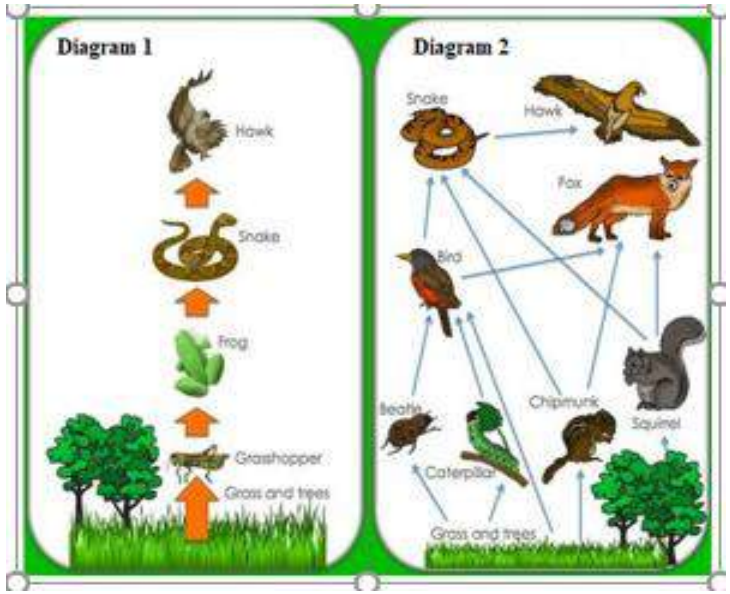
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	Reading and Comprehension ***Nutrition*** *All living things- plants, animals and human beings need food. Foods contain certain substances called nutrients which build and maintain the body and give it power and energy to do work. Some of these substances or nutrients are Proteins, Carbohydrates, Fats, Vitamins and Minerals.* *Proteins are body-building foods. They replace and repair worn-out and broken-down tissues. They are found in foods such as meat, milk, fish, cheese, eggs, peas, beans and lentils. Growing children need a good supply of proteins. They need more than adults. Carbohydrates contain starches and sugars. They supply the body with power and energy to do work. They are found in rice, flour, bread, roti and ground provisions like yam, dasheen, tannia, eddoes and cassava. People who do physical work or labour on the fields need more carbohydrates than those who work in offices.* *Fats supply us with energy and warmth. You will find them in butter, margarine, cheese and certain kinds of meat and vegetable oils. Most animals store up fat in their bodies. Later, they use it as energy. We should avoid eating too much fat, especially animal fat which we get by eating food from animals. Too much fat in our diet can cause clogging of our arteries or the tubes that carry blood to our heart.* *Vitamins protect the body against certain diseases of the skin, eyes and bones. They are contained in whole milk, egg,*	- Animals also get **Vitamin D** from exposure to sunlight and then we eat the animals for energy -another cycle! (*an animals' skin secrete oils or waxes which coat and impregnate its fur or feathers. Sunlight then interacts with the oil and produces vitamin D, which is then ingested by the animal or bird when it grooms itself.*) In this way the suns' energy gets passed to animals directly and through plants they eat and then we eat the animals (another cycle of energy) Let us draw another picture to recall that whole process. **Food Chain and Food Webs**  Retrieved from https://images.twinkl.co.uk/tw1n/image/private/s--dQdi2MEr--/c_fill,q_auto:eco,w_600/v1/create/library/Rainforest-Heroes-Final-Pattern-Page.png

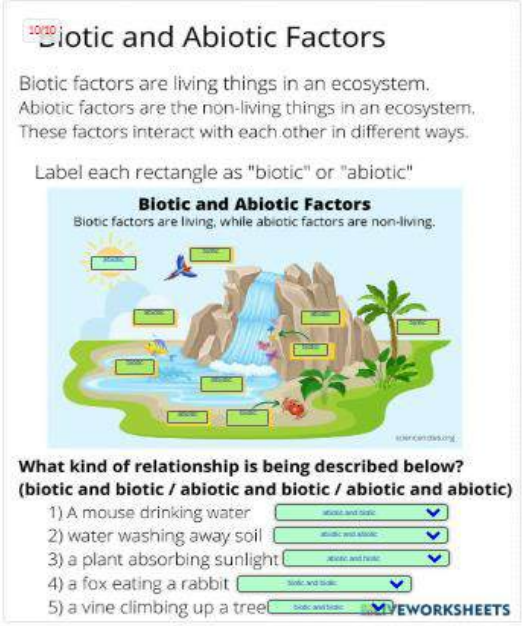
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	meat, fish, yellow vegetables like carrots and dark, leafy greens like spinach. They are also found in oranges and other citrus fruits, tomatoes and leafy vegetables. *Minerals are of different kinds. They are important for the general health of the body. You can find them in milk, cheese, egg yolk, cabbage, cauliflower, bananas, liver, heart, kidney, whole-wheat, fish, nuts, dates, asparagus and spinach.* *It is wise to eat a balanced diet. This means that you have a daily intake of a little of each of the different kinds of food mentioned. You must not eat more than your body requires to give you sufficient energy to go about your daily work. If you eat more than you require, you will store up the excess food in the form of fat. After a while you will become obese or overweight, especially if you are lazy and not in the habit of doing daily physical exercise. Obesity is harmful to health and can cause serious illnesses that are life-threatening. Therefore, you must always bear in mind that proper eating is the key to good health.* ***Sample Questions*** 3. *Why are nutrients essential to the body? (Nutrients build and maintain the body and give it power and energy to do work.)*	Learners, do you know what an ecosystem is? (An ecosystem is made up of all of the living and non-living things in an area. This includes all of the plants, animals, and other **living things** that make up the communities of life in an area. An ecosystem also includes non-living materials—for example, water, rocks, soil, and sand.) Retrieved from: https://kids.britannica.com/kids/article/ecosystem/433377#:~:text=An%20ecosystem%20is%20made%20up,rocks%2C%20soil%2C%20and%20sand.  https://cdn.britannica.com/59/232059-050-70F0B14D.jpg Can you give examples of different ecosystems? (*examples the sea, forest, mangrove, swamp, rainforest).* Let us now briefly describe these ecosystems. (using pictures learners will describe these ecosystems- example animals and

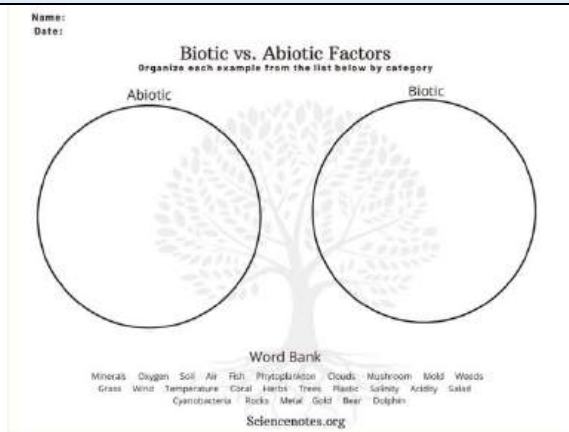
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	2. *Which of the following is not stated in the last paragraph?* a) *over-eating can cause over-weight* ***b) Eating less causes you to lose weight.*** c) *Over-eating without exercising may be worst for you.* d) *Obesity can lead to serious illness* 3. *Which of the following can you infer or conclude from the last paragraph?* a) *obese people are over-weight* b) *excess food is stored as fat* c) ***exercise can help in preventing you from adding weight.*** d) *being lazy or inactive also contributes to over-weight* 4. *Give a word or phrase for each of the following:* a) *Substances which build and maintain the body (nutrients)* b) *Body-building foods (proteins)* c) *Foods that give power and energy (carbohydrates)* d) *A diet which contains a little of each of the different nutrients (a blanched diet)* Source: ***A Basic English Course Primary Level 4 (Revised Edition) Uric Narinesingh pages 134-135*** ***Click on the link below to complete a quick assessment on Invasive Species.*** ***https://www.liveworksheets.com/w/en/biology/1498344***	plants found in these ecosystems, are these ecosystems found in their country) Organisms in ecosystems rely on each other for food. Do you know the name of the order of events in an ecosystem, where one living organism eats/ feeds on another organism? (a food chain) ***Useful Anchor Text for Teaching Reliance in Ecosystems*** Wolf Island by Celia Godkin YouTube® Read Along: https://www.youtube.com/watch?v=N6LsBdRnboI (6:29 mins) **Food chain** A food chain consists of different relationships we call trophic levels. The trophic level of an organism is the position it occupies in a food web. Within a food web, a food chain is a succession of organisms that eat other organisms and may, in turn, be eaten themselves. The trophic level of an organism is the number of steps it is from the start of the chain. Trophic levels have the same nutritional relationship to the primary sources of energy.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	 Answer sheet	**Trophic Levels** ■ Producers ■ Consumers ➢ Primary consumers ➢ Secondary consumers ➢ Tertiary consumers ■ Decomposers  Retrieved from: https://www.onlinebiologynotes.com/food-chain-trophic-levels-and-flow-of-energy-in-ecosystem/ or 

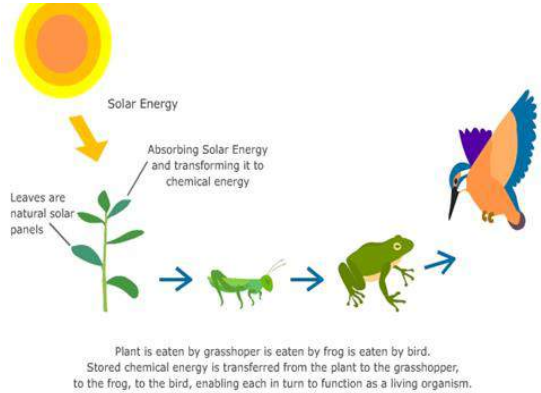
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Retrieved from: https://medium.com/@ellisnelson.au/difference-between-food-chain-and-food-web-1a1ce5af24c1 **Video Resource for Learning About Food Chains** Pose the following questions before learners watch the video so as to promote active listening/watching https://www.youtube.com/watch?v=hLq2datPo5M (4:57min) 1. Where does all energy come from for living things? (*the sun)* 2. How does the energy get from the sun to animals? *The sun is necessary to make plants grow. The animals eat the plants.)* 3. What are producers? (*plants are producers because they make their own food*). 4. What are herbivores, carnivores, omnivores and decomposers? • some animals (herbivores) eat plants. • some animals eat other animals (carnivores)that have eaten plants. • some animals eat both plants and animals (omnivores) • decayed plants and animals contribute fertilizer to the ground where plants again begin to grow.(action of decomposers)

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	 Retrieved from https://www.liveworksheets.com/w/en/science/2140053	Have learners discuss and answer questions in small groups. **Distinguishing Food Chains** Have learners observe the two following diagrams  Retrieved from: https://www.bing.com/images/search?view=detailV2&ccid=xiCnjAuv&id=3116F171EB2DBF6CCE8B13A7A16222B33082F6B9&thid=OIP - Which diagram shows a food chain? *(Diagram 1)* - What is a food chain? *(The flow of energy in the form of food from plants to animals and other animals in series.)*

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	 Retrieved from https://www.liveworksheets.com/w/en/science/2140053	- What does the arrow in a food chain represent? *(The arrows represent the direction of the flow of energy)* - What does diagram 2 represent? *(Food web/ combination of food chains/ ecosystem)* - What do you understand by the terms: - **producers** *(Organisms (plants) that can capture energy from the sun and make their own food by the process of photosynthesis)* - **consumers (***Organisms (animals) that feed on plants and other animals)* Another component of many food chains is called a **decomposer.** A decomposer is any organism that breaks down or eats decaying material for its energy source. Decomposers are important within the environment because they break down the bodies of dead animals or plants, and recycling those materials back into the Earth. Some examples include fungi, bacteria and insects

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	 Retrieved from: https://sciencenotes.org/wp-content/uploads/2022/04/Biotic-vs-Abiotic-Factors-Worksheet.pdf  Retrieved from: https://www.purposegames.com/game/types-of-ecosystems-quiz	 Retrieved from: https://www.expii.com/t/decomposer-definition-role-10471 ***Differences between food chains and webs*** **Food chain** / **Food web** Single/ linear flow of energy / Many connected paths of energy flow One food source for animals / Some animals have more than one food source

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	Identify the following ecosystems: • Shrubland Ecosystem • Tropical rainforest • coral reef • dessert • Grassland • Mangrove Swamp • coastal • Tundra	***Similarities between food chains and webs*** *They start with plants* *Involve the flow of energy from plants to animals* - Why do food chains and webs start with plants? *(Plants make/ produce food which provides energy but animals cannot, they eat plants or other animals that eat plants)* - Where do plants in food chains and webs get their energy to make food? (*The main source of energy for plants to make food is the sun)* Explain to learners that the energy released from food was once energy from the sun that was captured by plants during a process called photosynthesis. Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion. The food of almost any kind of animal can be traced back to plants. Have learners observe a chart and/ or watch video to sum up discussions on the sun as the source of energy in foods.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		E.g. Chart  Retrieved from: https://www.bing.com/images/search?view=detailV2&ccid=CyCf4Tjg&id=7BDC2290AA8B25F709C115610721E004841A0E6B&thid=OIP. **Learner Formative Assessment** Think about plants and animals in your community and make a list. Now draw an example of a flow chart/food chain that shows how the energy is transferred from the sun to other living things. How does pollution affect food chains and webs? Ask learners their ideas about why pollution might disturb a food chain or food web. (*kill off members, stall growth, limit offspring)*

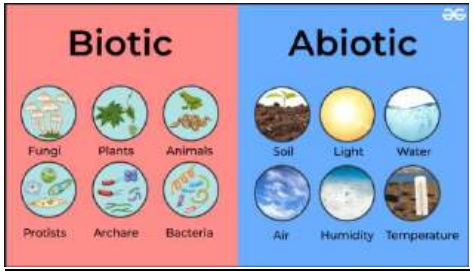
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Pollution disrupts food chains and webs by affecting the health, reproduction, and survival of organisms at various trophic levels. "Pollution, in its various forms, can have a profound impact on food chains and webs. For instance, air pollution can lead to acid rain, which can acidify soils and water bodies. This can harm or kill certain species of plants and animals, particularly those at the bottom of the food chain, such as algae and plankton in aquatic ecosystems. This can have a knock-on effect on the rest of the food chain, as these primary producers are the main source of energy for other organisms." Quoted verbatim from: https://www.tutorchase.com/answers/ib/ess/how-does-pollution-affect-food-chains-and-webs Ask learners how global warming might disturb a food chain? (*changes in climate affect habitat and could kill of f members of an ecosystem; water level changes may impact habitat and limit growth and reproduction of species*) **Invasive species and Interrupting food chains** What does the word "invade" mean to you? *(move into a place where you don't belong)* We know that wars are often caused by one ruler invading the country of another ruler with the sole intent of taking over the new land for their own.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		An invasive species maybe a plant or animal that more often accidentally moves into an ecosystem where it usually doesn't exist. Because they are a new species in the system, there is great potential to upset the balance of prey/predator, .producer/consumer etc. Invasive Species Invasive species are plants, animals, or microorganisms that are not native to a particular ecosystem and have the potential to cause harm to the environment, economy, or human health. These species often have no natural predators or controls in their new environment, inviting them to multiply rapidly and outcompete native species.  https://sciencenotes.org/invasive-species-definition-and-examples/ <u>How Do Invasive Species Interrupt Food Chains?</u> Do you know how invasive species can interrupt a food chain? *(teacher listens to learners responses and make notes)*

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Teacher will then explain that Invasive species can disrupt food chains by preying on or outcompeting native species. They can also alter the availability of resources, such as food and habitat, which can have a cascading effect on other organisms in the ecosystem. For example, if an invasive species preys on a native species that is an important food source for another species, it can lead to a decline in the population of the second species. This can then affect the predators or other organisms that rely on the second species for food, causing a disruption in the food chain. We can help prevent the spread of invasive species. Are there any animals which are new to your school, garden or community? (perhaps the invasive species may be reported on the news). Can you list a few? (*teacher listens to learners suggestions and make notes)* Teacher then explains ways we can prevent the spread of invasive species. Preventing the spread of invasive species is crucial to protect native ecosystems. Here are some ways we can help: 1. **Clean your gear:** When visiting natural areas, make sure to clean your shoes, clothes, and equipment to remove any seeds, insects, or other organisms that could be carrying invasive species.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		2. **Don't release pets or plants:** Never release pets or plants into the wild. They may become invasive and disrupt native ecosystems. 3. **Plant native species:** Choose native plants for your garden. They are adapted to the local environment and are less likely to become invasive. 4. **Be a responsible boater:** Clean your boat and equipment before moving to a new body of water to prevent the spread of aquatic invasive species. We will now watch a short you tube video on invasive species. **Useful Video Resources to Exemplify the Reliance of Species on One Another** As learners watch the following videos, the teacher should post the following questions to consider as they watch. 1. What do you notice about the relationship between plants and animals in an ecosystem? (*The animals rely on the plants, since the animals are consumers.*.) 2. What do you think will happen if you remove something from an ecosystem?(*The plants and other organisms may not grow and thrive.*) 3. Invasive species are living things that often get added to an ecosystem by mistake. What do you think happens to ecosystems when an outside species is added? (*They cause damage to the area.*)

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		4. Can you think of an invasive species (plant or animal) that has invaded your community? (*lion fish)*  Retrieved from: https://www.youtube.com/watch?v=bJEToQ49Yjc (6:22 mins)  Retrieved from: https://www.youtube.com/watch?v=gYNAtw1c7hI (3:32 mins)

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Biotic/Abiotic  The learners will be engaged in a discussion about ecosystems and energy systems. What makes up an ecosystem? *(learners will give their responses and teacher will take notes)* The teacher will then say, "The ecosystems are made up of both living (biotic) and non-living (abiotic) components. Do you know what the word "biotic" means? (*the teacher will write their responses on the board.)* Teacher will then explain to the learners that Biotic factors refer to all living organisms within an ecosystem. **Biotic factors** interact with each other and with their environment, playing important roles in the functioning of ecosystems. "Can You list a few examples of biotic factors?" *(teacher will listen to the responses and record them on the board)* **- Plants**: Trees, flowers, grass, and other vegetation. **- Animals:** Birds, mammals, reptiles, amphibians, and insects. - **Microorganisms**: Bacteria, fungi, and protists.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Biotic factors can be further classified into producers, consumers, and decomposers. **Producers,** such as plants, are able to produce their own food through photosynthesis. **Consumers**, such as animals, obtain their energy by consuming other organisms. **Decomposers**, such as bacteria and fungi, break down dead organisms and organic matter, returning nutrients to the ecosystem. The teacher will then ask the learners if they know what the word **"abiotic"** means. *(the teacher will write their responses on the board.)* The teacher will then explain that Abiotic factors, on the other hand, are non-living components of the environment that influence the living organisms within an ecosystem. These factors can include physical and chemical characteristics of the environment, such as temperature, sunlight, water availability, soil composition, and air quality. "Can You list a few examples of abiotic factors?" *(teacher will listen to the responses and record them on the board)* - **Temperature:** The average temperature of an area. **- Sunlight:** The amount of sunlight an area receives. - **Water availability**: The presence of water and its availability to organisms. - **Soil composition**: The type and quality of soil in an area. - **Air quality:** The composition of gases in the air.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Abiotic factors can have a significant impact on the distribution and abundance of biotic factors within an ecosystem. For example, certain plants may only be able to survive in specific temperature ranges, while some animals may require a certain amount of sunlight to thrive. **Components of an Energy system : Distinguishing Biotic/Abiotic** The teacher will ask the learners to review what abiotic and biotic means. (*Abiotic factors are the non-living things in an ecosystem. and Biotic factors are the living things in an ecosystem.)* The teacher will then ask the learners to group the factors within an ecosystem that fall into these categories. They will choose at least 5 living things they have identified and suggest how they are related in the ecosystem. (***They must suggest how these components of the system are related to energy from the sun.)*** **<u>Field Trip</u>** Learners will observe their local environment (or participate in a virtual field trip). Learners will list six examples of abiotic and biotic factors.

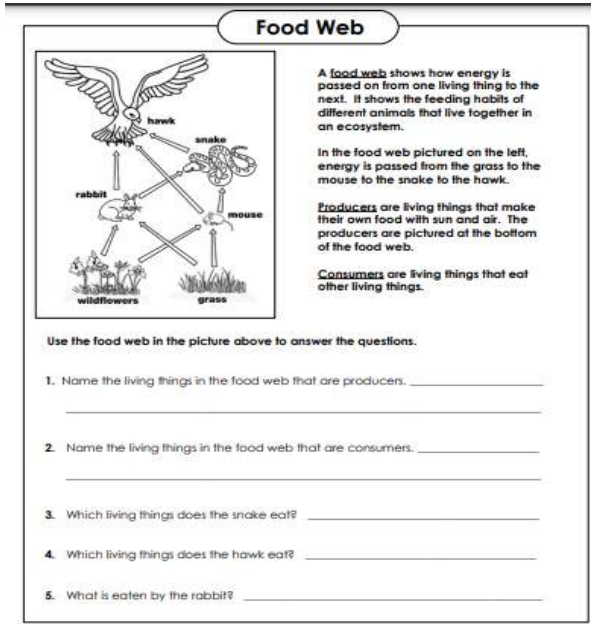
Additional Useful Content Knowledge for the Teacher

Difference between food chains and food webs
https://www.careerpower.in/school/biology/difference-between-food-chain-and-food-web

Differences between food chain and food webs
https://medium.com/@ellisnelson.au/difference-between-food-chain-and-food-web-1a1ce5af24c1

Global Warming Poses a Threat to Food Chains
https://www.uwa.edu.au/news/article/2021/march/global-warming-poses-threat-to-food-chains

Additional Resources and Materials



Food Web

A food web shows how energy is passed on from one living thing to the next. It shows the feeding habits of different animals that live together in an ecosystem.

In the food web pictured on the left, energy is passed from the grass to the mouse to the snake to the hawk.

Producers are living things that make their own food with sun and air. The producers are pictured at the bottom of the food web.

Consumers are living things that eat other living things.

Use the food web in the picture above to answer the questions.

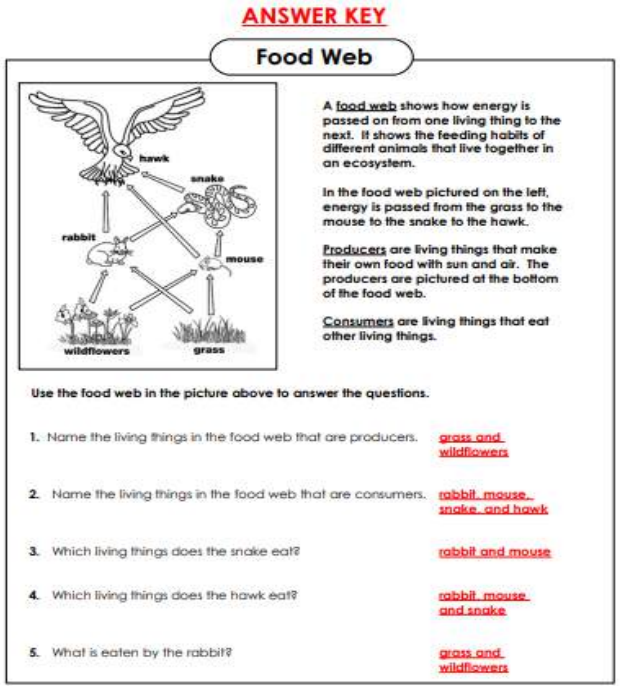
1. Name the living things in the food web that are producers. _____

2. Name the living things in the food web that are consumers. _____

3. Which living things does the snake eat? _____

4. Which living things does the hawk eat? _____

5. What is eaten by the rabbit? _____



ANSWER KEY

Food Web

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In the food web pictured on the left, energy is passed from the grass to the mouse to the snake to the hawk.

Producers are living things that make their own food with sun and air. The producers are pictured at the bottom of the food web.

Consumers are living things that eat other living things.

Use the food web in the picture above to answer the questions.

1. Name the living things in the food web that are producers. grass and wildflowers
2. Name the living things in the food web that are consumers. rabbit, mouse, snake, and hawk
3. Which living things does the snake eat? rabbit and mouse
4. Which living things does the hawk eat? rabbit, mouse and snake
5. What is eaten by the rabbit? grass and wildflowers

Retrieved from: https://www.superteacherworksheets.com/food-chains/food-web-worksheet_WQRQM.pdf

Food chain: https://www.k12reader.com/worksheet/whats-eating-you/view/

Food web power point: https://slideplayer.com/slide/9241839/

How does climate change influence food web dynamics?https://www.tutorchase.com/answers/igcse/biology/how-does-climate-change-influence-food-web-dynamics

Opportunities for Subject Integration

Mathematics: interpreting, graphing climate data
Social Studies: List ways in which food chains and webs can be disrupted in nature example natural disasters, interference of man example clearing forested areas for building homes and roads, overfishing
Language Arts: Writing descriptions of various ecosystems. Expository essay on the various types/kinds of nutrients. Writing about how pollution and global warming can affect food chains and food webs.
TVET: Creative ways of growing foods example using plastic bottles to grow lettuce, setting up a hydroponics system
Agriculture: Growing foods containing the various nutrients.
Art and Craft: making food chart showing the different groups (nutrients) of food
Health: Preparing a balanced menu and preparing a balanced meal. Preparing a balanced intake of your food for a day for breakfast, lunch, supper

Elements from Local Culture, Technology, TVET, Environment that are Integrated

School trips to visit and learn information about ecosystems in their country example mangrove swamps, forests,
Visiting various hydroponics, aquaculture, farms or places with green houses.
Setting up a school garden to supply nutritious foods, for example vegetables.

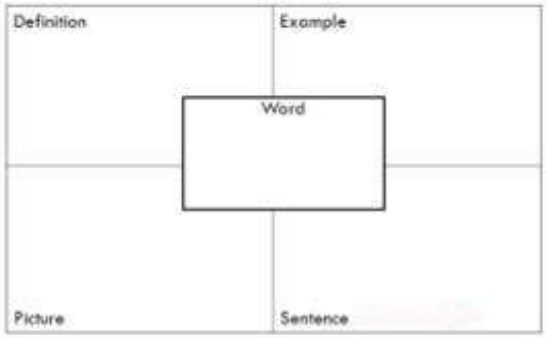
Items of Inspiration

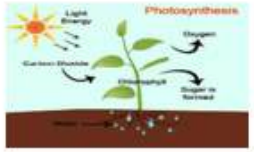
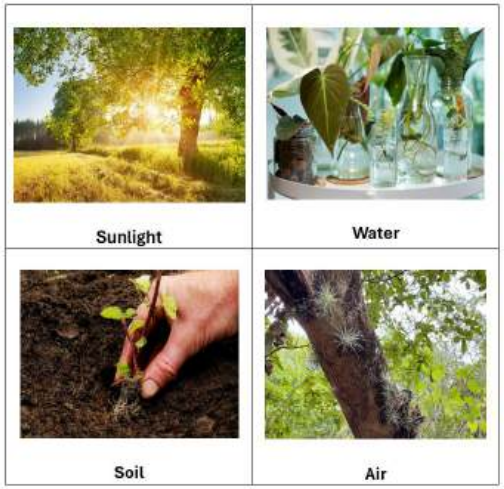
Learners can research on how
(a) pollution can affect food chains
(b) how global warming poses a threat to food chains.

Essential Learning Outcome 2: Support an argument that plants get the materials they need for growth chiefly from air and water.

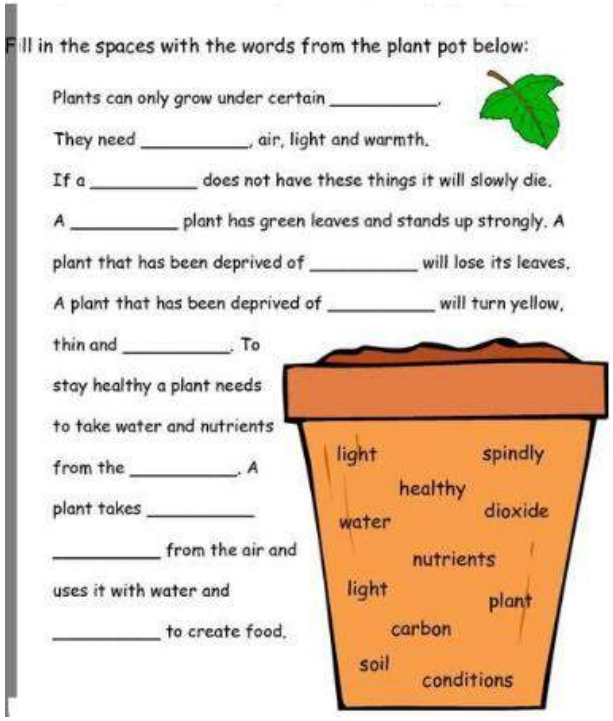
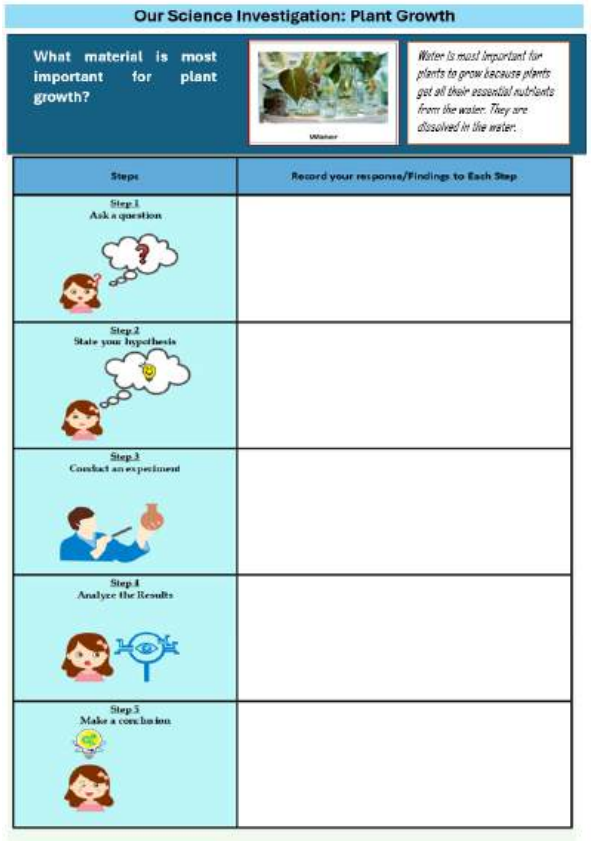
Clarification Statement: Emphasis is on the idea that plant matter comes mostly from air and water, not from the soil.
Grade Level Expectation: Refer to grade level expectations at the beginning of this curriculum document.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Learners are expected to: **<u>Knowledge</u>** Define the terms: • growth • air • oxygen • carbon dioxide • soil • sunlight • controlled experiments • valid • reliable • photosynthesis • respiration • glucose • hydroponics • nutrients Explain the main steps of the scientific method	**Research Report** Learners should create a report that outlines the following: ➢ What do we usually think that plants need to survive? (*nutrients, water, sunlight*) ➢ Which variables of plant growth did you investigate? ➢ What did you find were the optimum amounts of water, soil, sunlight? ➢ The research question asked "Can a plant get its nutrients without soil? What were your findings? (*the science of hydroponics demonstrates that water and air are MOST important and that soil is not necessary*) ➢ Explain using the concept of photosynthesis and a detailed diagram, how the sun's energy is centrally important to the growth of plants.	*Materials: Picture of plants/Plants near a window being watered Alternatively, the teacher can bring the learners outside into the garden to take care of some plants.*  Retrieved from: https://www.bhg.com/gardening/houseplants/care/watering-houseplants/ What living thing are we observing? (*Plants*) Do you have any plants at home? (*Yes/No*) Do you have orchids at home?(*Yes/No*) Look at the video below.

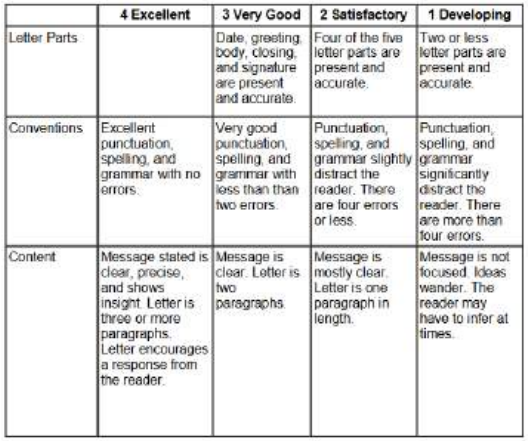
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Describe basic science process skills. State the materials necessary for plants to grow. Account for the need for plants to obtain nutrients to grow. Explain the process of photosynthesis in plants. **Skills** Design and implement a controlled experiment Observe plant growth in seeds and seedlings. Infer that sunlight, water and carbon dioxide are necessary for photosynthesis in plants. Measure plant growth using scientific instruments. Predict the results of experiments. Construct hypotheses to guide plant experiments. Investigate the conditions necessary for plant growth.	Rubric: Question responses-content 5 marks/grammar & punctuation 5 marks/ diagram 5 marks/ explanation 5 marks **Photosynthesis Vocabulary** Place the word photosynthesis in the centre of this Frayer square and ask learners to fill in the 4 quadrants with the appropriate information. Frayer Model (Four Square) Reinforcing Vocabulary  	 Retrieved from: ***https://www.youtube.com/shorts/Ed6NNpfAO1o*** How do you and your family take care of the plants at home? (*Water them, ensure they have sunlight, remove old leaves, etc.*) Why do you think we/people water plants? Why do plants need water? (*To grow*) What else do you think plants need to grow? (sunlight, carbon-dioxide/air) The learners' responses are noted.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Graph data on plant growth to identify patterns and trends. Interpret the results of the graph. Demonstrate interest/curiosity while conducting experiments. **Attitudes/Values** Appreciation of the importance of materials for the growth of plants. Respect for evidence. Appreciation of importance of scientific method. Work cooperatively in groups. Stewardship/Respect for Living Things When conducting practical and group work, display sensitivity and offer assistance to peers who may have physical or learning challenges. Participate actively in classroom discussions.	Growth of Plants The Process of Photosynthesis ON YOUR OWN 1  Provide answers to these questions. 1. The process by which plants make their own food is called _____. 2. What name is given to the green pigment in plants? _____. 3. Energy for photosynthesis comes from the _____. 4. The two gases involved in the process of photosynthesis are _____and _____. 5. What makes food for the plant? _____ 6. Two things that plants need to grow are _____ and _____. 7. What will happen to plants if they do not have enough nutrients? _____ 8. Where does plant growth begin? _____ 9.Two places where plants live are _____ and _____. 10. Plants breathe in _____. Retrieved from: https://education.gov.gy/web2/index.php/learners-resources/primary-school-resources/grade-5/grade5-worksheets/grade-5-worksheets-science/5991-grade-5-science-week-6-2022-consolidated-worksheet/file	**Brainstorming:** The learners are placed in groups. Each group will be given the following: (1) cards with the following words: sunlight, water, soil and air. (2) blank index card (3) poster board (4) markers and (5) glue Sample cards:  "Sunlight Picture" Retrieved https://davisphinneyfoundation.org/sunlight-and-parkinsons/ "Water Picture" Retrieved from https://www.ruralsprout.com/houseplants-to-grow-in-water/

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	Comprehension Task Read each question carefully, then shade the letter next to the correct answer. 1. Photosynthesis is the process by which a. plants make their own food. b. plants search for food. c. animals make their own food. d. animals search for food. 2. Select the main organ of photosynthesis. a. Leaves b. Flowers c. Roots d. Stems 3. Chlorophyll I. is the green pigment in leaves. II. is found in the chloroplast. III. converts light energy into chemical energy. a. I and II b. I and III c. II and III d. I, II and III 4. During photosynthesis plants take in a. carbon dioxide and water. b. oxygen and glucose. c. oxygen and carbon dioxide. d. water and glucose. 5. During photosynthesis plants give off a. carbon dioxide and water. b. oxygen and glucose. c. oxygen and carbon dioxide. d. water and glucose. **Answer key** 1. a 2. a 3. d 4. a 5. b	"Soil Picture" Retrieved from https://www.thespruce.com/success-tips-for-transplanting-and-moving-gardens-1402470 "Air Picture" Retrieved from https://www.airplantsupplyco.com/blogs/articles/6081302-epiphytes The learners will discuss the following question in their groups: *What material is MOST important for plant growth?* Each group must select an option/card and write down a reason for their choice based on what they know about the plants on an index card. The groups share their answers with the class. The teacher gives each group a poster board with a graphic organizer to stick their card. Sample graphic organizer with cards:

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	Retrieved from: Science Made Easy A preparation tool for Primary Science Examinations. Jonathan Benn and Brisshana Benn (2021). Ministry of Education, Co-operation republic of Guyana **Assessment**  retrieved from https://www.pinterest.com/pin/134052526388039920/	 Retrieved from: https://www.edrawmax.com/article/scientific-graphic-organizer-examples.html

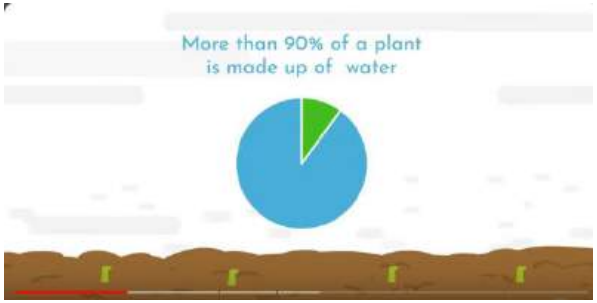
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	Answer Key: Plants can grow under certain **conditions.** They need **water,** air, light and warmth. If a plant does not have these things it will slowly die. A **healthy** plant has green leaves and stands up strongly. A plant that has been deprived of **nutrients** will lose its leaves. A plant that has been deprived of **light** will turn yellow, thin and **spindly**. To stay healthy a plant needs to take water and nutrients from the **soil** . A plant takes **carbon dioxide** from the air and uses it with water and **light** to create food. **Assessment** Write a friendly letter to your friend's dad who is a farmer, explaining the importance as to why plants need the basic conditions in order to grow healthy and produce more fruits or food.	**Introducing the Scientific Method/Process** Scientists are naturally curious persons. Science is all about accounting for unusual occurrences, asking questions and finding answers to them. Traditionally, scientists have tried to solve problems and explain their solutions using a stepwise process which we will talk about today. While these steps are important, in real science research, they are part of a cycle of science with multiple entry points, that involves good questions, experimental design, testing, analysing results and asking more questions. (***Teacher note***: see cycle of science lower in the template) For the purposes of conducting science experiments in elementary school, it is useful to consider the traditional process called the Scientific Method. Our graphic organizer gives us the main steps in the Scientific Method. [Teacher can identify steps and discuss the steps from the graphic organizer] Learners, it is important in designing an investigation that we apply the notion of a **controlled experiment**. For example: If we were going to decide which pair of running shoes would result in the fastest track time for an athlete, what the experiment look like? I think you would agree: 1) The person running has to stay the same 2) The same track must be used 3) The starting and finish lines must be the same 4) The timing of the run must be measured the same 5) It would b best if the person running did so at the same time of day with equivalent rest

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	Friendly Letter Rubric Name_____ Date_____  Assessment 10-11 points = 4 8-9 points = 3 7 points = 2 Retrieved from: https://www.lcps.org/cms/lib4/VA01000195/Centricity/Domain/7963/Friendly%20Letter%20Rubric.pdf **Plants Are Producers: A Comprehension Literacy Task** ***Read the passage below carefully and answer the following questions*** Cross-Curricular Focus History/Life Science People are consumers. We have to spend large parts of our days finding, buying, cooking and eating our	These are called **experimental controls** and we can have better confidence that we choose the fastest running shoes because took care to control many of the variables that might impact the measured time of a lap of the track. So, whenever you do an experiment that compares multiple variables, you should think about what controls you can apply so your results are **valid** (the experiment answers the question with confidence there are no confounding variables) and **reliable** (the results are reproducible) **We are using the scientific method to find out what plants need to grow and why.** ***Learners, as you conduct this experiment, I want you to think about how you are doing a controlled study- what variables are you maintaining as constant? [The groups will carry out an experiment based on their chosen material/condition. (To save time, the class may set up each experiment on each material/condition for plant growth simultaneously and then the groups independently record their data).] The research question will be written in their graphic organizer. (*A question usually initiates and guides the scientific process*) The learners, with the teacher's assistance, will develop a hypothesis based on the question. A hypothesis is a guess based on the information we know. This guess will invite us to carry

	4 Excellent	3 Very Good	2 Satisfactory	1 Developing
Letter Parts		Date, greeting, body, closing, and signature are present and accurate.	Four of the five letter parts are present and accurate.	Two or less letter parts are present and accurate.
Conventions	Excellent punctuation, spelling, and grammar with no errors.	Very good punctuation, spelling, and grammar with less than than two errors.	Punctuation, spelling, and grammar slightly distract the reader. There are four errors or less.	Punctuation, spelling, and grammar significantly distract the reader. There are more than four errors.
Content	Message stated is clear, precise, and shows insight. Letter is three or more paragraphs. Letter encourages a response from the reader.	Message is clear. Letter is two paragraphs.	Message is mostly clear. Letter is one paragraph in length.	Message is not focused. Ideas wander. The reader may have to infer at times.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	food. Did you ever think it might be nice to be able to make your own food like plants do? Plants are producers and perform a process called photosynthesis using light from the sun, water and carbon dioxide. Carbon dioxide is one of the gases we exhale when we breathe. The end result of this chemical reaction is sugar for the plant to feed on. The plant releases water and oxygen, a gas all animals need to breathe, into the air. So how do plants do it, and why can't we? Plants have special structures called chloroplasts that animals don't have. Chloroplasts are round, flat organelles that are arranged in stacks called grana. These stacks are filled with chlorophyll. Chlorophyll is what gives leafy green plants their green colour. Their main job is to absorb light from the sun. Chloroplasts can absorb every colour except green. Light activates the chlorophyll. It creates an energy that splits molecules of water, separating them out into hydrogen and oxygen. Chemical reactions take place. Hydrogen from the water combines with carbon from the carbon dioxide we breathe out. Oxygen is released into the air. People and plants make perfect partners. Plants rely on the carbon dioxide from the air that we breathe out, and we rely on the oxygen that they produce. This is one good reason for protecting plant life on Earth. Algae fields near the poles produce a constant	out steps to collect data that will tell us if our guess is a good one and provide answers to our questions. Hypothesis: If plants get no/little _____, then their growth rate will _____ (increase/decrease). Now that we have our hypothesis, the next step of the scientific process (Scientific Method) is to test it. The learners will gather the materials and set up the experiments by following the experimental procedure in order to observe and collect data. The teacher will provide guidance. In carrying out the scientific method/process, scientists design experiments or investigations that test their hypothesis/guess. The experiments will give the scientists the data necessary to see if their guess was valid or not. **Experiment #1: How does water affect plant growth?** Materials: 5-10 plants the same size and age (learners can grow tomato or red bean plants in preparation for these experiments), 4 pots the same size, soil, cup measure, ruler, observation sheet, tape, marker, and water. Procedure: 1. Use a measuring cup/balance to place the same amount of soil into five different same-size pots. The

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	supply of oxygen for us. So do the many plants of Earth's rainforests. We need plants in order to survive. Conservation projects around the globe are aimed at protecting our natural resources, including numerous species of plants. Our quality of life and the very quality of the air we breathe depend upon our green plant partners. <u>Answer the following questions based on the reading passage. Don't forget to go back to the passage whenever necessary to find or confirm your answers.</u> 1. Why are plants called producers? 2. Where do plants get their green colour? 3. Explain the relationship between people and plants. Why are we good partners? 4. What would happen if there were not enough plants on earth? 5. What is chloroplast?	same type of soil should be in each pot. (You can also put two plants under the same conditions) 2. Plant each plant to the same depth in a pot 3. Label the plants: A-no water, B- 120 ml water, C- 240 ml water, D- 360 ml water, and E- 480 ml of water. 4. Place the plants in a place where they can get about the same amount of sunlight e.g. by a window. 5. Measure the height of the plant on the first day 6. Add the required amount of water to the plants every day at the same time for 4 weeks. 7. Measure the height of each plant for 4 weeks. 8. Record all data in the observation table Sample Observation Table: Height (cm) Plant / Start / Week 1 / Week 2 / Week 3 / Week 4 A-No water B- 120 ml C- 240 ml D- 360 ml E- 480 ml After the groups have collected data over the past four weeks, the learners stick their completed observation table in their graphic organizer. Overall growth in height (cm) can be calculated for each plant as well as the percentage increase. Learners will also draw a graph to show the results. (*Mathematics Integration*) and they will answer the questions below.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	 **Plants Are Producers** **Cross-Curricular Focus: History/Life Science** People are consumers. We have to spend large parts of our days finding, buying, cooking and eating our food. Did you ever think it might be nice to be able to make your own food like plants do? Plants are producers and perform a process called photosynthesis using light from the sun, water and carbon dioxide. Carbon dioxide is the gas we exhale when we breathe. The end result of this chemical reaction is sugar for the plant to 'eat.' The plant releases water and oxygen, a gas all animals need to breathe, into the air. So how do plants do it, and why can't we? Plants have special structures called chloroplasts that animals don't have. Chloroplasts are round, flat organelles that are arranged in stacks called grana. These stacks are filled with chlorophyll. Chlorophyll is what gives leafy green plants their green color. Their main job is to absorb light from the sun. Chloroplasts can absorb every color except green. Light activates the chlorophyll. It creates an energy that splits molecules of water, separating them out into hydrogen and oxygen. Chemical reactions take place. Hydrogen from the water combines with carbon from the carbon dioxide we breathe out. Oxygen is released into the air. People and plants make perfect partners. Plants rely on the carbon dioxide that we breathe out, and we rely on the oxygen that they "breathe" out. This is one good reason for protecting plant life on Earth. Algae fields near the poles produce a constant supply of oxygen for us. So do the many plants of Earth's rainforests. We need plants in order to survive. Conservation projects around the globe are aimed at protecting our natural resources, including numerous species of plants. Our quality of life and the very quality of the air we breathe depends upon our green plant partners. Name: Key Answer the following questions based on the reading passage. Don't forget to go back to the passage whenever necessary to find or confirm your answers. Actual wording of answers may vary. 1) Why are plants called producers? They produce their own food. 2) Where do plants get their green color? chlorophyll 3) Explain the relationship between people and plants. Why are we good partners? because we breathe out carbon dioxide which plants need and they release oxygen which we need 4) What would happen if there were not enough plants on Earth? We would run out of oxygen to breathe, or There would be too much carbon dioxide in the air. 5) What is a chloroplast? an organelle in plant cells Copyright ©2012 K12Reader - http://www.k12reader.com Retrieved from https://www.k12reader.com/worksheet/plants-are-producers/	**Some questions to guide the analysis of the data from the observations table: [use for all experiments 1 - 4]** • Which plant showed the biggest increase in height? • How much water did we put each day in this plant? • Which plant showed the least amount of growth? • Which plant began to wilt? **Discussion of Results** Water is needed for growth. Let us learn more about why plants need water.  Retrieved from: https://youtu.be/KUrHihEOhaw?si=cOUh60Y6ca4hzUDK (1:10) Can you identify three ways plants use the water they take in from the video? (*Transportation of chemicals, for photosynthesis, helps plants stay upright.*) The importance of water to your plants goes beyond merely keeping them alive. Water is also a necessary element to help plants thrive. Water is what invites for the uptake of vital nutrients from the soil. It is also water that helps to carry sugar

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		and other elements that may be required by flowers or fruit. Water itself has to be broken down and changed into a new chemical during photosynthesis. • If a plant's soil is given too much water the roots can rot. The plant leaves begin to wilt and there is poor growth as it is not getting enough oxygen and nutrients. Eventually, the branches become affected and the plant dies. • If a plant is not given enough water, the nutrients it needs cannot travel through the plant. • A plant cannot grow if it doesn't have healthy roots, so the proper balance of water is key when growing plants. **Experiment #2: How does air affect plant growth?** Materials: 4 plants the same size and age (learners can grow tomato or red bean plants in preparation for these experiments), 4 pots the same size, soil, cup measure, ruler, observation sheet, tape, clear bags, and water. Procedure: 1. Use a measuring cup/balance to place the same amount of soil into four different same-size pots. The same type of soil should be in each pot. (You can also put two plants under the same conditions) 2. Plant each plant to the same depth in a pot 3. Measure the height of each plant and place in the observation table 4. Add 240 ml of water to all the plants and place them in a place where they can all get sunlight.

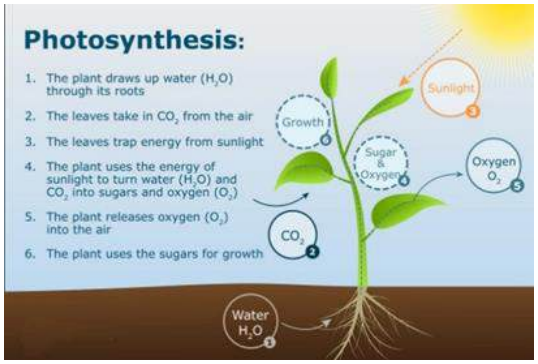
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		5. Place clear bags over two plants and tape them to the bottom of the pots. Zip-lock bags can also be used. 6. Measure the height of the plants after one week. 7. Water the plants with 250 ml water and record the height at the end of the week for 4 weeks. Record all measurements in the observations table. Learners will also draw a graph of their results. Sample Observation Table Plant / Height (cm): Start, Week 1, Week 2, Week 3, Week 4 A - Air B - Air C – No Air D – No Air After the groups have collected data over the past four weeks, the teacher will guide the learners in interpreting the data. The learners stick their completed observation table in their graphic organizer. Systematically collecting data is very important in carrying out the scientific process/method. The data will be used to tell us whether our guess is supported by the data we collect. In science, we use evidence from scientific investigations to create knowledge and solutions to problems around us. **Discussion of Results** Plants primarily get the materials for growth from the air and water. Air contains many gases. They include nitrogen, oxygen, carbon dioxide, and water vapour. Plant utilize the carbon dioxide in the air to make their food, in a process called

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		photosynthesis. The plants also use oxygen to generate energy. Sunlight provides the energy that is required to create food through photosynthesis. **Experiment #3: How does sunlight affect plant growth?** Materials: 4 plants the same size and age (learners can grow tomato or red bean plants in preparation for these experiments), 4 pots the same size, soil, cup measure, ruler, observation sheet, and water. Procedure: 1. Use a measuring cup/balance to place the same amount of soil into four different same-size pots. The same type of soil should be in each pot. (You can also put two plants under the same conditions) 2. Plant each plant to the same depth in a pot 3. Measure the height of each plant and place in the observation table 4. Add 250 ml of water to all the plants 5. Place two plants in a place where they can get a lot of sunlight. 6. Place two plants in a dark cupboard where they can get no sunlight. 7. Water the plants with the same amount of water at the same time every day for 3-4 weeks. 8. Measure the height of the plants each week (try to do it on the same day) and place the measurement in the results table. Learners will also draw a graph of their results.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Sample Observation Table  After the groups have collected data over the past four weeks, the teacher will guide the learners in interpreting the data. The learners stick their completed observation table in their graphic organizer and draw a line graph to show their results. **Experiment #4: How does soil affect plant growth?** Materials: 4 plants the same size and age (learners can grow tomato or red bean plants in preparation for these experiments), 4 pots the same size, loam, clay, sand, cup measure, ruler, observation sheet, and water. Procedure 1. Use a measuring cup/balance to place the same amount of loam, clay, and sand into three different same-size pots. 2. Label the pot with loam 'loam', the second pot with clay 'clay', and the third pot 'sand'. 3. Plant each plant to the same depth in a pot 4. Measure the height of each plant and place it in the observation table 5. Add the same amount of water to all the plants and place them in a place where they can all get sunlight.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		6. Water the plants every day for three weeks. Measure the height of the plants each week and place them in an observation table. Learners will also draw a graph of their results. Sample Observation Table  After the groups have collected data over the past four weeks, the teacher will guide the learners in interpreting the data. The learners stick their completed observation table in their graphic organizer. **Discussion of Results** Loam has the water and nutrients plants need to grow best. Plants in poor soils will struggle to grow, even if optimal water and light are available. Clay soil is sticky and doesn't have much air in it. It tends to hold a lot of water. It is not ideal for plant growth for this reason. Sand on the other hand does not hold any water and many plants will struggle to get the water and nutrients needed to grow. Extension: [The teacher can ask the learners to research the types of plants grown in clay and sand conditions. What adaptations do these plants have to ensure they survive in these types of soils? A farmer may also serve as a guest speaker and deliver a talk about growing different crops.]

Plant	Height (cm)				
	Start	Week 1	Week 2	Week 3	Week 4
A - Soil					
B - Clay					
C – Sand					

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Review of Photosynthesis  Retrieved from: https://www.hortidaily.com/article/9197158/faster-plant-growth-through-more-efficient-photosynthesis/ We get our energy from the food we eat. Plants do not get food in the same way as we do. Plants take materials from the environment around them, the carbon dioxide in the air, and water from the soil to make their food (photosynthesis). Plants use the energy from the sun to power the process of photosynthesis. The first product of photosynthesis is glucose (sugar). Light is not a material; it is energy. Leaf cells trap light energy and use it to convert water and carbon dioxide into sugar. The sugar is stored as chemical energy in the plant. When this process takes place, leaf cells release oxygen as a byproduct. This process is called photosynthesis.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Plants absorb water from the soil and take it in through their roots. The water travels up the stem and reaches the cells in the leaves where photosynthesis occurs most often. Plants must have water to invite the nutrients to be absorbed. The nutrients from the water are used to convert the sugar produced from photosynthesis to other essential substances such as proteins that the plants need. Plants invite carbon dioxide from the air to enter their leaves through tiny holes, and it enters the leaf cells. Without air, plants would be missing one of the ingredients necessary to create glucose. Reference: https://www.varsitytutors.com/5th_grade_science-help/support-how-plants-need-air-and-water-to-grow Let us watch a video that reviews how photosynthesis takes place in plants. As you watch, write done answers to the following questions: ● What are the raw materials needed for photosynthesis? (*carbon dioxide, water, sunlight*) ● How do they get these? (*water absorbed from roots; carbon dioxide from the air through the pores in the leaves*) ● What are chloroplasts? (*The place where photosynthesis takes place*) ● What is chlorophyll and its role in photosynthesis? (*green pigment found in the chloroplast of leaves, traps the sunlight necessary for photosynthesis*)

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		• How are the products of photosynthesis used? (*glucose used to make other food or stored; oxygen released into the atmosphere)* • Why are plants called the lungs of the world? (*They utilize carbon dioxide and produce the oxygen we need to breathe and respire*)  Retrieved from: https://www.youtube.com/watch?v=D1Ymc311XS8 (3:41 mins) **Experiment showing the oxygen created by the plants** Retrieved from: https://www.kids-fun-science.com/plant-experiments.html The Teacher can guide the learners to see the oxygen created by plants using this experiment. [Materials, procedure, and observation table can be accessed via the link]

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Growing Plants without Soil The Teacher will use the following picture to initiate a discussion on whether plants can grow in the absence of soil.  Retrieved from: https://letpot.com/en-ca/blogs/hydroponic-plant-growing-knowledge-and-tips/how-to-grow-hydroponic-cherry-tomatoes-indoors Learners, I saw a picture of a greenhouse where they were growing tomatoes all year round. But look at this picture. There is no soil, only water and air to grow the tomato. **Guiding Question: Can plants be grown without soil?** The learners can grow basil in water https://manoa.hawaii.edu/sealearning/sites/default/files/5LS_Plants%20Without%20Soil_Activity%20Sheet.pdf Learners can be engaged in lab work to investigate growing plants without soil (**Hydroponics**)using the link: https://www.sciencebuddies.org/science-fair-projects/project-ideas/PlantBio_p045/plant-biology/hydroponics-gardening-without-soil

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		So is soil necessary for a plant to survive, or can plants survive in just water? What if the water had all of the nutrients in it that soil does? Plants can survive without being planted in soil. The science of growing plants in nutrient-rich water is **hydroponics**. The word hydroponics means "working water" and comes from the Latin words hydro, meaning "water," and phonics, meaning "work." In hydroponics, the nutrients are available at the plant's roots. So, without any work, the plant gets its food and nutrition. A plant with roots in the soil has to work hard to extract its nutrition from the soil, and it can waste a lot of energy doing that. But a plant in nutrient-rich water can spend its energy growing bigger leaves, fruits, and flowers in a shorter amount of time. One benefit of growing plants hydroponically is that the nutrients in the water can be completely controlled, and the plant can receive exactly the right amount of nutrients at exactly the right time. Another benefit of hydroponics is that it works in areas where the soils are not arable (not suitable for farming) and in areas where there is no soil. **Air in Soil** We know that the soil usually contains nutrients for growth but there is something else about the soil that is very helpful for plant growth.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		<u>Seed Experiment as a Demonstration</u> Conduct a demonstration experiment for the learners. 1. Place a radish or lettuce seed in a cup of soil and add water to dampen the soil. Place the cup by the window in full sunlight. 2. Boil water to remove all gases and then let it cool. Place a seed in a cup of that water, then add 1 mL of vegetable oil and again put the cup in full sunlight. (repeat 1 & 2 above) in 2 more pairs of cups and talk about the importance of multiple trials in science) 3. Continue to add water to both soil and soil-less cups. The seeds will crack and begin to sprout. The seed in the water cup will sprout and leaves will remain covered with water and eventually die, whereas the soil cup will have a little plant growing. **This experiment can also be conducted with wet paper towels in zip lock bags) Ask learners what they noticed about the two cups? (*the soil plant lived and the water plant died.)*

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		 Retrieved from: https://www.giftofcuriosity.com/seed-experiment-3-do-seeds-need-air-to-grow/ Ask learners why they think the water plant died? (*no nutrients like the soil*) But we know that plants are sometimes grown with just water in greenhouses. They call that **hydroponics**. They must add nutrients to the water to help the plant grow. But learners, there is something else that is different. The water/oil that was added to the seed in the cup without soil kept air away from the leaves. Do you think maybe air is important for plant growth? In the cup of water, the plant had no access to carbon dioxide and limited access to the energy from the sun so it couldn't make food for itself. So what have we determined in this experiment?

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		· Plants need access to nutrients either through the soil or through water that has been supplemented with nutrients (hydroponics) · Plants need access to the sun because the energy is used to make food for the plant to grow (photosynthesis) Plants need access to air because it contains carbon dioxide which can be converted to glucose which is food for the plant. **Plants which grow without soil** There are some special plants which need trees for support. They do not harm the tree. Look at the photos below.  Retrieved from: https://cdn.britannica.com/50/5650-050-77351097/Epiphytes-orchids-roots-air-moisture-plants-hosts.jpg

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		 Retrieved from https://www.epicgardening.com/epiphytes/ Have you seen these plants before in your garden or in the community? (*yes / no*) Do these plants need soil to grow? (*yes/ no*) What do these plants need to grow? (*sunlight, air, water*) **Drawing Conclusions from experimental data and discussion of results. (Completion of Graphic Organizer)** This step of the scientific method/process provides a summary of what you found out by carrying out the scientific method/process. Each group will use these statements to write conclusions about the experiment and their hypothesis on an index card. The teacher will provide guidance.

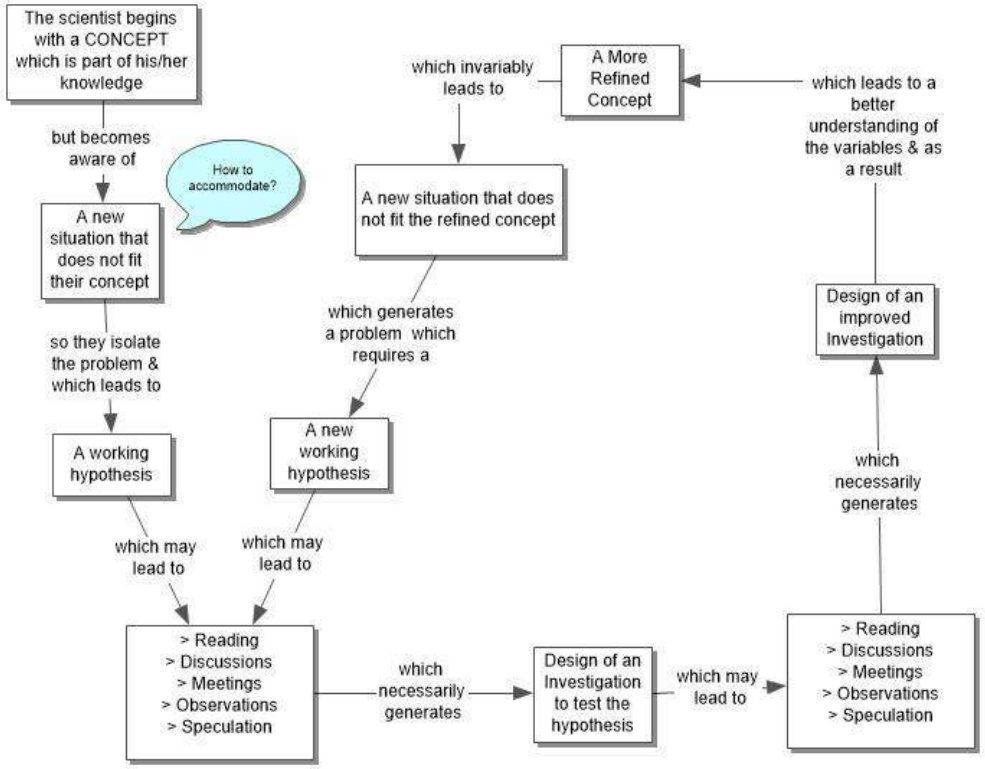
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		The data _____ (supported/did not support) my hypothesis. I found that _____. The index card with the conclusory statements will be added to the graphic organizer. **The Science Process Skills** Learners, we used science process skills when we engaged in the scientific process. The science process skills are the things scientists do when they study and investigate. Scientists use the science process skills to carry out the steps in the Scientific Method. Here are some of the science process skills that we used to find out about the materials plants need for growth [The teacher can play the video or create a chart on the six basic science process skills.]  Retrieved from: https://youtu.be/mJv9Mbq9eTM?si=BokD7a3Tg-LunZ0n (2:57 mins)

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Let us discuss: How did we use these science process skills in our investigations? **Observing** What part of our bodies do when we are observing our plants? (*our senses*) We use our senses to see, hear, smell and feel. This enables us to take down information about what we are observing. **Measuring** What did we measure about our plants? *(height*) Why? (*to tell us which one grew faster*) What did we use? *(ruler/ tape measure*) When we measure we use science instruments that can give accurate data that can help us explain what we are investigating. **Comparing** What did we compare in our investigations? (*Plants grown in different conditions*) Why? (*To see which one grows faster*) We compare things to see similarities and differences. **Classifying** People put things into categories based on their similarities and differences. This is what we do when we classify things. **Inferring** When we state an idea based on what we observe and measure, we are inferring.

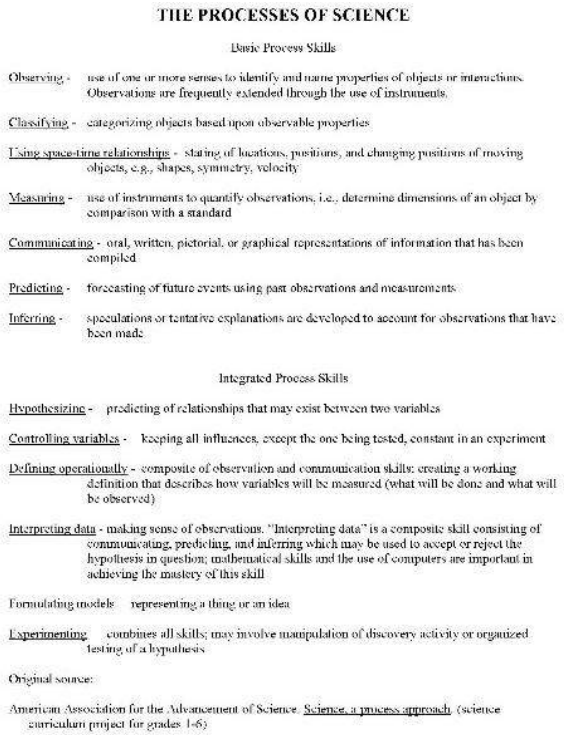
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Let's think about our experiment where we grew plants in the cupboard and some in direct sunlight. When we looked at their height measurements and observed how they looked over time, what were we able to say about the plants? (*Those in sunlight grew faster than those in the cupboard. Those in the cupboard were wilting*) This is inferring! Our observations invited us to come make those statements. When we infer we use our data to form conclusions about what we are studying. Can you think of other examples where the class used the science process skill inferring? (*conclusions made from the various experiments*) **Communicating** Scientists always share their findings. This enables other scientists to critique their work and verify their findings.

Additional Useful Content Knowledge for the Teacher:

Science as a Cycle of Investigation



Basic and Integrated Process Skills



THE PROCESSES OF SCIENCE

Basic Process Skills

Observing - use of one or more senses to identify and name properties of objects or interactions. Observations are frequently extended through the use of instruments.

Classifying - categorizing objects based upon observable properties

Using space-time relationships - stating of locations, positions, and changing positions of moving objects, e.g., shapes, symmetry, velocity

Measuring - use of instruments to quantify observations, i.e., determine dimensions of an object by comparison with a standard

Communicating - oral, written, pictorial, or graphical representations of information that has been compiled

Predicting - forecasting of future events using past observations and measurements

Inferring - speculations or tentative explanations are developed to account for observations that have been made

Integrated Process Skills

Hypothesizing - predicting of relationships that may exist between two variables

Controlling variables - keeping all influences, except the one being tested, constant in an experiment

Defining operationally - composite of observation and communication skills; creating a working definition that describes how variables will be measured (what will be done and what will be observed)

Interpreting data - making sense of observations. "Interpreting data" is a composite skill consisting of communicating, predicting, and inferring which may be used to accept or reject the hypothesis in question; mathematical skills and the use of computers are important in achieving the mastery of this skill

Formulating models - representing a thing or an idea

Experimenting - combines all skills; may involve manipulation of discovery activity or organized testing of a hypothesis

Original source:

American Association for the Advancement of Science. Science, a process approach. (science curriculum project for grades 1-6)

Controlled Experiments

https://www.khanacademy.org/science/biology/intro-to-biology/science-of-biology/a/experiments-and-observations

Additional Resources and Materials

How plants use water: https://extension.wvu.edu/lawn-gardening-pests/news/2021/03/01/how-plants-use-water

Activities on plant and air: https://kidsgardening.org/wp-content/uploads/2020/11/Plant-Needs-Air-3.pdf

What plants need to grow: https://letstalkscience.ca/educational-resources/backgrounders/needs-plants
https://www.varsitytutors.com/5th_grade_science-help/support-how-plants-need-air-and-water-to-grow
https://thewonderofscience.com/mlsep72
https://thewonderofscience.com/mlsep71
https://www.sciencebuddies.org/science-fair-projects/project-ideas/PlantBio_p045/plant-biology/hydroponics-gardening-without-soil
https://teaching.betterlesson.com/lesson/633008/where-do-plants-get-the-materials-they-need-day-1-gathering-evidence-to-support-your-claim
https://www.education.com/download/worksheet/70188/photosynthesis-fill-in-the-blank.pdf

Type of Air plants
https://www.youtube.com/watch?v=21MryORNtCw
https://www.youtube.com/watch?v=VUX0VXLY-o8

Worksheets:
https://education.gov.gy/web2/index.php/learners-resources/primary-school-resources/grade-5/grade5-worksheets/grade-5-worksheets-science/5991-grade-5-science-week-6-2022-consolidated-worksheet/file
https://www.liveworksheets.com/w/en/science/778199

Opportunities for Subject Integration

Mathematics: Measuring plant growth using various instruments, for example measuring tape. Graph data on plant growth to identify patterns and trends.
Social Studies: The use of technology in growing plants before and now.
Language Arts: Writing a simple expository paragraph explaining the process of photosynthesis.
TVET: creating various designs for a simple hydroponics farm or other gadgets that can be used to grow plants, for example seed boxes.
Agriculture: Conducting experiments to find out which soil type is best for plant growth example, which soil retains the most water? Undertaking a project and creating a simple hydroponics farm.
Health: Safe practices when using substances like fertilizers in the growing of plants to avoid pollution and damage to the body.

Elements from Local Culture, Technology, TVET, Environment that are integrated

Researching how plants were grown in the past and the technology used now in plant production. Research various method of plant propagation such as air layering, placing cutting in water to grow roots etc.
Visiting farms which are using modern technology, for example greenhouses, hydroponics and vertical columns
Researching on the effects of climate change/global warming on the growing of plants.
Researching GMOs and drought resistant crops.

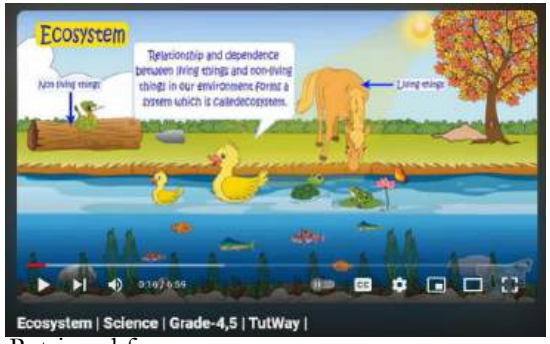
Items of Inspiration (teaching tips, inspirational passages, connections to educational research)

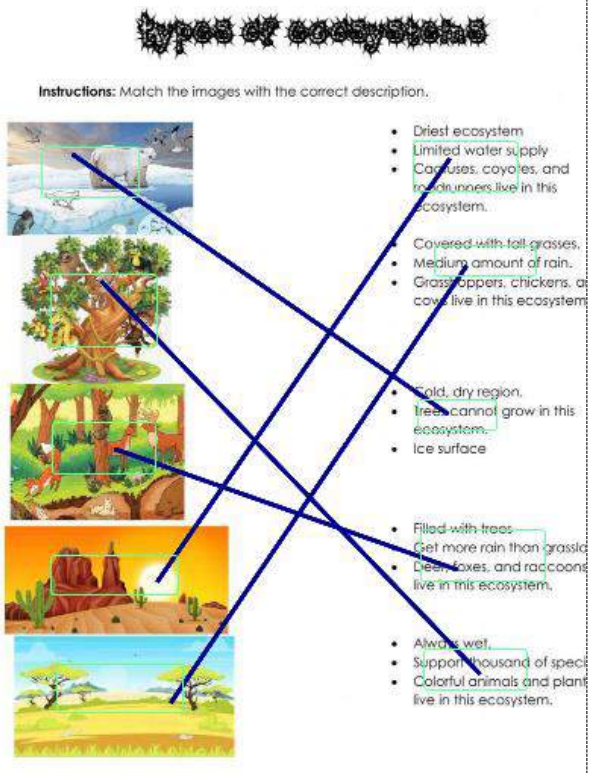
How The Scientific Method Inspired My Teaching Approach retrieved from chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://files.blogs.illinois.edu/files/1499/180076/103545.pdf

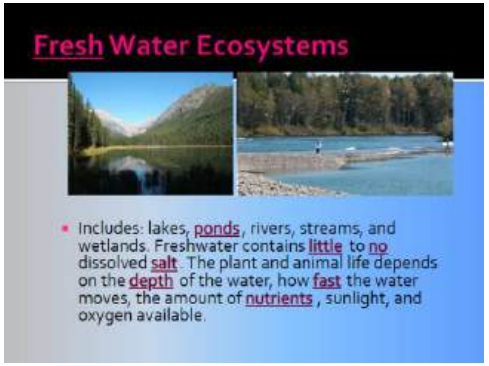
Essential Learning Outcome 3: Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

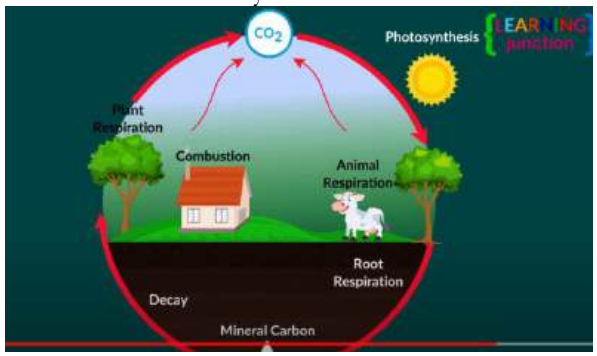
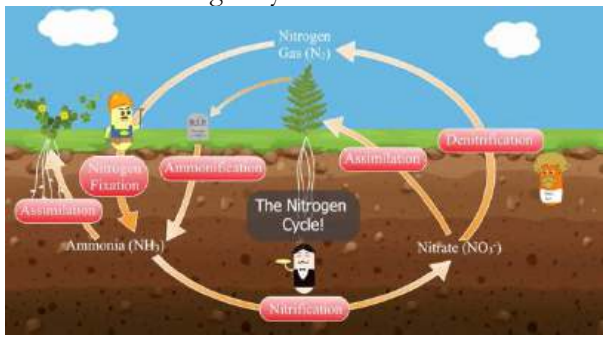
Clarification Statement: Emphasis is on the idea that matter that is not food (air, water, decomposed materials in soil) is changed by plants into matter that is food. Examples of systems could include organisms, ecosystems, and the Earth.
Assessment Boundary: Assessment does not include molecular explanations.
Grade Level Expectation: Refer to grade level expectations at the beginning of this curriculum document.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Learners are expected to: **<u>Knowledge</u>** Define the terms: • Ecosystems • Habitat • Fresh water ecosystem • Marine ecosystem • Terrestrial ecosystem • Energy transfer • Fertilize • Decompose • Bacteria • Fungi • Nutrients • Decomposers • Recycling • Compost • Herbivore • Carnivore • Invasive species	**Reviewing the Anchor Text Salamander Room** **Ask learners these questions:** ➢ Describe the habitat that the boy was trying to recreate in his room. ➢ What type of an ecosystem did the salamander live in? ➢ As an ecosystem, outline some of the relationships between the plant and animals. ➢ While the boy was well-intentioned, what could be done to better protect the salamanders' natural habitat? **Transfer of Energy & Recycling Matter in my Ecosystem** On a single page, have learners describe and draw a diagram of how plants and animals recycle matter and transfer energy in their own island ecosystems. Rubric:	**Introduction** Learners, ecosystems are great recyclers! What do you think I mean by that? A hint…think about how plants use the sun to grow, gather water from the water cycle and take nutrients from the soil and then what? (*they get eaten by animals or they die and fall to the ground*). That is a part of it for sure but what happens after that? Today we are going to talk about how the recycling continues! Let us do a review first. What can you tell me about ecosystems? *1) Different types depending on climate* *2) Inter-connected with producers and consumers* *3) They involve food chain which are susceptible to changes* *4) We have to care for them otherwise they can be disrupted*

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Describe features of a fresh-water ecosystem. Describe the features of a marine ecosystem. Describe the features of a terrestrial ecosystem. Account for the importance of plants within an ecosystem. Describe how does energy transfer to ecosystems originate at the sun? **Skills** Classify ecosystems as terrestrial, freshwater and marine Describe your own ecosystem Describe how does energy transfer to ecosystems originate at the sun? Interpret an anchor text (Salamander Room) Communicate effectively when working in groups	➢ comprehensive inclusion of plants and animals 5 marks ➢ neat and logical diagram 5 marks ➢ grammar and punctuation in description of the model diagram 5 marks Look at the worksheet "Types of Ecosystems" below. Click on the link, read each description and match it to the correct picture.  Retrieved from: https://www.liveworksheets.com/w/en/science/1191601	**What is an Ecosystem? Introduction** The ecosystem is an amazing place filled with exciting creatures. Let us review what an ecosystem includes by watching a short YouTube ® video.  Retrieved from: https://www.youtube.com/watch?v=SYNEjBvPkps (6:09 minutes) To further elaborate and engage the learners in a discussion on ecosystems, the book "The Salamander Room" will be viewed highlighting how the main characters try to create an ecosystem. 

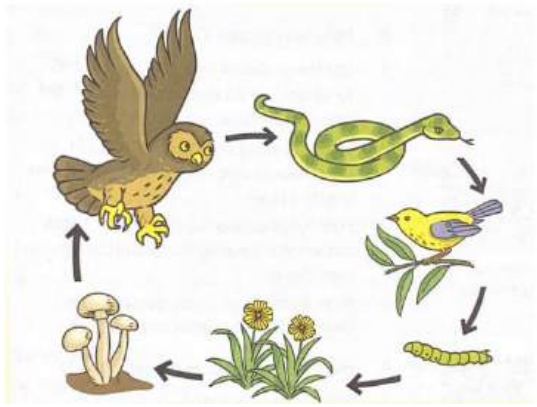
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Construct models of the different ecosystems **Attitudes/Values** Work collaboratively in groups to complete given tasks. Stewardship/Respect for Living Things When conducting practical and group work, display sensitivity and offer assistance to peers who may have physical or learning challenges Participate actively in classroom discussions.	**Answer Sheet**  Retrieved from: https://www.liveworksheets.com/w/en/science/1191601	Retrieved from: https://www.youtube.com/watch?v=hZrtzCA9pmY (3:18 mins) **Alternative Introduction** Have learners view the short clip of Lion King seen in the link below: The Lion King 3D - 'Morning Lesson With Mufasa'- Official Disney Movie Clip (youtube.com) (1:13 mins) The Teacher will ask learners the following questions: 1. What is the key message of Mufasa's speech? *everything in an ecosystem is important; life is recycled; everything is connected* 2. What did Mufasa mean when he said: "When we die we become the grass?" *We decompose and become food for the grass.* 3. Can you create the food chain described by Mufasa? *grass → antelope → lion* **Different types of Ecosystems** Ecosystems vary. There are three broad categories of Ecosystems. Can you identify them? (the learners will list them - fresh water, marine and terrestrial)

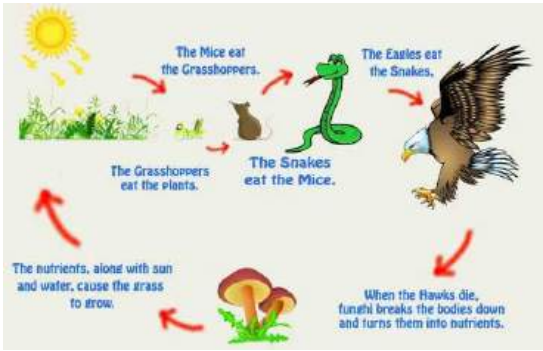
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	Project We have learnt that there are many types of ecosystems. Below is a model of an ecosystem and a video to guide you. You are free to try another type of ecosystem you are comfortable with. Retrieved from: https://www.youtube.com/watch?v=SpSev_Bf8uc **Sample ecosystem project**  Retrieved from: https://i.ytimg.com/vi/SpSev_Bf8uc/sddefault.jpg **Differentiated Instruction** For those learners who are particularly interested in agriculture, you may want to assign a PowerPoint® presentation project where they present to their classmates about two related processes in the recycling that happens in ecosystems- namely:	The teacher will then explain that each of these types of ecosystem can hold a huge variety of living conditions (**habitats**) **Freshwater Ecosystems** include wetlands, ponds, reservoirs, lakes, rivers and groundwater. Freshwater is an ideal resource as it can be used for lots of things, including agriculture, sanitation and transportation. Plus, freshwater is drinkable and helps to sustain a huge variety of organisms, including reptiles, birds, mammals, worms, fish and amphibians. Plants, phytoplankton and algae are all in abundance too and form the skeleton of the freshwater food cycle.  Excerpt from slides at: https://slideplayer.com/slide/7765872/ **Ocean Ecosystems** cover around 70 per cent of the Earth's surface. Included amongst marine ecosystems are the oceans, coral reefs and coastal areas. These ecosystems differ from freshwater as the water contains salt. Plants and animals living amongst these types of ecosystems must therefore be tolerant of salt. Many fish, such as flounder, sea bass, whales and

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	➢ The carbon cycle  Retrieved from: https://www.youtube.com/watch?v=p3R-dB9K4ss (3:28 mins) ➢ The nitrogen cycle  Retrieved from: https://www.youtube.com/watch?app=desktop&v=uip4Q6t7yfQ (5:53 mins)	dolphins are examples of the diverse animal life found in the ocean ecosystem.  Excerpt from slides at: https://slideplayer.com/slide/7765872/ **Terrestrial Ecosystem** is a network of plants, animals and other organisms that live on an area of land. These ecosystems endure great movements in temperature, which the lifeforms must adapt to or be tolerant of. Terrestrial environments include grasslands and forests and provide many of the items which humans need to survive. These include food and materials for shelter or clothing. 

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Excerpt from slide at: https://slideplayer.com/slide/7765872/ Now that we have refreshed our memories, we will now select an ecosystem we are comfortable with and create a model depicting the relationship among abiotic and biotic factors which help create food chains and food webs. In today's session, we will do a quick review as a class in order to refresh our memory. **Energy Transfer and Decomposers: A Review** Let's start off with an example of energy transfer using cows and goats. *(Cows and goats get energy to live by eating grass that has grown because of rain and energy from sunshine. This is **energy transfer.)*** As humans we get energy by eating meat and vegetables. When animals, like cows process food, they create waste. The manure can be used to **fertilize** the growth of more plants. This is a cycle of plants being eaten and also being grown again. Plants that die and begin to break down are said to **decompose**. This decomposition is assisted by **bacteria** and **fungi** (e.g. mushrooms). This puts **nutrients** back into the soil. (see soil nutrients here https://www.soils4teachers.org/lessons-and-activities/teachers-guide/soils-food-health)

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Decomposers Some plants and animals are decomposers. Decomposers are responsible for **recycling** materials within ecosystems. They feed on dead and waste matter causing it to **decompose**. During this process, they release carbon dioxide and minerals into the environment which can be reabsorbed and re-used by plants. Decomposers include fungi, bacteria and some kinds of worms. Retrieved from: Caribbean Primary Science Level 6 2024. Contributors Karen Morrison, Lorraine DeAllie, Lisa Greenstein, Catherine Jones. Hodder Education One product of decomposition is called **compost.** This broken-down vegetable matter can also be used for fertilizer to grow more plants. In many industries (e.g. cocoa and nuts) when they remove shells to access the desired food, the shells are often recycled as fertilizer. (The teacher will draw the food chain on the board and engage the learners in a short discussion, where they will answer a few assigned questions.)

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		 Retrieved from: Caribbean Primary Science Level 6. 2024 Impression Number 10 Contributors Karen Morrison, Lorraine DeAllie, Lisa Greenstein, Catherine Jones, Hodder Education. **Questions** a. Look at the diagram above. What name is given to the diagram? *(Ans. Food chain)* b. Identify the type organisms in the diagram. *(Ans.* ***herbivore-*** *grasshopper,* ***carnivore*** *– rat, carnivore – snake, carnivore- eagle)* c. Look at the mushroom in the picture. To which group of organisms does it belong? *(Ans. Decomposers)* Decomposers are organisms that break down or feed on dead and decaying matter or organisms.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Put on your thinking caps, can you list a few examples of decomposers? (*Ans: worms, bacteria, sowbugs, mushrooms)* Now that you know a little more about decomposers, explain why you think that decomposers are important in a food chain or ecosystem. *(Ans: When the decomposers break down the dead matter it acts or serves as nutrients that are absorbed by plants as food.)*  Retrieved from: https://medium.com/@kitchenem/why-are-decomposers-important-to-the-food-chain-health-tips-e42591753f5c **Interrupting a Food Chain** A picture of the above will be posted on the board or shown on the screen. Invite the learners a few seconds to observe the picture and ask the following questions.

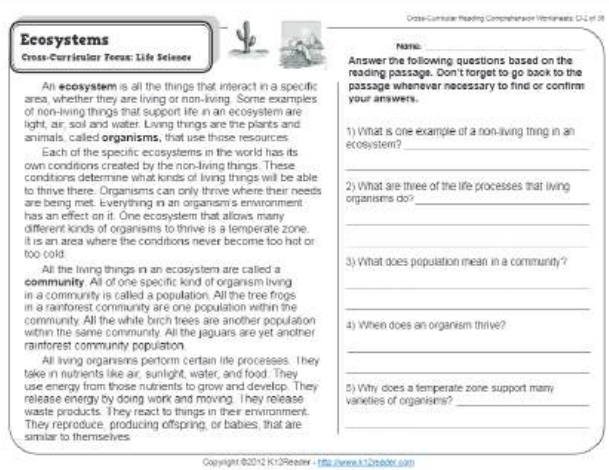
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		1. What might happen to this ecosystem as a result of bringing in monkeys? (*the cycle / chain would be interrupted, and some species will die off for lack off food)* 2. What would happen if humans began killing the eagles or eating all the mushrooms? *the cycle / chain would be interrupted, and some species will die off for lack off food)* **<u>Activity</u>** As part of a class project, the learners will construct a school houmous (compost) pile to create fertilizer for a small garden on the school grounds. *(The food grown can be used by the kitchen for the school feeding program)* They can: ● Designate a location ● Create information posters to direct their peers to add organic matter to their pile ● Dig a growing plot to use their decomposed fertilizer ● Creating a Compost pile instructions: https://www.youtube.com/watch?v=Q5s4n9r-JGU (5:19 min)

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Steps to creating a compost  Retrieved from: https://www.notsomodern.com/how-to-compost/

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Conclusions From Our Learning About Ecosystems as Recyclers • Plants get water, nutrients and energy from sunshine in order to grow. • Plants are eaten by animals who then produce waste • Waste supplements the soil and replaces some if the nutrients, fertilizing the soil • Plants die and fall to the ground • Plants decay and such things as fungi, bacteria and insects further break the plant down to replace nutrients in the soil • Rich soil invites for seeds to grow into plants with the warmth of the sunshine and moisture from the water cycle. That is how some matter and energy is recycled through ecosystems!

Additional Useful Content Knowledge for the Teacher

Caribbean Primary Science Level 6 2024 Impression 4. Contributors Karen Morrison, Lorraine DeAllie, Lisa Greenstein, Catherine Jones. Hodder Education. (Living in an ecosystem page 68 - 74)



Ecosystems

Cross-Curricular Focus: Life Science

Name:

Answer the following questions based on the reading passage. Don't forget to go back to the passage whenever necessary to find or confirm your answers.

An **ecosystem** is all the things that interact in a specific area, whether they are living or non-living. Some examples of non-living things that support life in an ecosystem are light, air, soil and water. Living things are the plants and animals, called **organisms**, that use those resources.

Each of the specific ecosystems in the world has its own conditions created by the non-living things. These conditions determine what kinds of living things will be able to thrive there. Organisms can only thrive where their needs are being met. Everything in an organism's environment has an effect on it. One ecosystem that allows many different kinds of organisms to thrive is a temperate zone. It is an area where the conditions never become too hot or too cold.

All the living things in an ecosystem are called a **community**. All of one specific kind of organism living in a community is called a population. All the tree frogs in a rainforest community are one population within the community. All the white birch trees are another population within the same community. All the jaguars are yet another rainforest community population.

All living organisms perform certain life processes. They take in nutrients like air, sunlight, water, and food. They use energy from those nutrients to grow and develop. They release energy by doing work and moving. They release waste products. They react to things in their environment. They reproduce, producing offspring, or babies, that are similar to themselves.

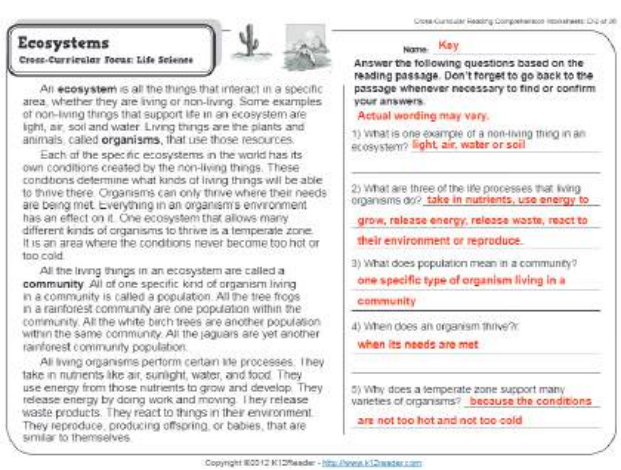
1) What is one example of a non-living thing in an ecosystem? _____

2) What are three of the life processes that living organisms do? _____

3) What does population mean in a community? _____

4) When does an organism thrive? _____

5) Why does a temperate zone support many varieties of organisms? _____



Ecosystems

Cross-Curricular Focus: Life Science

Name: Key

Answer the following questions based on the reading passage. Don't forget to go back to the passage whenever necessary to find or confirm your answers.

Actual wording may vary.

An **ecosystem** is all the things that interact in a specific area, whether they are living or non-living. Some examples of non-living things that support life in an ecosystem are light, air, soil and water. Living things are the plants and animals, called **organisms**, that use those resources.

Each of the specific ecosystems in the world has its own conditions created by the non-living things. These conditions determine what kinds of living things will be able to thrive there. Organisms can only thrive where their needs are being met. Everything in an organism's environment has an effect on it. One ecosystem that allows many different kinds of organisms to thrive is a temperate zone. It is an area where the conditions never become too hot or too cold.

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All living organisms perform certain life processes. They take in nutrients like air, sunlight, water, and food. They use energy from those nutrients to grow and develop. They release energy by doing work and moving. They release waste products. They react to things in their environment. They reproduce, producing offspring, or babies, that are similar to themselves.

1) What is one example of a non-living thing in an ecosystem? light, air, water or soil

2) What are three of the life processes that living organisms do? take in nutrients, use energy to grow, release energy, release waste, react to their environment or reproduce.

3) What does population mean in a community? one specific type of organism living in a community

4) When does an organism thrive?: when its needs are met

5) Why does a temperate zone support many varieties of organisms? because the conditions are not too hot and not too cold

Question

Name two microorganisms which act as decomposer? How is this activity useful to us?

Solution

Decomposer:

1. **Decomposers** are the microbes which degrade the complex organic molecule to simpler form.
2. Microbes like bacteria and fungi play an important role as decomposers.
3. The decomposers convert dead organic matter into rich humus, thereby enriching the soil with nutrients.
4. Bacteria like *Rhizobium* are present in the root nodules which basically fix the atmospheric nitrogen and convert it into usable forms like ammonia, nitrates etc.

Benefits by decomposers:

1. Bacteria and fungi help in the process called **biodegradation**.
2. Bacteria also remove pollutants from the soil called **bioremediation**.
3. Both fungi and bacteria help in metabolizing the hazardous waste from industries, farms, and cities and oil spills.

Retrieved from: https://byjus.com/question-answer/name-two-microorganisms-which-act-as-decomposer-how-is-this-activity-useful-to-us/

Additional Resources and Materials

Composting Tips: https://www.oregonmetro.gov/tools-living/yard-and-garden/composting/tips-composting-success

Using Sargassum Seaweed as Fertilizer, Biofuel or Food? : https://phys.org/news/2023-05-food-fertilizer-fuel-solutions-caribbean.html

Compare fertilizer use across the Caribbean nations in kg per hectare of arable land:
https://data.worldbank.org/indicator/AG.CON.FERT.ZS?end=2021&locations=XJ&skipRedirection=true&start=1961&view=chart

Opportunities for Subject Integration

Mathematics: Designing graphs to show living things in an ecosystem example number of animals, plants etc.
Social Studies: Identifying the different types of ecosystems in their country.
Language Arts: Write descriptions about various ecosystems. Write a paragraph about if there were no decomposers.
TVET: Constructing models of ecosystems.
Agriculture: Identifying the importance of decomposers in the environment.
Health: Research ways ecosystems can be polluted and ways it can be reduced.
Art and Craft: Learners can design models of the various ecosystems.

Elements from Local Culture, Technology, TVET, Environment that are integrated

Families from rural communities, "the country" often dispose of kitchen waste in the backyard where it can decompose and later be used as soil for the kitchen garden.

6 Steps To Start An Organic Compost Program At Your School https://cleanriver.com/resource/6-steps-start-organic-compost-program-school/

Items of Inspiration:

Research on reasons as to what may cause ecosystems to change over time.

Earth Systems

Introduction to the Subject

The study of science encompasses knowledge, processes and values. Scientifically literate persons will foster an attitude of caring not only for themselves, but as responsible citizens, for the world around them. Their decision making will be enhanced by a systematic study of the structure and behaviour of the physical and natural world through observation and experiment. In learning science, learners benefit from leveraging and evaluating available technological tools to study and therefore understand the world and their relationship to it.

Strand: Earth Systems

Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes.
Understanding the scope of the earth's resources and the systems that cycle and maintain those resources, is instrumental in humans being good stewards of the environment.

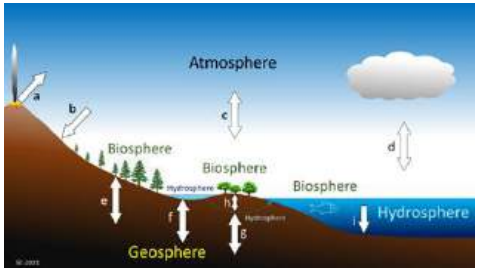
Essential Learning Outcome 1: Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

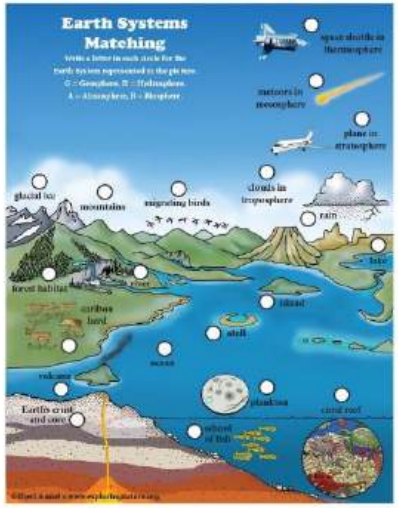
Clarification Statement: Clarification Statement: Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere, and biosphere are each a system.

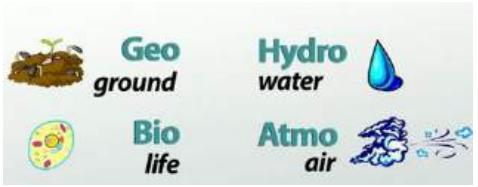
Assessment Boundary: Assessment is limited to the interactions of two systems at a time.

Grade Level Expectations: Refer to grade level expectations at the beginning of this curriculum document.

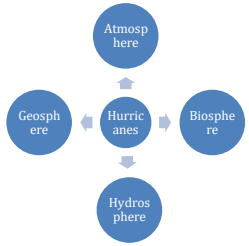
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Learners are expected to: **<u>Knowledge</u>** Define the terms: • Hydrosphere • Biosphere • Geosphere • Atmosphere • Lithosphere • Lava • Pyroclastics • El-Nino Identify the characteristics of each of the four spheres. Give examples of how earth system spheres can interact. Identify within pictures, the four spheres that comprise Earth system science. **<u>Skills</u>** Rationalize how real earth events can impact the 4 spheres. Construct models of earth systems	**Video Resource: Introduction of Systems** While the earth system is one sphere, it comprises several distinct spheres that are all interconnected. As they watch the video (https://www.youtube.com/watch?v=N3EqcUNdIl8 (7:47 mins), learners should write down their definitions of: 1. Biosphere 2. Geosphere 3. Hydrosphere 4. Atmosphere Learners should also look for answers to the following questions: *1)* Why does the atmosphere have so much carbon dioxide now compared to many years ago? (*burning fossil fuels)* 2) How does atmospheric carbon dioxide become part of the biosphere? (i)*added to calcium, it forms calcite, which contributes to the shells of organisms* (ii). *Carbon dioxide from the atmosphere becomes part of the biosphere mainly through the process of photosynthesis, where plants convert it into food and oxygen. During photosynthesis, plants take in carbon dioxide and, using sunlight and water, convert it into glucose (food) and oxygen.*	Learners, have you ever thought about how vulnerable living things like humans, animals and plants are to the earth's natural processes? Earth events can have alarming effects that go beyond what we initially anticipate, impacting often many of the earth systems. Take for example, volcanos in the Caribbean and worldwide. Learners, describe your experience when La Soufriere erupted in Saint Vincent and the Grenadines. Was your community impacted-explain how. In the first instance, we have a great fear of the molten rock that presents as **lava** and **pyroclastics** (airborne molten rock). These are very dangerous components of what we call the **geosphere.** But the clouds of dangerous gases travel into the air and affect also the **atmosphere** which we ultimately breath. In island and coastal nations that eruption can impact water temperature and wildlife that make up the **hydrosphere**. Residing near the eruption, means all living things (**biosphere**) can experience necessary relocation from their ecosystem, damage to habitat or death. In our next few lessons we are going to look at the different earth systems but also consider how they necessarily interact. **Reviewing the Earth Systems** The diagram below gives details about the interaction of spheres for the teacher. Note that sometimes, the geosphere is called the **lithosphere.**

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Research how earth events can affect earth sphere systems. Investigate how volcanoes and hurricanes can impact earth sphere systems. Compare the impact of mountain ranges on wind patterns and cloud formation by constructing a model that demonstrates how these landforms influence atmospheric conditions and local climates. Interpret models of earth systems. Assess potential impact of spheres on humankind Classify components of earth's systems as geosphere, atmosphere, biosphere and hydrosphere. Communicate their understand through models, written work and presentations Predict how changes to one earth system affect another. Construct graphic organizers that compare sphere interaction.	3) How does the calcite contribute to the geosphere? (*The shells, coral, limestone, etc., die and get compacted into the soil in the earth's geosphere)* 4) What % of the water on earth is salt water oceans? *(~97%)* 5) How does the atmosphere interact with the biosphere? (*Through photosynthesis carbon* **Video Resource: Interaction of Spheres** After watching the video*:* https://www.youtube.com/watch?v=hXZPRocjXsU *(5:49 mins), your task is to identify at least three ways the different spheres interact.* *The water cycle is the movement of water between the hydrosphere (oceans, rivers, lakes) and the atmosphere (air). Water evaporates from the surface of oceans, lakes, and rivers into the air (atmosphere) as water vapour. It then cools and condenses to form clouds. Eventually, it falls back to the Earth as precipitation (rain, snow), replenishing the water in rivers, lakes, and oceans (hydrosphere).* *Nitrogen fixation in legumes is a natural process where nitrogen-fixing bacteria convert atmospheric nitrogen into a form that plants can use. This process enriches the soil with essential nutrients. In agriculture, planting legumes and practising crop rotation are key strategies for maintaining soil fertility, reducing the need for chemical fertilisers, and promoting sustainable farming practices.*	 Retrieved from: https://environmental-geology-dev.pressbooks.tru.ca/wp-content/uploads/sites/73/2021/07/figure-1.2.1.png The labelled interactions of Figure 1.2.1 can be summarised as follows: 1. During a volcanic eruption, gases (including H_2O, CO_2 and SO_2) from the geosphere mix with the atmosphere, while volcanic rock fragments (ash) remain suspended in the atmosphere for a short time (weeks). Atmospheric gases (especially Carbon Dioxide (CO_2), water (H_2O) and oxygen(O_2) react with rocks of the geosphere during weathering (an example is provided below). 2. There is an exchange of gases between the biosphere and the atmosphere because of photosynthesis, in which CO_2 in the atmosphere combines with H_2O to produce glucose ($C_6H_{12}O_6$) and O_2, and respiration, in which glucose combines with O_2 to produce CO_2 and H_2O and energy. 3. There is an exchange of water via evaporation and condensation and of liquid water as rain between the hydrosphere and the atmosphere. 4. Components of the biosphere (e.g., plants) extract chemicals (e.g., phosphorous, potassium, magnesium, sulphur and

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Investigate how human interactions impact earth systems **<u>Attitudes/Values</u>** Demonstrate an understanding that the spheres work together and it is our responsibility to care for our earth systems. Demonstrate an understanding that earth events can cause big problems with our earth sphere systems and we need to be prepared to mitigate hose problems in our everyday life. Consistently ask questions and clarifications during investigations including questions that exhibit the desire to do follow up activities Work effectively in groups, accepting responsibility for their part in the task-its success and failure. Understand that all animals in the biosphere play a part in the community and should be treated with care, attention and respect. As we construct models, accept and obey safety precaution warnings and help to explain to others why such warnings are important	**Earth System Matching** Learners write a letter in each circle for the earth system represented in the picture below.  **Retrieved from** https://www.exploringnature.org/db/view/Earth-Systems-Matching-Geosphere-Hydrosphere-Atmosphere-Biosphere **Quiz on Biosphere, Geosphere, Atmosphere, and Hydrosphere** 1. What is the biosphere? a) The part of Earth where life exists b) The layer of gases surrounding Earth c) The solid part of Earth d) The water on Earth's surface	calcium) from the geosphere, and in turn deposit material that gets incorporated into the geosphere. 5. There are two-way chemical transfers between the rocks of the geosphere and the surface water of the hydrosphere (for example, some elements in rocks dissolve into surface water during weathering and then may be deposited from surface water to form new rocks). 6. There are two-way chemical transfers (including elements such as calcium, potassium, sodium, sulphur and carbon) between the rocks of the geosphere and the groundwater of the hydrosphere. 7. There are two-way chemical transfers between groundwater and the biosphere. 8. Components of the biosphere (especially carbon-bearing organic matter) and the hydrosphere accumulate as sediments (geosphere) on the floor of the ocean (and lakes). After discussing, the teacher will place learners into four groups. Each group will be given the task of researching a system. Learners can use books, magazines, and computers/computer labs to assist with the research. Each group will be given chart paper or manilla paper. Learners explore various materials found in the different spheres to be able to describe and define each sphere. The teacher will provide learners with the following questions to guide the research: 1. What does the prefix on your word mean? • Hydro- • Geo- • Bio- • Atmo-

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Understand human impact on earth's system and how it can be mitigated. When conducting practical and group work, display sensitivity and offer assistance to peers who may have physical or learning challenges. When conducting practical and group work, display sensitivity and offer assistance to peers who may have physical or learning challenges. Participate actively in classroom discussions.	2. Which of the following is part of the geosphere? a) Rivers and lakes b) Plants and animals c) Mountains and rocks d) Air and clouds 3. What makes up the atmosphere? a) Rocks and minerals b) Living organisms c) Water in rivers and oceans d) Gases like oxygen and nitrogen 4. The hydrosphere includes: a) All the rocks on Earth b) All the air surrounding Earth c) All the water on Earth d) All the living things on Earth 5. What is the main gas found in the atmosphere? a) Oxygen b) Nitrogen c) Carbon dioxide d) Hydrogen 6. Which of the following is a part of the biosphere? a) A mountain b) A river c) A cloud d) A tree	 Retrieved from: https://study.com/learn/lesson/the-four-spheres-of-earth-geosphere-hydrosphere-biosphere-atmosphere.html 1. Where is your system located? 2. What makes up your system? 3. Are there numbers or data related to your system? 4. How does your system impact us? https://betterlesson.com/lesson/resource/3210509/guiding-questions Each group will present their findings as they become experts in the systems researched. **Interactions Between Spheres** In groups, learners should be asked to create a labelled diagram of how two or more spheres may interact through earth systems and processes. Groups are expected to share their diagrams (including an explanation) with their classmates. **The Place of Humans in the Biosphere and Beyond** Learners think about the humans in the biosphere and how our actions impact all of Earth's spheres. In a one-page response paper, they should explain how the behaviour of people in their own country have dramatically and negatively impacted one or more spheres. Their paper should end in a description of how

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	7. What does the geosphere consist of? a) Only the Earth's surface b) The Earth's core, mantle, and crust c) The Earth's water bodies d) The Earth's atmosphere 8. Which sphere interacts with the geosphere to cause weathering of rocks? a) Biosphere b) Atmosphere c) Hydrosphere d) All of the above 9. Rain and snow are part of which sphere? a) Geosphere b) Biosphere c) Hydrosphere d) Atmosphere 10. Which sphere is affected by deforestation? a) Geosphere b) Atmosphere c) Hydrosphere d) Biosphere Answers 1. a) The part of Earth where life exists 2. c) Mountains and rocks 3. d) Gases like oxygen and nitrogen 4. c) All the water on Earth 5. b) Nitrogen 6. d) A tree 7. b) The Earth's core, mantle, and crust 8. d) All of the above	citizens could work together to mitigate impacts on the environment. **The Hydrosphere and Climate** There is growing evidence that water temperatures within the Caribbean are increasing. This not only poses potential harm to marine animal habitat but is an example of how the hydrosphere can affect the atmosphere. Explain to learners the **El-Nino** affect on climate **Quoted** verbatim from: (https://en.wikipedia.org/wiki/El_Ni%C3%B1o%E2%80%93Southern_Oscillation) "**El Niño–Southern Oscillation (ENSO)** is a global climate phenomenon that emerges from variations in winds and sea surface temperatures over the tropical Pacific Ocean. Those variations have an irregular pattern but do have some semblance of cycles. The occurrence of ENSO is not predictable. It affects the climate of much of the tropics and subtropics, and has links (teleconnections) to higher-latitude regions of the world. The warming phase of the sea surface temperature is known as *El Niño* and the cooling phase as *La Niña*. The Southern Oscillation is the accompanying atmospheric oscillation, which is coupled with the sea temperature change."

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	9. c) Hydrosphere 10. d) Biosphere **Modelling the Spheres** Creating a 3D model of the water cycle can be a fun and educational project for learners to understand how water moves through Earth's spheres (atmosphere, hydrosphere, geosphere, biosphere). Below is a step-by-step guide to create a simple yet effective 3D model using materials commonly found at home or in the classroom. Materials Needed: • Large Styrofoam® or cardboard sphere (as the base) • Modelling clay or play-dough • Blue cellophane or coloured paper • Small plastic trees, plants, or figurines • Cotton balls or polyester fibrefill • Craft glue, tape, scissors • Markers or coloured pencils • Optional: Toothpicks, thin wire, or string for creating connections Steps to Create the 3D Water Cycle Model: 1. Prepare the Base Sphere: • Use a large Styrofoam® or cardboard sphere as the base for your model. This represents the Earth. 2. Represent the Geosphere: • Landforms: Use modelling clay or play-dough to create mountains, hills, valleys, and other landforms on the surface of the sphere.	**Formative Assessment Labelled Web of Hurricanes** Have learners draw a labelled web of the impact hurricanes have on the different spheres you have discussed.  ***Possible Interactions*** Hurricanes: • Cause the atmosphere to generate great winds and often extensive rainfall • Cause damage to the geosphere by promoting erosion due to high winds damaging plants and high water levels causing flooding • Cause big changes in waterways (hydrosphere) through flooding and overflow of river banks • Cause damage to living things where high winds can change habitat and kill living things (biosphere) **Humans Impact Earth Systems** Teacher should engage a discussion of the behaviour of humans, in caring for the earth, can have negative impact on the spheres that make up earth systems. The learners should brainstorm and offer suggestions. The Teacher notes: • *Polluting atmosphere* • *Polluting hydrosphere* • *Poor water-use practises*

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	• Labelling: Use markers or coloured pencils to label these landforms directly on the sphere as "Geosphere." 3. Depict the Biosphere: • Plants and Trees: Place small plastic trees, plants, or figurines on the landforms you created with clay. • Labelling: Label these plants and trees as "Biosphere." 4. Create the Hydrosphere: • Water Bodies: Use blue cellophane or coloured paper to create rivers, lakes, and oceans on the surface of the sphere. • Labelling: Label these water bodies as "Hydrosphere." 5. Represent the Atmosphere: • Clouds and Sky: Use cotton balls or polyester fibrefill to create clouds around the sphere, representing the atmosphere. • Labelling: Label this area as "Atmosphere." 6. Show Interactions: • Arrows or Connections: Use toothpicks, thin wire, or string to create arrows between the different components (geosphere, biosphere, hydrosphere, atmosphere) to show interactions. For example: o Arrows from the atmosphere (clouds) to the biosphere (plants) to represent rain. o Arrows from the hydrosphere (rivers) to the geosphere (soil) to show water infiltration.	• *Mining that impacts geosphere* • *Deforesting that impacts biosphere* • *Extinction of habitats in the biosphere* • *Climate change due to greenhouse effects*

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	7. Add Labels and Explanations: • Use small pieces of paper or cardstock to write labels for each sphere (geosphere, biosphere, hydrosphere, atmosphere). • Write brief explanations of the interactions and attach them near the corresponding arrows or spheres.  **Mountain Range Model – Geosphere Interacting with Atmosphere** Learners will explore how mountain ranges impact wind patterns and cloud formation through research and multimedia resources. 3D Model Construction: o Using materials such as foam, cotton balls, and markers, learners will construct a model that shows how mountains affect atmospheric conditions. Comparison Presentation: o Learners will compare the weather patterns on the windward and leeward sides of	

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	mountain ranges and explain the differences in cloud formation and precipitation. ***Rubric for Assessment***: 1. Model Accuracy and Detail: • Excellent (4): Model accurately depicts the interactions between spheres with detailed and realistic features. • Good (3): Model accurately depicts the interactions with some detail. • Fair (2): Model depicts interactions with minimal detail and some inaccuracies. • Needs Improvement (1): Model lacks accuracy and detail. 2. Comparison Analysis: • Excellent (4): Comparison is thorough, well-explained, and supported by detailed examples. • Good (3): Comparison is clear and supported by examples. • Fair (2): Comparison is mentioned but lacks depth and supporting examples. • Needs Improvement (1): Comparison is unclear or missing. 3. Creativity and Presentation: • Excellent (4): Model is highly creative, well-organized, and effectively presented. • Good (3): Model is creative, organized, and clearly presented. • Fair (2): Model shows some creativity and organization but is somewhat unclear. • Needs Improvement (1): Model lacks creativity, organization, and clarity.	

<table>
<tr><th>Specific Curriculum Outcomes</th><th>Inclusive Assessment Strategies</th><th>Inclusive Learning Strategies</th></tr>
<tr><td></td><td>
4. Collaboration and Participation (if group work):

Excellent (4): All group members actively participated and collaborated effectively.
Good (3): Most group members participated and collaborated effectively.
Fair (2): Some group members participated and collaborated.
Needs Improvement (1): Few group members participated or collaborated.

The Far-Reaching Impact of Earth Events: Volcanoes
Have learners conduct internet research to identify how each of the earth's systems were impacted by the occurrence of a volcano which initially involves the geosphere.
<table>
<tr><td>Country</td><td>Research</td><td>Impacted earth systems</td></tr>
<tr><td>SVG</td><td>https://www.youtube.com/watch?v=Q-JY6uxpbIQ</td><td></td></tr>
<tr><td>Montserrat</td><td>https://www.youtube.com/watch?v=ESYjE2FVGT4</td><td></td></tr>
<tr><td>Iceland</td><td>https://www.youtube.com/watch?v=gzeNb2Wa-kM</td><td></td></tr>
<tr><td>New Zealand</td><td>https://www.youtube.com/watch?v=qzaFejmPEvU</td><td></td></tr>
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Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	Learner groups would be assigned one of these volcanoes and create a PowerPoint® or media presentation (poster) where they explained the event and spoke to how the geosphere ultimately impacted the hydrosphere, atmosphere and biosphere. ***Rubric***: evidence of research 5 marks/quality of explanation 5 marks/quality of media resources 5 marks/grammar & punctuation 5 marks	

Additional Resources and Materials

Earth System Models for Children to Construct**:**
https://www.youtube.com/watch?v=4_wp1YlXaaQ (1:37 mins)
https://countonkupe.com/earths-sphere-interactions-modeling-in-science/
https://x.com/SarahKrauseOPS/status/1162810414482284546

Additional Useful Content Knowledge for the Teacher

Earth Systems:
https://education.nationalgeographic.org/resource/earths-systems/
https://scied.ucar.edu/learning-zone/earth-system
https://www.sciencelearn.org.nz/resources/3274-earth-systems-and-climate-change

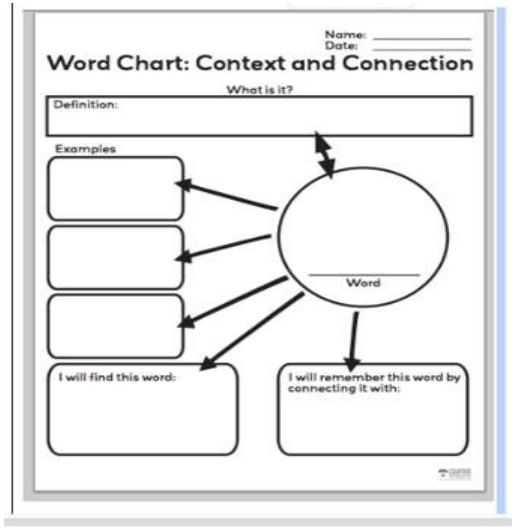
Opportunities for Subject Integration

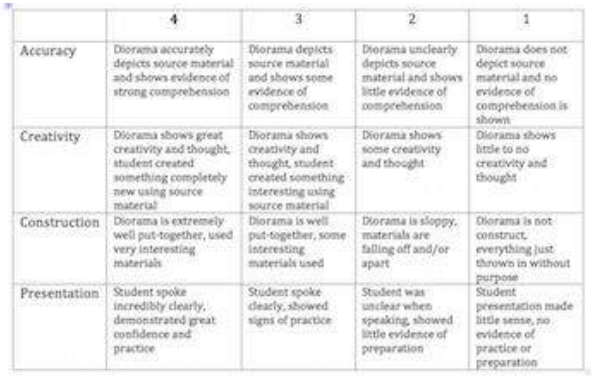
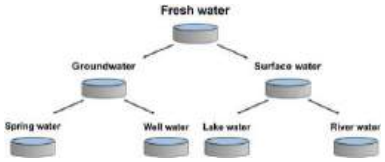
Social Studies: care of the different spheres is a responsibility of citizens and initiatives to protect our environment are great social causes.
Mathematics: researching statistics around damage to the environment (all spheres)
Language Arts: researching information and communicating information in different formats
TVET: building models/ technologies that monitor earth systems

Essential Learning Outcome 2: Describe and graph the amounts of salt water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.

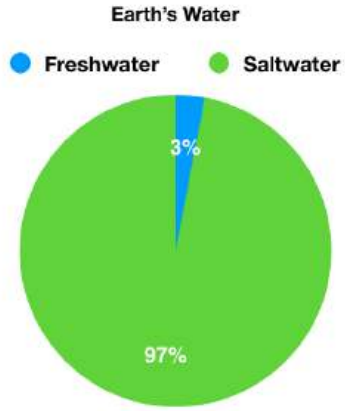
Assessment Boundary: Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.
Grade Level Expectations: Refer to grade level expectations at the beginning of this curriculum document.

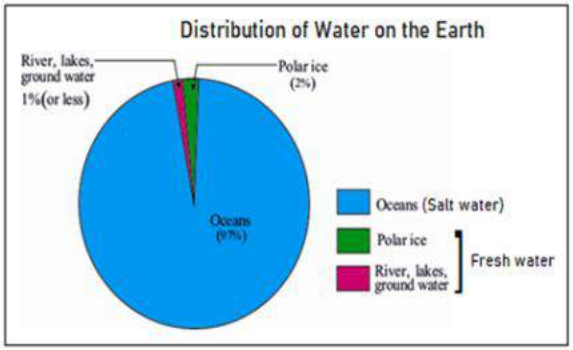
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Learners are expected to: **<u>Knowledge</u>** Define the terms: • ocean • lakes • streams • rivers • pipes • ponds • springs • reservoirs • glaciers • polar ice cap • estuary • density • conservation • desalination Demonstrate they understand the water cycle.	**Water Source Description** Learners complete this table after viewing and discussion on water sources They use water sources relevant to their own countries Source of water | Description | Form (solid, liquid, gas) E.g., ocean | Contains large amounts of salt | liquid **Working with Vocabulary** Teachers can use the graphic organizer below to check for comprehension of terminology associated with water sources and uses**.**	**Introduction** **Learner**s are each given a clear cup containing water They are told; Learners, what you have in front of you is the most important liquid in the whole world. Let's observe it. Learners look at, smell and finally drink their cup of liquid, which they identify as water. Learners briefly discuss why water is the most important liquid. They are asked, Where do you think the water, you just drank, came from? They name the different sources of water *(pipes, river, lake, well, pond, spring).* Sometimes we call water sources like lakes or ponds or dammed up water **reservoirs**. What you probably were less familiar with is the quantity of water that is stored in the oceans (salt water), **glaciers & polar ice caps** (fresh water).

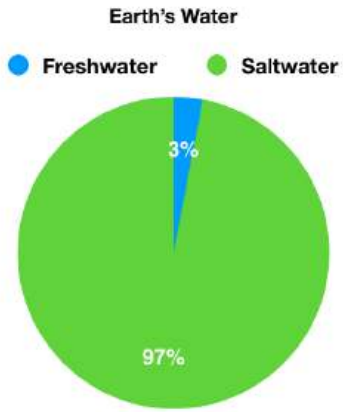
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Account for differences in freezing points of fresh and salt water based on experimental observations. Explain the process of desalination. Identify the main sources of water for your community & country Distinguish the chemical difference between fresh and saltwater Identify bodies of water that contain fresh or saltwater. Demonstrate awareness that a large portion of fresh water on earth originates in the ice that makes up the glaciers, ice bergs and polar ice cap. Describe how humans make use of earth's water resources. Demonstrate awareness that estuaries are unique points of contact of fresh and salt water that potentially have impact on habitats. **<u>Skills</u>** Classify water sources. Make predictions about water distribution on earth.	 Name: Date: Word Chart: Context and Connection What is it? Definition: Examples Word I will find this word: I will remember this word by connecting it with: **Retrieved from**: https://www.pinterest.com/pin/340584790569110462/ **Models of Water Sources: Make a Diorama** The teacher can access simple materials such as paper, plasticine, sticks, pipe cleaners etc. and pose a list of requirements for the diorama to display such as: ➢ Three sources of water ➢ Realistic habitat ➢ Evidence of water cycle	They are shown posters or PowerPoint® media of various water sources. They discuss any one they did not previously identify.  Retrieved from: https://media.geeksforgeeks.org/wp-content/uploads/20231108114717/Sources-of-Water.png  **Retrieved from:** https://i.pinimg.com/originals/11/6b/c5/116bc567a5f04e5c273dc2fea219b311.png

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Make predictions about the relative distribution of fresh and saltwater on earth, Interpret the data for distribution of both fresh and salt water on earth. Graph available data for distribution of water by source. Conduct experiments that distinguish the properties of fresh and salt water. Infer from experiments that density of objects (like eggs & potatoes) determines how they will behave in fresh and salt water. Research information on water use in communities. . Communicate community initiatives to conserve water. Investigate information around engineering approaches to access fresh water. **<u>Attitudes/Values</u>** Explain the importance of taking care of our fresh water sources and conserving water.	Sample Diorama  **Retrieved from**: https://i.ytimg.com/vi/sbPaPDqatp0/maxresdefault.jpg **Sample Scoring Rubric for Diorama**  **Retrieved from**: https://study.com/academy/lesson/diorama-rubric-tips.html	**Fresh and Salt Water: Sources** They identify sources of each type of water  **Retrieved from**: https://www.researchgate.net/publication/321585727/figure/fig1/AS:1144354739630080@1649846839105/Freshwater-drinking-sources.ppm  **Retrieved from:** https://www.teacharesources.com/wp-content/uploads/2020/03/11634-Fresh-Water-and-Salt-Water-Sources-300x215.png

	4	3	2	1
Accuracy	Diorama accurately depicts source material and shows evidence of strong comprehension	Diorama depicts source material and shows some evidence of comprehension	Diorama unclearly depicts source material and shows little evidence of comprehension	Diorama does not depict source material and no evidence of comprehension is shown
Creativity	Diorama shows great creativity and thought, student created something completely new using source material	Diorama shows creativity and thought, student created something interesting using source material	Diorama shows some creativity and thought	Diorama shows little to no creativity and thought
Construction	Diorama is extremely well put-together, used very interesting materials	Diorama is well put-together, some interesting materials used	Diorama is sloppy, materials are falling off and/or apart	Diorama is not construct, everything just thrown in without purpose
Presentation	Student spoke incredibly clearly, demonstrated great confidence and practice	Student spoke clearly, showed signs of practice	Student was unclear when speaking, showed little evidence of preparation	Student presentation made little sense, no evidence of practice or preparation

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Explain ways that communities are working to maintain and conserve water sources. Investigate the impact of estuaries on the biosphere. Collaboration & Cooperation within group activities. Stewardship/Respect for Living Things Safety in using tools and processes for building models When conducting practical and group work, display sensitivity and offer assistance to peers who may have physical or learning challenges. Participate actively in classroom discussions.	**Classification of Water Sources** Have learners show their understanding of pie charts by answering the following questions:  **Retrieved from**: https://vt-vtwa-assets.varsitytutors.com/vt-vtwa/uploads/problem_question_image/image/90852/Screen_Shot_2020-07-01_at_9.15.58_AM.png 1. What does the green represent? 2. What does the blue represent? 3. What percentage of earth's water is saltwater? 4. What percentage of Earth's water is freshwater? 5. How much more salt water is there than freshwater? *Answers: 1. Saltwater, 2. Freshwater, 3. 97%, 4. 3%, 5. 94% more*	Learners write a top ten list for the ways they use water and which type of water they use They can discuss which type of water source is most commonly used for everyday activities **Where is the Water on Earth**? Learners identify the oceans/water sources on a globe or world map. Ask Learners: *Can you identify how much of earth's water is salt? Fresh?* *Can you identify the sources of each?* Call on volunteers to share ideas. Collect probability data related to the amount of earth's water by gently tossing an inflatable globe from learner to learner, recording each time the right thumb lands on water. (Tally in a given table.) Toss the ball to the learner and ask them to say where their thumb landed. Instruct learners to record the type of water in a data table…. Continue until every learner has at least one chance to catch the globe. Sample Table: **Data Collecting and Probability Globe Toss** **Predict** | Land | Salt Water | Fresh Water | Frozen Water **Actual** | Land | Salt Water | Fresh Water | Frozen Water

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	Place these sources of water under the correct heading Fresh water | Salt water **Lake, Sea, River, Spring Ocean, Stream** **Multiple Representations of Data**  **Retrieved from**: https://media.cheggcdn.com/study/e65/e65cdd32-b832-4a05-b352-58024b82daa5/4918-3-1rq-i1.png To help learners understand the relative distribution of fresh water, have them take the data from the pie chart and make a bar graph showing percentage on the y axis (ordinate) and type of water on the x axis (abscissa)	**How is the Water Distributed Across the Globe?** Ask Learners: *What have you learned about water distribution on earth?* *What does this knowledge cause you to wonder about?* Show five gallons of water in an aquarium tank or bucket to learners and tell them "Let's say this is all the amount of water in the world." Ask Learners: What percentage of this water is available to all living things? (Less than 1 drop) What percentage of this water do you think is salt water? Explain that 97% of earth's water is located in oceans. Now ask learners what percentage of this bucket do you think is fresh water? Remove 3% of the water from the bucket. One at a time, remove from the clear container each amount as called by learners and record in a table as shown below: **Source** | **Remove from 2.8% fresh water container** 2.00% is found in icegcaps/glaciers | 1 cup | 250 mL 0.62% is found in ground water | 1/3 cup | 79 mL 0.009 is found in fresh water lakes | 1/8 teaspoon | 0.6 mL 0.008 is found in inland seas/salt lakes | 1/8 teaspoon | 0.6 mL 0.001 is found in atmosphere | 1 drop 0.0001 is found in rivers | 1 flick

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	<u>Activity Worksheets for Fresh Water/Saltwater Experiments</u> **How does food colouring react with fresh and saltwater?** **Prediction**: What do you think will happen when food colouring is added to fresh water? **Prediction**: What do you think will happen when food colouring is added to saltwater? **Observations**: What did you see happening? Freshwater | Saltwater Why do you think the food colouring reacted the way it did? **Does an egg float or sink in fresh and saltwater?** **Predictions:** What do you think will happen to the egg in freshwater? **Predictions:** What do you think will happen to the egg in saltwater? **Observations:** What did you see happening?	 **Retrieved from**: https://vt-vtwa-assets.varsitytutors.com/vt-vtwa/uploads/problem_question_image/image/90852/Screen_Shot_2020-07-01_at_9.15.58_AM.png ***Demonstration***: Teacher shows learners a measuring cylinder containing 1000 ml of water coloured blue. Two other measuring cylinders are placed on the table in front of them. Teacher says, Learners, I will now pour water from my cylinder into these two cylinders. One will have all the saltwater on Earth and the other will get all the freshwater. Which one do you think will have more? Learners respond giving predictions and explanations Teacher then pours 970 ml into the saltwater cylinder and 30 ml into the fresh water cylinder Learners discuss the accuracy of their predictions

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies

Freshwater	Saltwater
Explain why your observations occurred	

Mixing salt and freshwater	
Colour of freshwater	Colour of saltwater
Prediction: What do you think will happen? Use your knowledge of colour mixing.	
Observation 1: After fresh water is placed on saltwater	
Observation 2: After glasses have been flipped for the first time	
Observation3: After second flip of glasses	
Observation 4:	

Retrieved from: https://1.bp.blogspot.com/-Xm4aUNovP6g/WmCrOsDo-HI/AAAAAAAAI8s/Lymevy4BkUoRrcIFURMcHU8Bfdc22JaewCLcBGAs/s1600/P1430467.jpg

Ask Learners:
What have you learned about water distribution on earth?
What does this knowledge cause you to wonder about?

Supplemental Video Resources on Water Bodies and Freshwater
https://www.youtube.com/watch?v=bNWuQD7QHBc (3:47 mins)
https://www.youtube.com/watch?v=oaQCiwzjnCM (4:16 mins)

Review the Water Cycle

Learners, do you remember the water cycle? It describes how water moves on Earth. Let's review by watching a video
See:
https://www.youtube.com/watch?v=IO9tT186mZw (2:53 mins)

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies

Does fresh or saltwater freeze faster?

Hypothesis: I think _____water will freeze faster

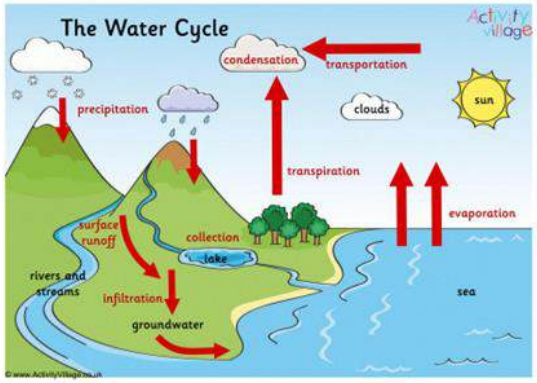
Provide an explanation for your results

Freshwater observation sheet

Place a tick to show where your liquid is at each time interval

Write the temperature at each time

	20 mins	40 mins	60 mins	80 mins	100 mins	120 mins
Liquid						
Starting to freeze						
Hard on top						
Frozen						
Temperature						



Retrieved from: https://www.activityvillage.co.uk/the-water-cycle

Fresh and Saltwater Experiments

In many island and coastal countries fresh water and saltwater mix with land run-off in the form of rivers and streams entering the ocean.

These mixing points are often referred to as **estuaries**.

Understanding the properties of these types of water (including density) is important with regard to future science studies around ocean currents and habitat changes for marine life.

Divide learners into groups so they can cycle through 5 experiment centres.

Set up the entire experiment area with the following items for each group

1 beaker/ clear jar containing fresh water (water from tap)

1 beaker/ clear jar containing salt water (2 tablespoons salt to 1 cup water)

1 egg

1 small potato

2 colours of food colouring

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies

Saltwater observation sheet

Place a tick to show where your liquid is at each time interval

Write the temperature at each time

	20 mins	40 mins	60 mins	80 mins	100 mins	120 mins
Liquid						
Starting to freeze						
Hard on top						
Frozen						
Temperature						

Responding to Water Shortages

Engineering Solutions
Because the majority of water exists on earth in the form of salt water, it is no surprise that humans have tried to develop technologies to remove the salt.

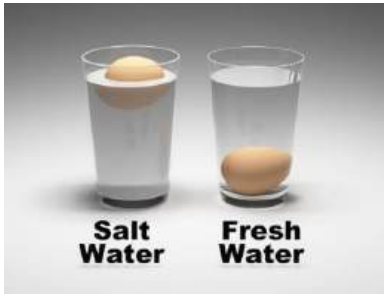
2 smaller clear glasses
½ sheet of cardstock
Thermometer
Cellophane tape
Observation record sheets
Access to a freezer is also needed
Paper towels for cleanup

Experiment 1
How does food colouring react with fresh and saltwater
First invite learners to fill in the prediction section of their observation sheet
Steps:

1. Pour salt water into one of the small glasses and freshwater into the other to about 1 inch from the rim
2. Add 3 drops of food colouring into the salt water
3. Repeat for the freshwater glass with the same colour
4. Observe the reaction for 1 minute
5. Record observations

Retrieved from:
https://i.ytimg.com/vi/W5MY3SJvrCY/maxresdefault.jpg

Why the difference?
https://www.youtube.com/shorts/u6opOMYVGk8
(*The food colouring is less dense than salt water so it sits on top!)*

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	Learners should conduct research using the links below to look at simple ways individuals have solved this problem as well as industrial-scale approaches. In groups they should prepare a poster that outlines these two approaches and be prepared to explain it to classmates. Primary sources: https://www.youtube.com/watch?v=AawLiTT2m9s https://ig7.ir/en/reverse-osmosis-ro/ Rubric: ➢ Clarity of poster information 5 marks ➢ Quality of information sources presented 5 marks ➢ Quality of presentation 5 marks ➢ Grammar and punctuation 5 marks **Responding at Home and in the Community** In essay format, learners will write a two-page researched essay that responds to the following questions: ➢ What are the main water sources in your community? ➢ What is the water consumption data that is publicly available for your country? ➢ What are the conservation approaches that your community currently uses? ➢ In general, how is water used in your home; categorize types of uses as low consumption, medium consumption, high consumption.	**Experiment 2** **Does an egg float or sink in fresh and saltwater?** **Does a potato float or sink in fresh and saltwater** Invite learners to record their predictions on the observation sheets Steps: 1. Gently drop the egg into the beaker/ clear jar containing fresh water 2. Record your observation 3. Remove the egg and dry off with paper towels 4. Gently place egg into the beaker/ clear jar of saltwater 5. Record your observations 6. Repeat steps 1 - 5 using the potato  **Retrieved from**: https://qph.cf2.quoracdn.net/main-qimg-7d6cb800cb1e3d41f3ba3b63237b8865 (*The egg is more dense than fresh water so it sinks but less dense than salt water so it floats/ The potato sinks in fresh water because it is more dense and floats on salt water because it is less dense; see also: https://www.youtube.com/watch?v=ClbkGhW5jAk*)

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	➢ What ways can your household better conserve water? ➢ What ways could your school better conserve water? ➢ What new initiatives could you imagine, as a concerned citizen, that would help your community to be more conscious of our water resources and ways to be responsible about it use? **Sample Rubric for Essay** **RUBRICS FOR ESSAY**  RUBRICS BY JENNY TUAZON BSE_MATH **Retrieved from**: https://www.slideshare.net/slideshow/rubrics-in-essay/29222266	**Experiment 3** **How do differences in density of fresh and salt water affect mixing?** Steps: 1. Colour the beaker of saltwater using food colouring (e.g. blue) 2. Colour the beaker of freshwater using a different colour (e.g. yellow) 3. Invite learners to record their predictions on observation sheets 4. Pour each type of water into a separate glass up to the rim 5. Place cardstock on the glass containing the freshwater so it forms a seal 6. Turn upside down and place over the glass containing saltwater 7. Remove the cardstock so there is nothing preventing the waters from mixing 8. Observe what happens where the waters meet 9. Take a photo 10. Hold both glasses firmly so no water spills and rotate them (glasses can also be taped around with cellophane tape 11. Observe again and take another photo 12. Repeat steps 10 and 11 until they have been mixed thoroughly 13. Record observations on sheet

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		 **Retrieved from**: https://www.science-sparks.com/wp-content/uploads/2013/08/density-water-trick-1024x1024.jpg (explanation : *Adding salt to water increases its density, so the less dense plain water sits on top. The two don't mix see: https://www.science-sparks.com/magic-and-density/*) **Experiment 4** **Does fresh or saltwater freeze faster?** Invite learners to record a hypothesis on their observation sheet Steps: 1. Fill one plastic container of saltwater and the other of freshwater 2. Measure the temperature of each water sample 3. Place both containers in the freezer 4. Check each container every 20 minutes and record observations in the data tables provided 5. Measure the temperature each time and record it

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		 **Retrieved from**: https://i0.wp.com/thehomeschooldaily.com/wp-content/uploads/2023/06/Screenshot_232.png?fit=446%2C280&ssl=1 *Explanation:* *Saltwater freezes at a lower temperature than fresh water. Adding any solute to a water will reduce its freezing point or raise its boiling point.* *The individual particles that make up salt (known as ions) arrange themselves around the water molecules. In doing so, they shield the water molecules from interactions among themselves, making it less likely that they will find each other and form ice. Quoted verbatim from:* *https://salinity.oceansciences.org/learn-more.htm?id=12*

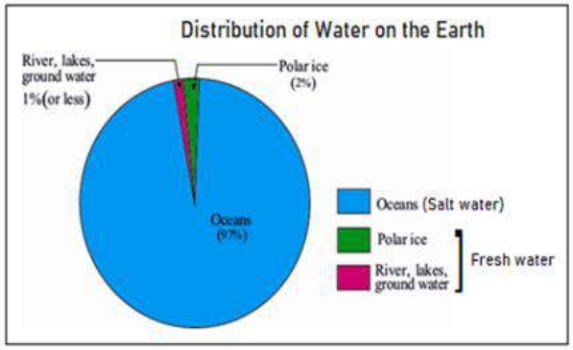
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies

Using Our Water Responsibly

Have learners fill in the table based on their community use of water.

Top ten list for water use	
Use	**Type of water**
E.g. 1. Bathing	Freshwater
E.g. 2. Diving	Saltwater
3.	
4. etc.	

Show learners this pie chart and make the point that the 3% of earth's water is fresh yet we only have access to 1% for drinking because 2% is stored as ice in glaciers and ice caps)



Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Retrieved from: https://media.cheggcdn.com/study/e65/e65cdd32-b832-4a05-b352-58024b82daa5/4918-3-1rq-i1.png Knowing that only a very small amount of the earth's water is available for us to use, what are some of the ways we care responsibly for this small amount of water? Have learners make a list of possible measures conservation. (*prevent water pollution, cut waste of wash water, recycle grey water, collect rainwater, prevent dumping of industrial effluent in rivers and streams*) The teacher should designate a poster in the classroom to put the learners' ideas in an effort to encourage water resource management initiatives.

Additional Resources and Materials

Water Distribution:
https://www.youtube.com/watch?v=e-FoTmQVL5c (1:45 mins)
https://www.youtube.com/watch?v=oaQCiwzjnCM (4:16 mins)
https://www.youtube.com/watch?v=GxqvvAaW9MQ (8:39 mins)

Water Consumption/Conservation
https://www.sdg6data.org/en/region/Latin%20America%20and%20the%20Caribbean
https://www.youtube.com/watch?v=6yCAPAqXodc (4:52 mins)
https://www.youtube.com/watch?v=JyzvcrZIuf0 (3:29 mins)

Additional Useful Content Knowledge for the Teacher

Common Sources of Drinking Water

Retrieved from: https://drowwater.com/the-ten-most-common-sources-of-drinking-water/

Opportunities for Subject Integration

Mathematics: interpretation and construction of graphs of water data (e.g. distribution, consumption, costing)
Social Studies: responsible use of water; politics of access to water sources including diversion of waterways and indigenous land use
Language Arts: Researching, reading and communicating issues around water access and use.
TVET: Design of models to showcase water sources; technologies for capturing water; desalination of saltwater

Elements from Local Culture, Technology, TVET, Environment that are integrated

Water collection systems.
Water conservation initiatives.
Presentations from local inventors or other resource plants on desalination units/plants

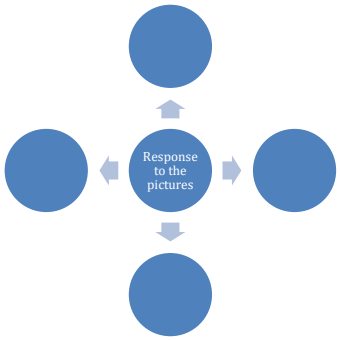
Items of Inspiration

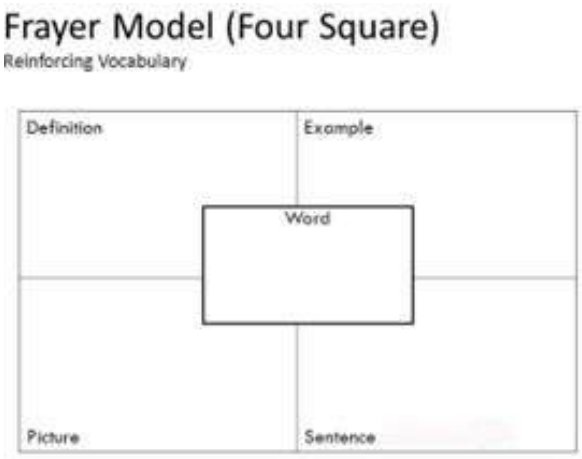
Water consumption and conservation are citizen responsibilities. Children at a young age should be made aware of the importance of a sustainable water supply.

Essential Learning Outcome 3: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

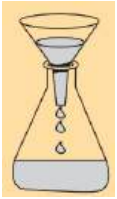
Grade Level Expectations: Refer to grade level expectations at the beginning of this curriculum document.

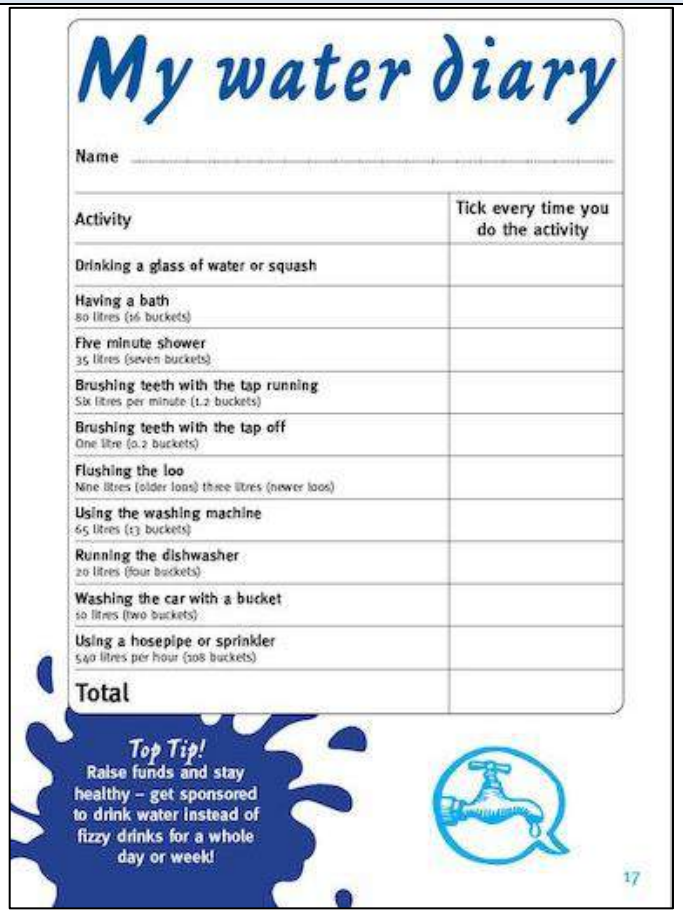
Specific Curriculum Outcomes	Specific Curriculum Outcomes	Specific Curriculum Outcomes
Learners are expected to: **<u>Knowledge</u>** Define the terms: • Polluting • Environment • Conservation • Turbid • Reservoirs • Water diary • Consumption • Atmosphere • Humid • Acid rain • Environmental destruction • Clean air • Environmental activists • Scrub • Solid waste • Industrial effluent • Fracking • Phosphate detergents	**Sorting Recyclable versus Non-recyclable Waste** "**solid waste** means any garbage or refuse, sludge from a wastewater treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, resulting from industrial, commercial, mining, and agricultural operations, and from community activities. Nearly everything we do leaves behind some kind of waste." Retrieved verbatim from: https://www.epa.gov/hw/criteria-definition-solid-waste-and-solid-and-hazardous-waste-exclusions The following excerpt classifies materials as recyclable:	**Our Environment** Learners should be shown the following pictures of a typical scene in the Eastern Caribbean.  

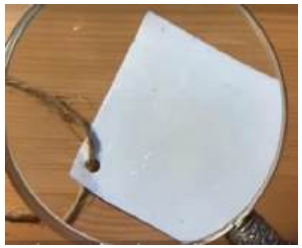
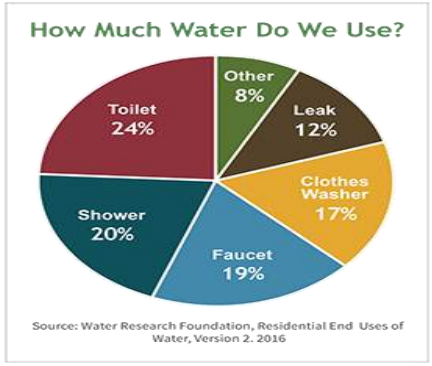
Specific Curriculum Outcomes	Specific Curriculum Outcomes	Specific Curriculum Outcomes
• Plastic recycling • Fossil fuels State properties of clean air and describe conditions of air e.g. hot, cold, sticky. (ST 1 ESS ER 4) Define the term solid waste, identifying methods of managing this waste in home/school/community (recycling, composting etc.) (ST 2 LS ECS 23) Define the term environmental destruction and investigate the factors that cause and prevent this destruction. (ST 2 LS ECS 24) Identify the role of recycling and other named conservation methods in the maintenance of a balanced environment. (ST 3 LS ECS 6) Demonstrate awareness that sustainable use of resources would help to minimize pollution and destruction of the environment. (ST 3 STSE 1) Describe correct methods of garbage disposal. (ST 5 ESS ER 3)	**Below are five major types of recyclable waste or materials:** 1. Waste paper: mainly includes newspaper, magazine, books, all kinds of packaging paper, office paper, advertising paper, paper case and so on. Tissue and toilet paper are not recyclable because the water-solubility is too big. Series stained paper and packaging is not recyclable either. 2. Plastic: mainly includes all kinds of plastic bag, plastic foam, plastic package, disposable fast food container, toothbrush, plastic cup, PET bottle, HDPE containers, etc. 3. Glass: mainly include all kinds of glass container, scrap glass, mirror, lamp bulb, etc. 4. Metal: mainly include aluminum cans, food tin, lead sheath of toothpaste, metal inside e-waste, etc. 5. Textile: mainly include used clothes, towel, tablecloth, schoolbag, shoes, etc. Unrecyclable waste commonly includes the materials that can be easily degraded in nature. For example, fruit shell, vegetable leaves, food leftovers, flowers and leaves, etc. It also includes cigarette end, muck, coal cinder, construction waste and paint which do not have big value after being discarded. Along with the development of recycling knowledge, in fact the above listed organic waste like kitchen waste and plant waste can be turned into fertilizer through proper processing. Harmful waste mainly includes paint, scrap battery, mercury thermometer, lamp tube, overdue medicines, etc. If these wastes are discarded randomly, it will be cause danger to human beings and seriously pollute the environment. Hence, these waste needs to be thrown into specialized bin which should be available in each residential community. Retrieved verbatim from: https://www.sinobaler.com/recyclable-waste-unrecyclable-waste/ The teacher could present the excerpt above and a cardboard box containing a range of garbage. Learners should use the information above to decide what could potentially be recycled. Teacher could use the following data table to have learners record their results. ***An extended activity would have the learners organize and implement a waste clean up drive in their community.*** Sample table: Item Identified / Potentially Recyclable / Non-Recyclable Plastic bottle / X / Paper bag / X / Banana peel / / X (compostable) Rusty nail / / X	*Learners, what comes to mind when you see these pictures? Let's draw a web of words that captures your reaction.*  (*a shameful environment*, *disappointment, anger, disgust, uncaring, indifferent*) This thoughtless disposal of garbage means we are **polluting** the earth for future generations. Divide the class into 8 groups where two groups each get a single picture to think about. Ask them to work in their group to respond to the following questions: 1) Can you identify the main environmental concern? (*garbage is polluting the seashore*) 2) Have you seen a similar concern in your community? (*a walk on any beach will identify garbage*) 3) What are the objects you see in the picture that don't belong? *(plastic bottles, plastic bags, packaging of food, rope)* 4) What are the causes of this problem? (*people dispose of containers used for convenience products in nature rather than proper bins*)

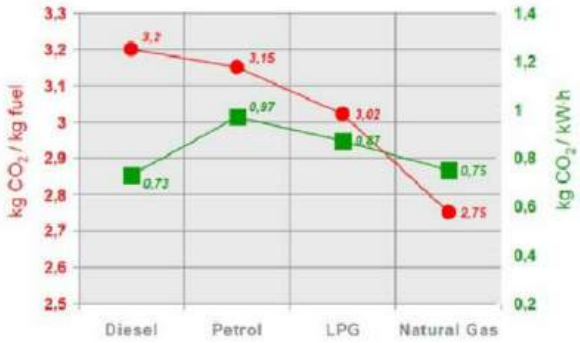
Specific Curriculum Outcomes	Specific Curriculum Outcomes	Specific Curriculum Outcomes
Identify that air is needed for burning, and describe how the process works. (ST 5 ESS ER 7) Explain the importance of 'clean' air in their country. (ST 5 ESS ER 11) Identify and name natural sources of water. (ST 5 ESS ER 12) Describe, with examples, the effects of water shortage in the environment and human activity. (ST 5 ESS ER 13) Identify and describe how water may be polluted, and how human activities help in this situation. (ST 5 ESS ER 14) Identify and name marine pollutants, explaining how each damages the environment. (ST 5 LS ECS 7) Describe how human activities may result in air and water pollution. (ST 5 LS ECS 8) Describe different methods of disposing of solid waste materials and demonstrate most appropriate methods of disposal. (ST 6 ESS ER 1) Describe and discuss how burning can cause air pollution. (ST 6 ESS ER 4)	**Evaluating Comprehension and Critical Thinking** <u>Industrial Effluent and Fuel Transport as Water Pollution</u> Learners will use the following primary sources to write a two-page summary of the mode of pollution and the impact on our environment. Rubric: description of event 5 marks/description of impact 5 marks A) Many industries small and large will use local streams to cool machinery but more dangerously, to dump chemical waste **(**called **industrial effluent).** The heating of water or pollution with chemicals can potentially kill marine life which in turn upsets the local ecosystem. https://www.fairplanet.org/story/how-the-fashion-industry-pollutes-our-water/ https://www.perchenergy.com/blog/environment/what-is-thermal-pollution-causes-impact B) Transportation of Fossil fuels has contributed to some of the biggest water pollution disasters the earth has ever experienced. https://www.bbc.com/news/world-latin-america-68413102 https://www.history.com/topics/1980s/exxon-valdez-oil-spill	5) What are the action items you might undertake to help solve the problem? (*plastics can be disposed of in proper bins and recycled or taken to landfill sites)* One of the words you may use to describe these pictures includes **environment.** I am sure you have heard the word before. As a review, I want each of you to place the word environment in the centre of this four-square and complete the quadrants.  Our **environment includes air, soil and water.** Ask learners why these (air, water and soil) are important and should be conserved. Have learners work in small groups to brainstorm 3 negative impacts of not protecting our air, soil and water. Share and review their lists on the board asking them to explain their examples using a spokesperson from each group.

Specific Curriculum Outcomes	Specific Curriculum Outcomes	Specific Curriculum Outcomes
List and explain which activities of humans may affect the water supply and pollute our scarce resources. (ST 6 ESS ER 8) Discuss ways of preventing and reducing water pollution. (ST 6 ESS ER 9) Compare pro and con opinions on contentious issues (e.g. fracking) Compare clean and dirty water. Distinguish clean and polluted air. Explain how acid rain is created by industry. **Skills** Explain to their classmates the need for environmental conservation in their country, outlining possible scenarios if such protection is neglected. (ST 3 LS ECS 7) Classify litter as recyclable and non-recyclable. (ST 5 ESS ER 4) Plan and participate in clean-up drive in their school. (ST 5 ESS ER 5)	**Contentious Issues – Pros and Cons Writing** **Fracking** is a technique recently developed for the oil industry. While it seems to be a useful and efficient technology, many opponents fear the strategy has the potential to damage water supplies. Learners should research the topic fracking and write up a two-page-response paper that responds to the following questions: (5 marks for each component below) 1) What is involved in the "fracking technique"? (you should draw a picture as it is helpful in your description) 2) What are the positive aspects of using this technique? 3) What are the negative aspect of using this technique? Learners may use the following as a primary source: https://www.youtube.com/watch?v=Uti2niW2BRA (5:03 mins) **Water Pollution Inventory** Learner groups should be tasked to use the following list to do an inventory of their home and community to judge whether clean water practises are being followed. Learner groups can report back on their findings and, as a class, they might would learn to write a formal letter to local politicians voicing their cumulative concerns.	**Comprehension of the Word Conservation** Read the following passage to learners and ask them to surmise what the word conservation must mean based on the context in the passage. "Felix was really worried. His garden was not doing well. At the beginning of the growing season the rains came and everything seemed to grow well. But he did not conserve water in a barrel or bucket and now, with no rain and a dry well, he had virtually no water left to nourish his plants. He realised too late that conservation of resources like water is very important in agriculture." Through discussion arrive at a working definition for conservation. (***Conservation refers to the methods used to prevent wasteful use of a resource***) **Cleaning Water** A jar of muddy water can be poured through a funnel with the following filters used. Learners should report on the properties of the water after it has been subjected to a filter. **Initial sample** | **Description** (brown -yellow) Paper filter | Sand | Gravel | Nylon fabric | Which filter did the best job removing colour from the muddy (**turbid**) water? And why? (*paper-smallest pores)*)

Specific Curriculum Outcomes	Specific Curriculum Outcomes	Specific Curriculum Outcomes
Design, construct and use discarded materials to make useful items. (ST 5 ESS ER 6) Compare devices that burn different fuels from the amount of pollution they cause. (ST 5 ESS ER 8) Compare the amount of air pollution in two named areas. (ST 5 ESS ER 9) Hypothesize as to the reasons for the differences exhibited in *ST 5 ESS-ER 9* above (ST 5 ESS ER 10) Classify litter, using actual examples, as recyclable and non-recyclable. (ST 6 ESS ER 2) Design and construct a device to detect air pollution. (ST 6 ESS ER 5) Investigate the amount of air pollution found in two distinctly different areas and suggest a 'theory' to account for the reasons for the differences. (ST 6 ESS ER 6) Design, construct and demonstrate the use of a device to determine the turbidity of water. (ST 6 ESS ER 10)	Ten Things You Can Do To Reduce Water Pollution "Just because it disappears, doesn't mean it goes away" 1. DO NOT pour fat from cooking or any other type of fat, oil, or grease down the sink. Keep a "fat jar" under the sink to collect the fat and discard in the solid waste when full. 2. DO NOT dispose of household chemicals or cleaning agents down the sink or toilet. 3. DO NOT flush pills, liquid or powder medications or drugs down the toilet. 4. Avoid using the toilet as a wastebasket. Most tissues, wrappers, dust cloths, and other paper goods should be properly discarded in a wastebasket. The fibre reinforced cleaning products that have become popular should never be discarded in the toilet. 5. Avoid using a garbage disposal. Keep solid wastes solid. Make a compost pile from vegetable scraps. 6. Install a water efficient toilet. In the meantime, put a brick or 1/2 gal container in the standard toilet tank to reduce water use per flush. 7. Run the dishwasher or clothes washer only when you have a full load. This conserves electricity and water. 8. Use the minimum amount of detergent and/or bleach when you are washing	Imagine the filtering that happens as rainwater passes through meters of soil to join underwater **reservoirs.**  Retrieved from**:** https://www.sfi.ie/site-files/primary-science/media/pdfs/col/cleaning_water_activity.pdf **Caring for Water** Put some water in a container and cover it. Tell the learners you have the most important thing in the world under the cloth and ask them to guess what it is. Explain the importance of water. Ask the learners to name all the ways people use water and write down their answers. To track the amount of water individuals/families use in the home, we are going to have learners keep a "**water diary"** (see below) Ask the learners to keep a water diary for a day or two to see how they use water and discuss their results. Are their opportunities to conserve the water in your home? **Invite an Expert** Consider inviting presentations from local water management authority. Have learners create a set of interview question sin advance.

Specific Curriculum Outcomes	Specific Curriculum Outcomes	Specific Curriculum Outcomes
Investigate ways in which polluted water can be made clean. (ST 6 ESS ER 11) Interpret information passages. Infer from pictures the environmental concerns. Use graphic organizers to clarify terminology. Research modes of pollution. Complete inventories of water usage. (consumption) Perform water filtering experiments. Perform air pollution detection experiments. Construct graphs from data. Interpret graphical information. **<u>Attitudes/Values</u>** Demonstrate awareness that unplanned scientific and technological activities may impact humans and the environment in such a way that there is little to leave behind for succeeding generations. (ST 1 STSE 4**)**	clothes or dishes. Use only phosphate free soaps and detergents. 9. Minimize the use of pesticides, herbicides, fertilizers. DO NOT dispose of these chemicals, motor oil, or other automotive fluids into the sanitary sewer or storm sewer systems. 10. If your home has a sump pump or cellar drain, make certain it does not drain into the sanitary sewer system. Retrieved from: https://www.simsbury-ct.gov/water-pollution-control/pages/ten-things-you-can-do-to-reduce-water-pollution **Protecting Our Water: Why Phosphate -Free Detergents?** **Phosphate detergents** are well known to produce the shiniest, clear glassware with no soap stains. However, this useful chemical technology has potentially detrimental effects on the environment when the effluent from dishwashers and clothes washers is dumped into lakes, rivers and streams. The phosphates promote an abundance of algae and weed growth which depletes oxygen in the waterway thereby killing fish and ultimately turning the waters murky. Learners should be tasked with doing an inventory of home use detergents to see what is phosphate-free and determine where their waste water eventually resides. They can write a lab report on their findings.	 Retrieved from https://resource-bank.scholastic.co.uk/resources/110745 Rank the learner answers showing the most frequent uses of water to the least frequent for your community sample. Share with the

Specific Curriculum Outcomes	Specific Curriculum Outcomes	Specific Curriculum Outcomes
Demonstrate awareness that unplanned and excessive Science and Technological activities may destroy the earth as we know it, resulting in untold disasters. (fracking, oil exploration, global warming etc.). (ST 2 STSE 2**)** Demonstrate awareness that humans must realise that in their attempts to understand the world and exploit the environment to fulfil their needs there are consequences. (ST 2 STSE 1**)** Demonstrate awareness that the real impact of scientific and technological activities may take years to be seen. (ST 4 STSE 2) Demonstrate an understanding that human production processes make goods and products which may impact the environment. (ST 5 PS MM 4) Demonstrate an understanding that humans desire to acquire understanding and to produce materials for their needs, and there may be consequences not anticipated. (ST 5 TE UT 1) Appreciate that the earth's water and air resources are sensitive to the abuse of humans.	**Testing for Air Pollution With a Simple Tester** Clean air has the properties of being light and refreshingly cool to breath. Sometime our air gets polluted by substances in the atmosphere. Let us design our own Prepare sample cards using instructions here (https://www.youtube.com/watch?v=PZdt3GnUgrw (1:37 mins) and place the cards at two different places in the school yard. Using a magnifying glass, analyse the amount and size of particles collected at two distinct locations. Account for differences. (*weather conditions including wind; passerby traffic could influence)*   Retrieved from: https://www.youtube.com/watch?v=PZdt3GnUgrw (1:37 mins)	class to establish some strategies for reducing **consumption** (means use of). **Graphing the Consumption Data** Have learners estimate how much water their family is using at home (gallons per day) by referring to the following data table (see also: https://water.usgs.gov/edu/activity-percapita.php) **Type of water use** / **Gallons per use** Full tub — 36 Shower — 5 gallons per minute Teeth brush — 1 gallon per minute Washing face — 1 gallon Dishwasher (new) — 6 gallons Hand wash dishes — 2 gallons per minute New Clothes washer — 25 gallons per load Toilet — 2 gallons per flush Drinking water — 8 glasses = 0.5 gallons Have learners graph their relative usage of different types with a pie chart; an example shown below. 

Specific Curriculum Outcomes	Specific Curriculum Outcomes	Specific Curriculum Outcomes
Demonstrate interest/curiosity to sample human habits like water consumption. Demonstrate an attitude of inquiry into new technologies that might impact the overall health of the earth. When conducting practical and group work, display sensitivity and offer assistance to peers who may have physical or learning challenges. Participate actively in classroom discussions.	**Burning Fossil Fuels Produces CO_2 & Contributes to Global Warming** Have learners review the graph below and answer the following questions. 1) Which fuel produces the most CO_2 /kg fuel burned? (*3.2 Diesel*) 2) Which fuel produces the least CO_2/kg fuel burned? (*2.75 Natural gas*)  **Retrieved from**: https://www.researchgate.net/figure/Comparison-of-CO-2-emission-for-different-fuels-11_fig1_274698881 **Dirty and Stagnant Water Can Cause Disease** Learners should be tasked with writing a research paper on the various waterborne diseases that have plagued the Caribbean in the last decade. Rubric:	Retrieved from https://www.epa.gov/watersense/how-we-use-water In brainstorming session, have learners suggest ways they could conserve water at home. These could be posted around the classroom as a conservation reminder. The following chart can be used to guide teachers and learners.  Retrieved from: https://solarschools.net/knowledge-bank/sustainability/reduce-reuse-recycle/reduce/water-usage

Specific Curriculum Outcomes	Specific Curriculum Outcomes	Specific Curriculum Outcomes
	Comprehensive coverage 5 marks Explanation of source of diseases 5 marks Demographic of countries most affected 3 marks Grammar and punctuation 5 marks	**Pollution of Water** Efficient use of water must be combined with protection of our water supplies. From our initial pictures, it is obvious that plastic garbage is often deposited into our water both in the sea and near ground water sources. "Unlike other materials, plastic does not biodegrade. It can take up to 1,000 years to break down, so when it is discarded, it builds up in the environment until it reaches a crisis point. This pollution chokes marine wildlife, damages soil and poisons groundwater, and can cause serious health impacts." Quoted verbatim from: https://www.un.org/africarenewal/magazine/may-2023/understanding-plastic-pollution-and-its-impact-lives Plastics are often recyclable, and many schools and communities have begun recycling programs where drink bottles and plastic packaging are separated in bins Does your community have a depot for recycling plastics? If so your class can begin a recycling program; if not, learners should be encouraged to reuse plastic containers such as cups, bottles, plates and utensils.

Specific Curriculum Outcomes	Specific Curriculum Outcomes	Specific Curriculum Outcomes
		 Retrieved from: https://www.researchgate.net/figure/Overall-mechanical-recycling-process-of-waste-plastics_fig2_354740283 **Protecting Our Air** Combustion (burning) of wood and fossil fuels requires air but it also produces unburned gases that pollute our **atmosphere**. Carbon dioxide is also formed in combustion, and this adds to global warming that makes our air seem more **humid** (containing water) rather than dryer. The result of this warming is climate change which impacts habitats and ecosystems. "Climate change refers to long-term shifts in temperatures and weather patterns. These shifts may be natural, but since the 1800s, human activities have been the main driver of climate change, primarily due to the burning of fossil fuels (like coal, oil and gas), which produces heat-trapping gases." Quoted verbatim from: https://www.un.org/en/climatechange/what-is-climate-change

Specific Curriculum Outcomes	Specific Curriculum Outcomes	Specific Curriculum Outcomes
		Industry also frequently creates other gases that appear as smoke from stacks. You will later learn more about the chemistry of sulphur and nitrogen oxides. These gases when released into the atmosphere can combine with water, oxygen, and other chemicals to become sulfuric and nitric acid respectively. These drop from clouds as dilute **acid rain** causing agricultural soils to be acidic and not suitable for some plants unless treated with lime (a neutralizing agent). This same acid rain falls in ponds and lakes causing a change in the aquatic environment. It is clear that industry, while it contributes convenient and useful products to humankind, it can also lead to **environmental destruction** by disturbing our **clean air** and destroying our water resources and associated ecosystems. This potential harm has been challenged by many **environmental activists** which has led to political pressure to "**scrub**" the gases that leave industrial stacks and limit dangerous effluents to local waterways. **Teacher note**: "A scrubber is a waste gas treatment installation in which a gas stream is brought into intensive contact with a liquid, with the aim of inviting certain gaseous components to pass from the gas to the liquid. Scrubbers can be employed as an emission-limiting technique for many gaseous emissions." Quoted verbatim from: https://emis.vito.be/en/bat/tools-overview/sheets/gas-scrubbing-general

Additional Resources and Materials

Turbidity of Water- DIY Tube: https://www.youtube.com/watch?v=bBl6KMyvS0M (2:59 mins)
Waste water treatment: https://www.coleparmer.com/tech-article/eight-stages-of-wastewater-treatment-process
Water recycling: https://www.youtube.com/watch?v=sCKPaNiOJDc (3:12 mins)

Additional Useful Content Knowledge for the Teacher

Recycling plastics:
https://www.recyclenow.com/how-to-recycle/plastic-recycling
https://www.recyclenow.com/how-to-recycle/recycling-symbols
Paper Recycling Process Diagram and Explanation: https://www.lactips.com/news/what-is-the-paper-recycling-process/?lang=en

Opportunities for Subject Integration

Mathematics: Collecting, Drawing and interpreting graphical data on air and water pollution /consumption.
Social Studies: problems of pollution and sustaining clean air and water are issues that all citizens should be schooled in
Health: Clean air and water are crucial to sustained good health and wellness/waterborne illnesses can be devastating to communities
Language arts: Research, comprehension of information and writing about social issues of environmental concerns including water quality and disease

Space Systems: Stars and the Solar Systems

Introduction to the Subject

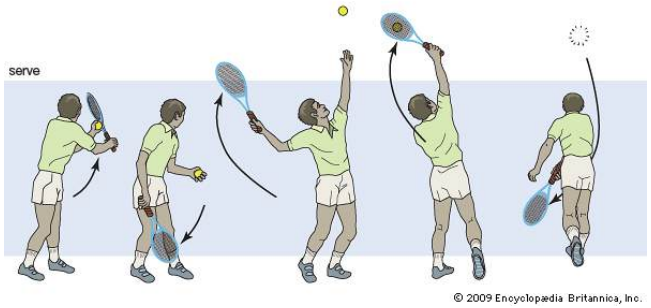
The study of science encompasses knowledge, processes and values. Scientifically literate persons will foster an attitude of caring not only for themselves, but as responsible citizens, for the world around them. Their decision making will be enhanced by a systematic study of the structure and behaviour of the physical and natural world through observation and experiment. In learning science, learners benefit from leveraging and evaluating available technological tools to study and therefore understand the world and their relationship to it.

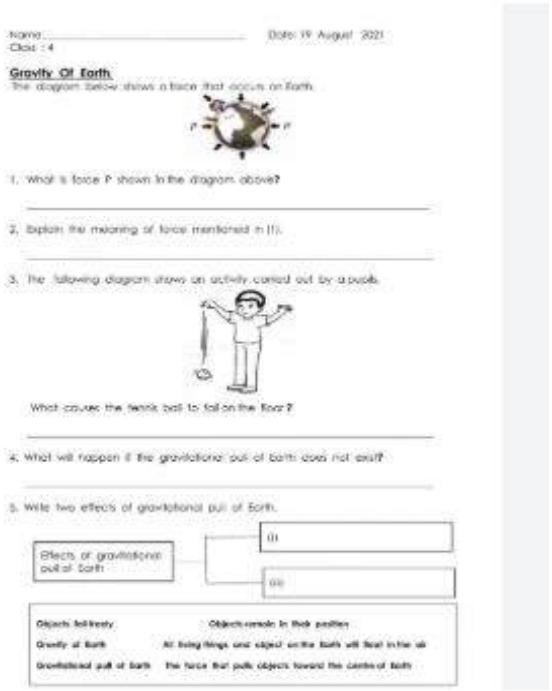
Strand: Space System: Stars and the Solar Systems

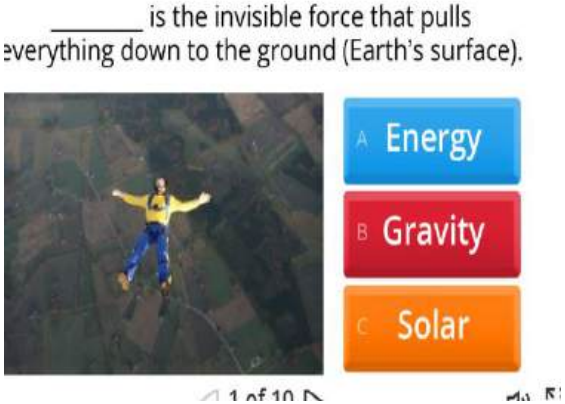
Learners benefit from understanding the place of the earth within interplanetary space as it defines certain characteristics of life on earth given the influences of celestial bodies such as the moon and the sun.

Essential Learning Outcome 1: Support an argument that the gravitational force exerted by Earth on objects is directed down.

Clarification Statement: "Down" is a local description of the direction that points toward the centre of the spherical Earth.
Assessment Boundary: Assessment does not include mathematical representation of gravitational force.
Grade Level Expectations: Refer to grade level expectations at the beginning of this curriculum document.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Learners are expected to: **<u>Knowledge</u>** Define the terms: • earth • force • gravitational force • gravity • invisible • mass • velocity • acceleration • air resistance • surface area • tides Demonstrate that the force of gravity pulls objects towards the earth. Compare the effects of gravity on the rate at which an object falls. Show that the bigger the object, the bigger that force of attraction that draws other objects to it. Explain the effects of air resistance on the shape of an object as it falls.	 Retrieved from https://www.istockphoto.com/search/2/image?mediatype=illustration&phrase=toy+rocket Learners are presented with a diagram of a model rocket and the following scenario. Simon launched a toy rocket his parents bought him. As it slowly ascended into the sky, he wondered just how high it could go. "I am worried I will never see it again" he said.. His parents told him: "*What goes up must come down*, it will fall back down to the earth eventually, then you can collect it up and launch it again"	***Learners, I have a question for you that you can help me with. A tennis player will serve a tennis ball by throwing it up in the air and hitting it with a racket. When they throw it up, they move their hand and apply a force upward. Describe for me what happens after the ball leaves their hand?*** (*the ball begins going upward but eventually slows to a stop and then begins falling*) So, the tennis player has to adjust their timing to swing the racket at the ball just at the right time!  Retrieved from: https://kids.britannica.com/learners/assembly/view/54079 Why does the ball slow down after it leaves their hand and eventually stop? (*the force they apply upward stops as soon as the ball leaves their hand but another force works against that upward motion to slow and stop the upward motion)*

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Account for the difference in gravity between earth and moon **Skills** Observe that gravity prevents objects from floating off into space. Infer what will happen if two objects of the same size and shape, one empty and filled are released from the same height. Predict the direction an object will go when dropped. Construct different parachutes and discuss which one will reach the ground first when dropped. Conduct experiments to observe the effects of gravity on different objects of varying mass and size. Collect data from experiments and they will record, analyse and interpret the data to make predictions on gravitational force.	**Introductory question** What does the statement " What goes up must come down and fall to the Earth eventually, mean?" Ans: (*The force of gravity pulls objects towards the earth.*) Complete the worksheet below.  Name: Class : 4 Date: 19 August 2021 Gravity Of Earth The diagram below shows a force that occurs on Earth. 1. What is force P shown in the diagram above? 2. Explain the meaning of force mentioned in (1). 3. The following diagram shows an activity carried out by a pupil. What causes the tennis ball to fall on the floor? 4. What will happen if the gravitational pull of Earth does not exist? 5. Write two effects of gravitational pull of Earth. Effects of gravitational pull of Earth (i) (ii) Objects fall freely Objects remain in their position Gravity of Earth All living things and object on the Earth will float in the air Gravitational pull of Earth The force that pulls objects toward the centre of Earth Retrieved from https://www.liveworksheets.com/w/en/science/1279996	We call the force that acts against that upward motion the **force of gravity**. Do all objects that we send upward with a force come back down again? (*yes*) Have you ever thrown something up in the air that didn't come down again? (*no*) So it seems that the force of gravity is constant all around us and it acts on all objects to pull them down to the earth. We know that spacecraft have successfully landed and remained on the moon so it must also have gravity! Today we will look at the nature of that force; how does it act on different objects? As a review, the teacher with access to technology may pose the following questions for learners to watch for as they view the following video on gravity. What is Gravity? (youtube.com) (6:42 mins) a. What is gravity? (*an invisible force that pulls everything together.*) *b.* What effects does gravity have on an object? (*pull things downwards)* c. How do we know there's gravity on Earth?(*everything falls down/ to earth*) d. Does the sun and the moon have gravity? (*yes*) *e.* Gravity is stronger (closer to OR further away) from an object. (*gravity depends on distance just like a magnet)*

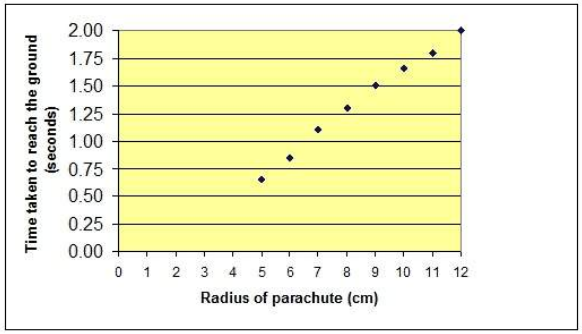
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Attitudes/Values Develop an appreciation for Science by recognizing the importance of gravity as a force which keeps things including humans grounded to the earth.. Work collaboratively/cooperatively with peers on classroom activities and discussions on gravity. When conducting practical and group work, display sensitivity and help peers who may have physical or learning challenges.	 Engage learners in a word wall activity on gravity. Retrieved from: https://wordwall.net/resource/37041756/gravity	f. What would happen if there was no gravity acting on objects? (*they will float away*) *g.* Does gravity pull all objects to the surface of the earth? (*Yes, this is how it is different from a magnet which normally only attracts certain metals gravity pulls down on all objects, whether it is made up of wood, metal , rock, plastic ,paper)* h. Can we see gravity? (*No , it is an invisible force*) *i.* Invite learners to stand and jump . Ask them why they did not just stay in the air when they jumped. (*because gravity pulls us back down).* **For Objects of Equal Mass, Does Shape Make a Difference in How Quickly an Object Falls?** **Activity** **What would you need?** 1. A4 paper 2. Thin card 3. Scissors **Step 1** Loosely scrunch an A4 piece of paper into a ball and hold in your hand at shoulder height. In the other hand, hold a flat piece of paper. **Ask learners what they predict will happen when you release both pieces of paper simultaneously? (***the crumpled ball will fall fastest*) **Step 2.** Drop both pieces of paper at the same time from shoulder height.

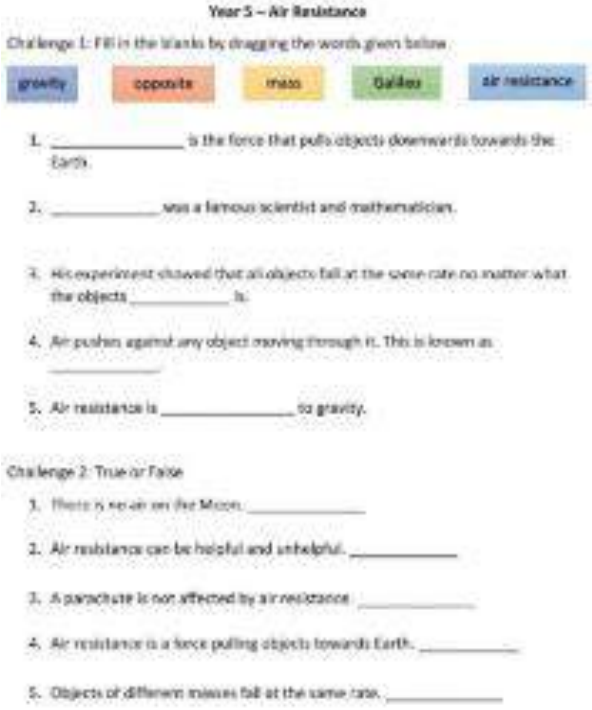
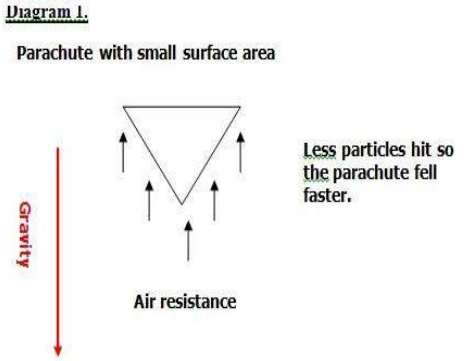
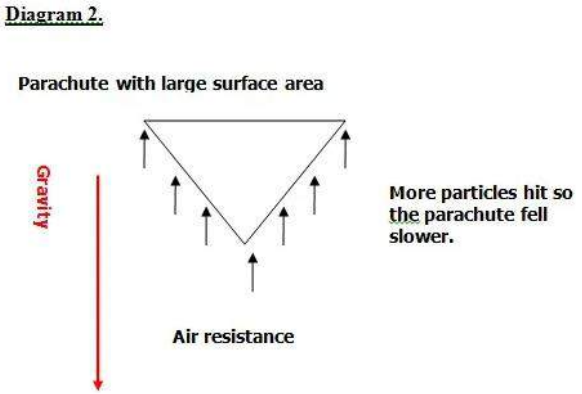
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	Learners complete the worksheet on tides below. **Part A: What tide is it ?** For this reason, high tides are slightly more than 12 hours apart. The afternoon high tide on one day is about 12hours and 50 minutes later than the afternoon high tide on the previous day, and the same holds true for low tides. **Tides for Cape May, New Jersey** **Day of Week** / **Low tides** (A.M., P.M.) / **High Tides** (A. M., P.M.) Tuesday 9:16 9:28 2:43 3:30 Wednesday 10:09 10:25 3:52 4:33 Thursday 11:00 11:20 4:54 5:28 Friday 11:50 12:07 5:48 6:17 Saturday 12:14 12:39 6:37 7:04 Sunday 1:06 1:28 7:25 7:51 Monday 1:57 2:15 8:12 8:38 • Use the information in the table above to determine the time between the low tides and high tides for the day. The first set is done for you. **Day of the Week** / **Time between low tides** / **Time between high tides** Tuesday — 12 hours 12 minutes — 12 hours 47 minutes Wednesday Thursday Friday Saturday Sunday Monday Retrieved from tides_worksheet.pdf (weebly.com)	**Which piece reaches the floor first? (***crimpled paper***)** **Ask learners why they think this happens? (***the uncrumpled paper floats on air on the way down***.)** **Ask learners: when people skydive from airplanes, what do they use to float on air? (***parachutes catch the air and slow them down)*** When scientists talk about the air slowing falling objects, they refer to it as **air resistance**. So in a correct sentence, we could say that air resistance causes pieces of flat paper or parachutes to fall slowly. But learners, what do they have in common? (they take up more space as they fall) We say that they have more surface for the air to push on. This is called **surface area**. In a complete sentence then…the surface area of a parachute gives more places for the air to resist the falling motion. **What if there was no air to resist the falling object?** A famous scientist named Galileo dropped a feather and a ball and found that the feather fell much more slowly because of air resistance.

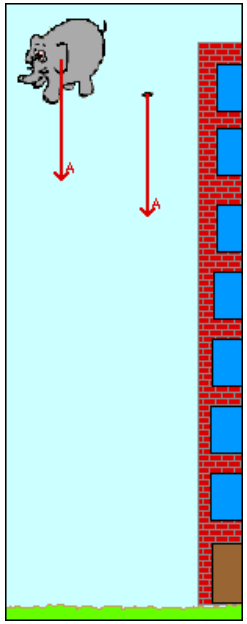
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	Group Activity Place learners in groups and carry out similar activities.). Learners will plan and execute how to determine the effect of Earth's gravitational pull on these objects. Materials for groups ➢ tennis balls ➢ leaf ➢ mango ➢ paperclip Learners will drop a tennis ball and a leaf from the same height simultaneously. 1.Which object fell first? (*The tennis ball fell faster than the leaf.)* Why do you think that happened? (*the leaf floated in the air rather than dropping fast because it has a larger surface therefore the air resistance will be greater*.) Learners will conduct similar activities with the mango and paperclip.	But scientists today have created a special experiment that invites us to remove the air and once again drop the ball and the feather. What do you think happened? You are right, they fell to the ground exactly at the same time. If we could go to the moon where there is no air we could duplicate this experiment! See: Galileo's Famous Gravity Experiment | Brian Cox | BBC Two (youtube.com) (3:34 min)  Screen captured from: https://www.youtube.com/watch?v=QyeF-_QPSbk

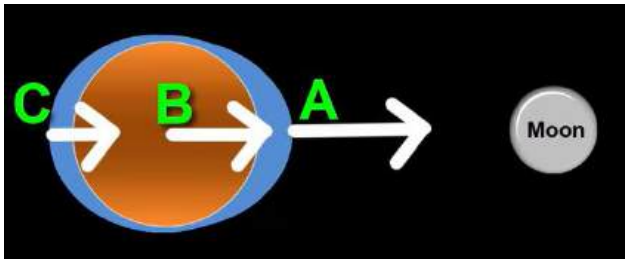
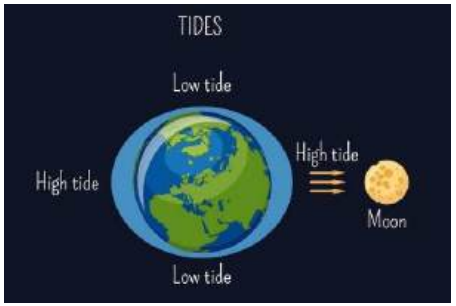
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	Invite learners to make paper planes and let them launch them into the sky. 1. What happened to the paper planes? (*After a few seconds they slowly descended.*) 2.Why did this happen? (*The force of gravity prevents objects from floating indefinitely.*) Learners will also make paper planes of various sizes and observe which will drop first. Have two learners drop two bottles simultaneously from a high place while the others observe. Learners can repeat the experiment to ascertain their observations. Lesson 2 Act 1 HowFall wkst draft5_TEDL_dwc.doc (teachengineering.org) The two bottles: one filled with water and the empty one, will hit the ground at the same time. No matter the mass of the object, in the absence of air resistance, it is being pulled down towards the Earth at the same rate of acceleration, because the force of gravity acting on them is at the same time.)	**Review** Let's write a new statement on what we know now. ● The shape of objects will determine how fast they fall from a height to the ground. (e.g. a crumpled paper will reach the ground faster than a flat surface , because there's less air resistance. ● In the absence of air resistance, objects fall to the surface of that planet at the same rate. 1. **Surface Area**: A crumpled piece of paper has less surface area than a flat sheet of paper. When you crumple the paper, it forms wrinkles and folds, reducing the overall area exposed to the air. 2. **Air Resistance:** Air resistance depends on both the velocity of the falling object and its geometry. Imagine a race car and a truck moving at the same speed. Which one experiences more air resistance? The truck, because of its larger surface area. Similarly, a crumpled paper encounters less air resistance due to its reduced surface area, inviting it to fall faster. 3. T**erminal Velocity**: If there were no air resistance, all objects would fall at the same rate regardless of their shape or mass. However, air resistance plays a crucial role. As an object falls, its velocity increases until air resistance balances out gravity.

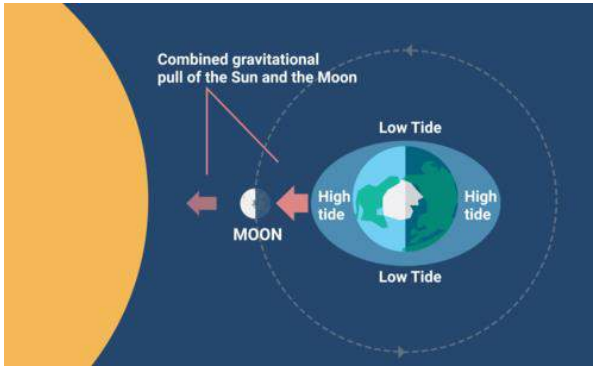
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	 Name: _____ Date: _____ **How Do Things Fall? Worksheet** Use this table to record your predictions and the results for this activity. List the objects in a pair in the first and second columns. In the third column, write which object you think will hit the ground first when you drop them. If you think they will hit the ground at the same time, write "same time." In the fourth column, explain why you think that object will hit the ground first. In the last column, record the results of dropping the two objects together. If one object hit the ground first, write the name of that object in the Results column. If they hit the floor at the same time, write "same time." Object 1 | Object 2 | Your Prediction: Which will hit the ground first? | Why? | Results Learners will be engaged in a word wall/Kahoot activity on Air resistance. They will be able to view their scores at the end of the activity. **Air Resistance Quiz** Visit the following website for a review quiz on air resistance:https://wordwall.net/resource/10216867/science/air-resistance  	Learners look at a video on how objects fall, then answer questions based on the video. Why do heavier objects fall faster? | #aumsum #kids #science #education #children (youtube.com) 1:07min a. Will the weight of an object affect the speed at which it falls? (*yes, the heavier the object the greater the force of gravity*) b. Why would the lighter object fall to the ground last? (*it has greater air resistance*) c. Would it be possible for a light and heavy object to fall to the ground at the same time? (*yes if there is no air resistance*) **More on Parachutes** Pupils are asked to look at the video on how to construct a parachute DIY Parachute Science Experiment | Easy At-home Experiment for Kids - YouTube(2:11 mins) The following graph gives information about time taken for different parachutes to fall to the ground. Have learners respond to the questions about the graph.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	Build a Parachute Activity Learners will be placed into 4 small groups to construct 4 parachutes of various sizes. Each group will be given the dimensions to construct a parachute. Upon constructing their parachutes , learners will drop them from a certain height and observe what happens. Pupils will draw a table like the one below to record their findings. Parachute # | Trial 1 (seconds) | Trial 2 (seconds) 1 2 3 4 They will answer the following questions 1.Which parachute took the least time to land? 2. Which parachute took the most time to land? 3. Arrange the parachute in the order they landed, from the one which took the least time to land to the one which took the most time to land. Pupils will construct a line graph and will plot the points at the rate the parachute falls based on the data collected.	 Retrieved from: https://owlcation.com/stem/A-grade-GCSE-Physics-experiment-Investigation-into-the-effect-of-parachute-surface-area-in-relation-to-its-fall-time a. Which parachute has the widest radius? (*the one with 12cm*) *b.* Which parachute will reach the ground first? (*the one with the smallest radius)* *c.* Which one will take the longest time to reach the ground? (*the 12 cm radius*) Why? (*the parachute with the largest surface area because the larger the surface area the more air resistance that will act on it)*

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	Learners will complete the worksheet below.  Year 5 – Air Resistance Challenge 1: Fill in the blanks by dragging the words given below gravity opposite mass Galileo air resistance 1. _____ is the force that pulls objects downwards towards the Earth. 2. _____ was a famous scientist and mathematician. 3. His experiment showed that all objects fall at the same rate no matter what the objects _____ is. 4. Air pushes against any object moving through it. This is known as _____. 5. Air resistance is _____ to gravity. Challenge 2: True or False 1. There is no air on the Moon. _____ 2. Air resistance can be helpful and unhelpful. _____ 3. A parachute is not affected by air resistance _____ 4. Air resistance is a force pulling objects towards Earth. _____ 5. Objects of different masses fall at the same rate. _____ Retrieve from: https://www.liveworksheets.com/w/en/science/1711987 **Rubric 1 mark per question. (10 marks)**	**How Does Surface Area Make a Difference: An Explanation** Teacher: Draw diagrams to explain to learners how air resistance affects objects with a wider radius.  Diagram 1. Parachute with small surface area Gravity Less particles hit so the parachute fell faster. Air resistance  Diagram 2. Parachute with large surface area Gravity More particles hit so the parachute fell slower. Air resistance Retrieved from: https://owlcation.com/stem/A-grade-GCSE-Physics-experiment-Investigation-into-the-effect-of-parachute-surface-area-in-relation-to-its-fall-time

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	Look at the diagram below and answer the following questions:  Retrieved from: https://www.physicsclassroom.com/mmedia/newtlaws/efff.gif **TRUE or FALSE:** 1. The elephant and the feather each have the same force of gravity. 2. The elephant has more mass, yet both elephant and feather experience the same force of gravity.	**The Nature of Gravity as a Force** As an object falls from a high point, it travels faster and faster as it descends to the ground. This is called **acceleration** because the velocity is increasing. Since the increase in velocity is due to gravity, we call **it acceleration due to gravity** **Moon Has Gravity That Pulls on the Earth & its Water!** The tides can be explained easily using an analogy of a magnet**.** Magnetic pull is dependent on the distance from the magnet to the object it is attracting (metal). When the moon's gravity acts on the earth, it pulls on 3 things, A) the water on the earth facing the moon, B) the earth itself and C) the water on the opposite side of the earth. Learners, what do you think the moon pulls the hardest? (*the closest of the three, the water on the side facing the moon*.) That is where we get a high tide. The moon also pulls the earth away from the water on the backside leaving a high tide opposite the moon. Learners, what do you think the moon pulls on the least of these three? *(the water on the opposite side of the earth)*

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	3. The elephant experiences a greater force of gravity, yet both the elephant and the feather have the same mass. 4. On earth, all objects (whether an elephant or a feather) have the same force of gravity. 5. The elephant weighs more than the feather, yet they each have the same mass. 6. The elephant clearly has more mass than the feather, yet they each weigh the same. 7. The elephant clearly has more mass than the feather, yet the amount of gravity (force) is the same for each. 8. The elephant has the greatest acceleration, yet the amount of gravity is the same for each. **Ans: (all answers are false)** Learners will write an essay explaining at least three main points why the force of gravity is important. This activity will be graded. **Rubric** ● Defining the term gravity (2 marks) ● Identifying and explaining at least three critical reasons why gravity is important. (12 marks) ● Summarizing the main points. (1 mark) **Total points : 15**	The moon essentially leaves that water alone and behind because of only a weak attraction, We get a high tide on the opposite side facing the moon.  Screen capture and explanation retrieved from: https://www.youtube.com/watch?v=3RdkXs8BibE (5:10 mins) Because the water is fluid to flow all-around the earth as it rotates , we get too low tides on the other two sides perpendicular to the side of the moon.  Retrieved from: https://www.abc.net.au/education/how-the-moon-affects-the-tides-on-earth/13920350

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	Challenge Question: Space Walks and Gravity When we watch videos of astronauts walking on the moon they appear to be bouncing across the surface. See: https://www.youtube.com/watch?v=NHeOpJh5Q-M (0:30 mins) Why does this happen? (*the gravity that a body possesses depends on its mass. The moon has much less mass than the earth and therefore less gravity. With less gravity the force that astronauts must exert is less on the moon. Because normal walking on earth takes more force per step, the astronauts must adapt to using less force on the moon to walk normally! It appears like they are hopping because they are so strong)*	Because the earth is rotating once every 24 hours we get two high tides and two low tides very day. Challenge questions: *1)* What do you think happens to the tides when the sun is aligned on the same side as the moon. (*the tides tend to be higher because the sun's gravity also pulls the same water as the moon)* *2)* What do you think happens to the tides when the sun is opposite the moon?. (*the tides tend to be lower because the sun's gravity also pulls the same water as the moon but in the opposite direction)* 

Additional Resources and Materials

https://www.youtube.com/watch?v=QFooUXyN-pA
https://www.wrschool.net/cms/lib/AZ02214740/Centricity/Domain/1624/EffectsofGravityStations%20PDF%20FIllable.pdf
Lesson: Comparing the speeds of different parachutes | KS3 Science | Oak National Academy (thenational.academy)
https://www.youtube.com/watch?v=KDp1tiUsZw8 (1:22 mins)

The Physics Classroom Website - The elephant and feather- air resistant experiment.

What Goes Up, Must Come Down: Conduct Galileo's Famous Falling Objects Experiment | Science Project (sciencebuddies.org) - what goes up must come down experiment.

Do Heavy Objects Actually Fall Faster Than Light Objects? DEBUNKED (youtube.com) (12:17 min)

Additional Useful Content Knowledge for the Teacher

https://th.bing.com/th/id/OIP.uqUPZQKepkCDgedXoNd4WQAAAA?rs=1&pid=ImgDetMain

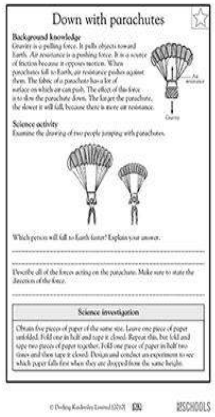
https://www.youtube.com/watch?v=KDp1tiUsZw8 (1:22 mins)

Why heavier objects fall faster than lighter objects? (explained) (youtube.com)(5: 01 min)

Invite learners to view a video on making parachutes https://www.youtube.com/watch?v=STDJ0l0cvFo

Retrieved from:https://www.greatschools.org/gk/wp-content/uploads/2015/04/26357.gif

ttps://www.pexels.com/photo/parachuters-on-air-70361/



Opportunities for Subject Integration

Mathematics:

- Use simple bar graphs to answer questions on the effects of gravity on different objects of varying mass and size..
- Use a simple bar graph/line graphs to show the time at which various objects reach the ground.
- Use tables to record observations on activities conducted.

Language Arts:

- Vocabulary, Reading comprehension (poem/stories) on gravity.
- Write a composition on the importance of gravity

Social- Science

- The importance of gravity in our daily life.
- Tidal fluctuations and damage to coastline habitats

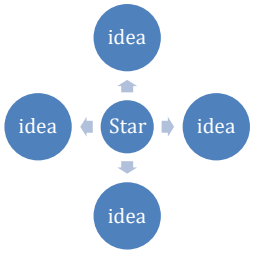
Elements from Local Culture, Technology, TVET, Environment that are integrated

Useful video describing forces in Freefall**:** **https://www.youtube.com/watch?v=0ewWkfBA3vw** **(5:22 mins)**

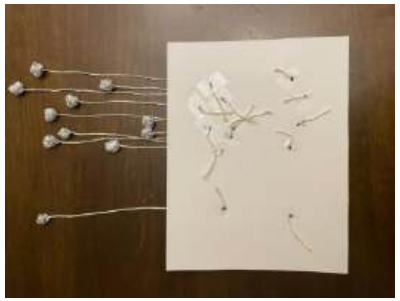
Essential Learning Outcome 2: Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth.

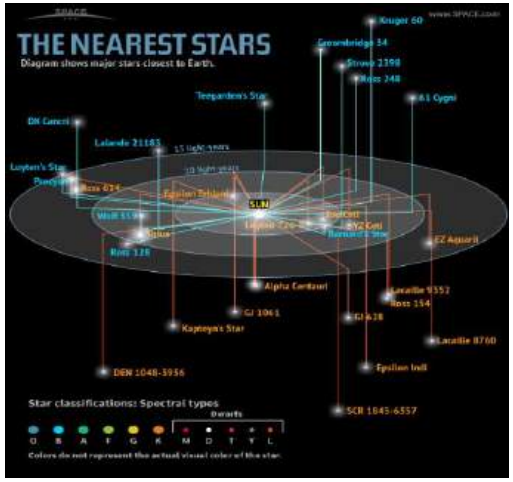
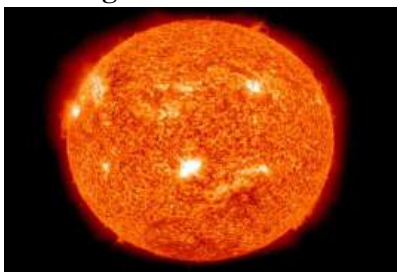
Assessment Boundary: Assessment is limited to relative distances, not sizes, of stars. Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, stage).

Grade Level Expectations: Refer to grade level expectations at the beginning of this curriculum document.

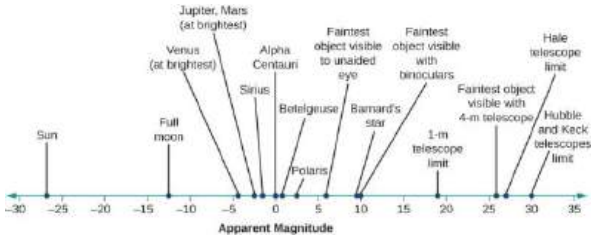
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Learners are expected to: **<u>Knowledge</u>** Define the terms: • Star • Sun • Refraction • Alpha Centauri • Light year • Brightness • Luminosity Demonstrate an understanding that the sun is considered a star Explain why we need the concept of a light year. Identify the nearest star to Earth	**Integration With Mathematics** How many times further away from the earth is the star Alpha Centauri by comparison to our sun? 40,208,000,000,000/152,000,000 = 264, 526 times further away. Why do scientists use light years instead of kms for measuring distances? (*the distances are too large to work with)* **Creative Writing** In a one-page response paper, learners should outline: 1) why the sun is an important star for the well-being of humans on earth? 2) How does pollution impact the usefulness of the sun? 3) How can the sun's rays be dangerous? 4) How can we use the suns energy more effectively (e.g. *solar power*)	**What Are the Characteristics of Stars?** Accessing Prior Knowledge Learners, you have probably heard of the word star before. What do you know about stars? (teacher note: draw a graphic organizer- web to capture their ideas- see example below)  What are the characteristics of stars…the sun is a star we know very well, what can you tell me about the sun? *(it seems like a sphere, it is bright, it seems to be burning, burning gases, very hot, gives us heat on earth, the waves leaving the sun (radiation) can be dangerous for our skin)*

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Explain how distance affects the apparent brightness of a star **Skills** Infer that the brightness of a light is affected by the distance the light must travel Recognize the importance of teamwork to prove that light intensity is affected by distance Communicate that the light year is a measure of distance Compare the distance of the nearest stars to that of the sun from Earth Analyse data to determine how distance from the earth impacts light intensity of the stars Create a model of a constellation **Attitudes/Values** Inquire into the names and relative distances of the nearest stars to Earth Be prepared to argue the importance of the sun in our very day lives	Rubric: Coverage of questions 5 marks Quality of Explanation 5 marks Punctuation and grammar 5 marks **The Difference Between Luminosity and Apparent Brightness- Paired Explanations** 1) Explain to a peer how the flashlight experiment shows the difference between luminosity and apparent brightness. (*luminosity is energy actually given off the surface of the star. Apparent brightness is what we perceive as that energy passes through space and our atmosphere*) *2)* Explain to a peer why stars twinkle. (*light travels at different speeds in different media, ; star light passes through many different mediums as it traves from its origin to our eyes)* **Star Gazing Activity** **Instruction** Star gaze when there is little or no moonlight and the sky isn't cloudy. Find an area away from streetlamps, neon signs, and headlights. And give your eyes a half hour to adjust to the darkness. Keep a notebook with you to sketch what you see in the sky and to keep a record of your sightings	A definition of a **star:** A point of light seen primarily in the night sky that produces its own light from a mass of burning gases **Why do Stars Seem to Twinkle?** Have a look at the picture of stars below. It is still, but we know when we look into the sky the stars seem to twinkle. Do you remember the song Twinkle Twinkle Little Star? Let us sing it from memory of we can!  Retrieved from: (https://www.funkidslive.com/learn/deep-space-high/space-explanation/why-do-some-stars-twinkle-and-some-dont/) Twinkle, twinkle, little star How I wonder what you are Up above the world so high Like a diamond in the sky Twinkle, twinkle, little star How I wonder what you are *Written by: Jane Taylor*

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Appreciate the citizens can play a role in maximizing the impact of the sun on the earth by managing our energy consumption and reducing pollution. When conducting practical and group work, display sensitivity and help peers who may have physical or learning challenges. Participate actively in classroom discussions.	Observe the brightest stars in the sky and look out for constellations! Identify one constellation and sketch it out on your notebook Note: Not all points of light you see at night are stars. Airplanes, satellites, and meteors (or "shooting stars") move fast, so they're easy to tell from stars. Planets also look like stars but don't twinkle like them! **Research** Research the name of your constellation and write down the story of how it got its name in your notebook. Present this story to your class! **Model of constellation** 	**Discussion Point:** Why do we see stars twinkle at night? ***Learners,*** let me help you think about this. When we place a pencil in a glass of water we see what appears to be a broken pencil. This observation we have talked about before is called **refraction.** We see the pencil two different ways because the light travels through water and air at different speeds as the image comes to our eyes. This is a *clue* about twinkling stars. I want you to think about how light must travel through different types of space a very long way, and what the light might encounter as it comes to our eyes. *(Answer: The light from stars travels light years to enter our eyes. As the light travels it must go through space that has a range of densities which causes the light to slow and speedup. This causes the stars to appear to twinkle)* **Questions About Stars- An Informational Video** Pose the following questions to learners BEFORE they watch the video to promote active listen/watching. https://www.youtube.com/watch?v=vcueS7w3q-Y (1:00min) 1. What is the closest star to earth? *(the sun)* 2. Why can't we see stars during the day? *(due to the bright light of the sun*) 3. How are stars and planets different? (*stars produce their own light and are bigger than planets)*

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	Retrieved from: https://www.bellmuseum.umn.edu/statewide-starparty/3d-constellation/ Materials: • String • Pieces of thin cardboard • Cardboard paper towel tube • Scissors • Markers or crayons Rubric: Creativity: 5 marks Accuracy: 5 marks Neatness: 5 marks Content: 5 marks Total: 20 marks 	**How Big is the Sun?**  **Retrieved from:** https://education.nationalgeographic.org/resource/sun/ **Teacher Demonstration:** Ask learners: How much bigger is the sun than our earth? Get them to compare a ball bearing (as earth) to: a marble (sun) or a golf ball (sun) or a cricket ball(sun) or soccer ball (sun). After having them guess, show them an exercise ball and point out how massive the sun is compared to earth. Because the sun gives off a lot of energy, make the point that even small changes in distance between earth and sun would make life on earth very difficult (*too cool or too hot!*). **Discussion point:** light from the sun makes it really easy to see things here on Earth, can you imagine living in a world without light? *(expected answer: it would be dark and we would not be able to see anything)* **Discussion point**: What do you think would happen if the sun moved one inch closer to the Earth? *(Even a small move closer to the*

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	Photo retrieved from: https://www.space.com/18964-the-nearest-stars-to-earth-infographic.html **Nearest stars activity** Learners will complete the following worksheet which outlines the nearest stars and their distance from our planet in light years. Retrieved from: NEAREST STARS - PROBLEM SOLVING The following list contains some of our nearest stars, and their distance from our planet in light years. STAR / DISTANCE (light years) / DISTANCE (nearest light year) / ORDER OF STARS Alpha Centauri A / 4.37 / 4 / Barnard's Star / 5.96 / / Lalande 21185 / 8.29 / / Procyon / 11.4 / / Proxima Centauri / 4.24 / / Ross 154 / 9.68 / / Sirius A / 8.58 / / Wolf 359 / 7.78 / / Questions: 1. Write down the distance of each star from our planet to the nearest light year on the table. 2. Write down the order of stars from our planet, from 1 to 8, with 1 being the closest and 8 being the furthest away.	*sun could have a huge impact. That's because warming would cause glaciers to melt, raising sea levels and flooding most of the planet*) If the teacher has a model, they can show learners the distribution of the sun and planets. See also: https://www.youtube.com/watch?v=Qd6nLM2QlWw (11:54 mins) Ask the learners what is the distance from the school to the nearest store? (*maybe 1, 2 or 3 kilometres?)* The sun is 152, 000, 000 (152 million km away) We can't even imagine how far that is. The distance all the way around the earth at the equator is only 40,000 kms! **Distance to Stars** Scientists have used very special instruments to measure the distance from the earth to the planets and stars. The nearest star beyond the sun is called **Alpha Centauri** and it is 40,208,000,000,000 km (40 trillion kms) away from the earth. In the night sky, you may best find Alpha Centauri by looking for the southern cross constellation first. 

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	3. How much further is Ross 154 away from us than Barnard's star? *(3.72 light years)* 4. How much closer is Proxima Centauri to us than Wolf 359? *(4.05 light years)* 5. How much further is Procyon away from us than Sirius A? *(2.82 light years)* 6. Tyger says the "The distance to Proxima Centauri and back is less than the distance to Sirius A" Is this true? *(it is true)* 7. Tyger says "In the time it takes light to travel from Earth to Procyon, it could get to Barnard's Star and back again" Is he correct? *(he is correct)* **Comparing the brightness of the sun to other stars and objects** **Instruction:** Using the apparent magnitude scale below, answer the following questions  Retrieved from: https://courses.lumenlearning.com/suny-astronomy/chapter/the-brightness-of-stars/	Retrieved from: https://www.duluthnewstribune.com/astro-bob-what-would-the-sun-look-like-from-alpha-centauri "The ancient astronomers believed the stars were attached to a gigantic crystal sphere surrounding Earth. In that scenario, all stars were located at the same distance from Earth, and so, to the ancients, the brightness or dimness of stars depended only on the stars themselves." Retrieved from: https://earthsky.org/astronomy-essentials/stellar-luminosity-the-true-brightness-of-stars/ We know now that the distance of the stars must have some impact on their brightness. Compare the brightness of the sun to the brightness of Alpha Centauri? **How to Better Measure Distances to Stars and Planets.** Because distances are so large from earth to most objects in the sky, scientists have developed another measure of distance. They know that light travels 300,000 kms/sec. A **light-year** is a measurement of distance a beam of light travels in a single Earth year, which equates to approximately 6 trillion miles (9.7 trillion kilometres). **What We Once Thought About Star Brightness** The ancient astronomers believed the stars were attached to a gigantic crystal sphere surrounding Earth. In that scenario, all stars were located at the same distance from Earth, and so, to the

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	1. Which object is the brightest? *(the sun)* 2. Which star is the brightest in our **night sky** in accordance with this magnitude scale? *(Sirius)* 3. What is the apparent magnitude of Betelgeuse? *(0.5)* 4. What is the approximate difference in apparent magnitude between Barnard's star and the faintest object visible to the unaided eye? (3) 5. According to this Scale, what is the name of the dimmest star in our night sky? *(Bernard's star)* **Model of Stars:** based on the worksheet above create a model to represent the ten brightest stars closest to the Earth in order of their distance. Labels should include: a. the name of the star b. the distance of the star from the Earth Materials: ● cardboard ● paint ● string ● playdough ● markers ● scissors	ancients, the brightness or dimness of stars depended only on the stars themselves." Quote retrieved from: https://earthsky.org/astronomy-essentials/stellar-luminosity-the-true-brightness-of-stars/ **What We Know Now Is that Brightness is Linked to Distance** For stars beyond 400 light years, astronomers use **brightness** measurements. They determine a star's colour spectrum, which indicates its actual brightness. By comparing this with the apparent brightness as seen from Earth, astronomers can estimate the star's distance. Stars exist in a range of colours: **red, orange, yellow, green, white and blue** with red being the coolest and blue being the hottest. A star's colour indicates it's temperature, composition and relative distance from earth. Quote retrieved from: https://lovethenightsky.com/what-color-are-stars/ Instruments like telescope are useful for such measurements (see Hubble here: https://hubblesite.org/home) Video resource to support light year discussion: https://www.youtube.com/watch?v=r1sxsMr-AMo (2:32 mins) Stars can give of equivalent energy – that brightness is called their **luminosity**.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	Rubric Creativity: 5 marks Accuracy: 5 marks Neatness: 5 marks Content: 5 marks Total: 20 marks	**Learner Activity** (3 learners) 2 torch bearers (flashlights) and 1 observer. Two identical flashlights with fresh batteries (torches) are taken out on a dark evening and turned on. W would say the flashlights have the same luminosity as they have the potential to give off an equivalent amount of light energy. One torch-bearer stands at 100 meters distance from the observer and the other torch-bearer stands at 500 meters distance from the same observer. From the observer's perspective, which torch light seems brighter? (*100 meter*). So learners, even though they give off the same light energy, the increased distance impacts the **apparent brightness** of the torches. . Distance therefore has an impact on brightness. Why do you think some stars appear brighter to us than others? *(The more distant an object is, the dimmer it appears. Therefore, if two stars have the same level of brightness, but one is farther away, the closer star will appear brighter than the more distant star - even though they are equally luminous!)* Video resource for review: https://www.youtube.com/watch?v=Zo-sKzMWYFA (5:09 mins)

Additional Resources and Materials

James Webb Space Telescope: https://www.youtube.com/watch?v=oLtFCUjAnuk (1:44 mins)
The Sun for Kids

A star's distance from Earth affects its brightness | MightyOwl Science | 5th Grade

Refraction

Closest Stars: https://www.space.com/18964-the-nearest-stars-to-earth-infographic.html

Additional Useful Content Knowledge for the Teacher

Overview of the Solar System:

- The Solar System consists of the Sun and all the celestial objects that orbit around it, including planets, moons, asteroids, comets, and meteoroids.
- The eight planets in our Solar System, in order of their distance from the Sun, are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune.
- The inner planets (Mercury, Venus, Earth, Mars) are rocky planets, while the outer planets (Jupiter, Saturn, Uranus, Neptune) are gas giants.
- The dwarf planet Pluto was reclassified as such in 2006 by the International Astronomical Union

Characteristics of Stars:

- Stars are massive, luminous spheres of plasma held together by gravity that emit light and heat.
- Stars vary in size, temperature, colour, and brightness. The colour of a star is an indicator of its temperature; for example, blue stars are hotter than red stars.
- The Sun is a star located at the centre of our Solar System. It is classified as a yellow dwarf star.

What are the brightest stars, and how to find them?
What is Magnitude in Astronomy? Should We Use Apparent or Absolute?

Opportunities for Subject Integration

Mathematics:
Statistics: Analyse data related to the size, temperature, and distance of celestial bodies.
Language Arts:
Writing: Write creative stories or poems inspired by the mysteries of space.
Reading: Explore science fiction novels about space exploration and extraterrestrial life from school libraries
Visual Arts:
Create artwork inspired by space, such as paintings of galaxies or sculptures of planets.

Elements that are integrated across subjects:

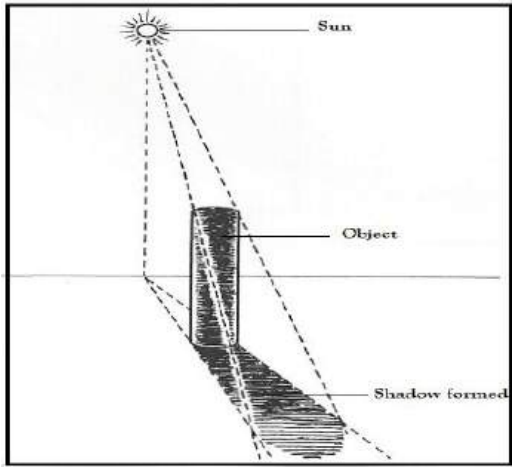
Calculation/data/statistics
Reading
Location

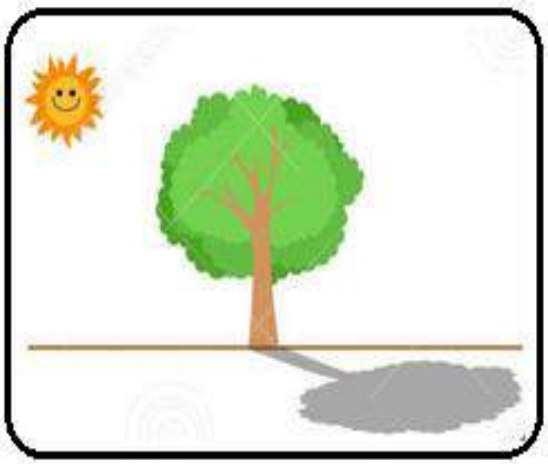
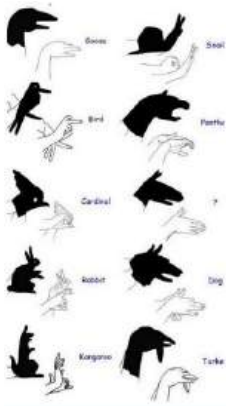
Elements from Local Culture, Technology, TVET, Environment that are integrated:

https://www.leidensciencemagazine.nl/en/articles/strand-en-sterren-astronomie-op-de-caribische-eilanden
https://www.storytellingresearchlois.com/2015/02/stoddard-where-sun-and-moon-came-from.html
chrome-extension: //efaidnbmnnnibpcajpcglclefindmkaj/https://solar-center.stanford.edu/folklore/Solar-Folklore.pdf

Essential Learning Outcome 3: Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.

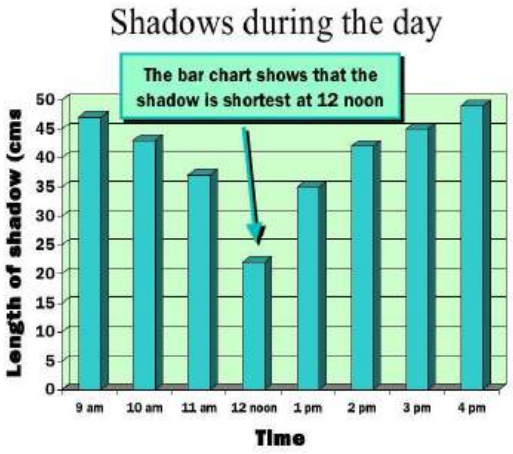
Clarification Statement: Examples of patterns could include the position and motion of Earth with respect to the sun and selected stars that are visible only in particular months.
Assessment Boundary: Assessment does not include causes of seasons.
Grade Level Expectations: Refer to grade level expectations at the beginning of this curriculum document.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Learners are expected to: **<u>Knowledge</u>** Define the terms: • Shadow • Rotation • Axis • Day and night • Star • Orbit Demonstrate that they understand the relationship between the position of the sun relative to the earth and the length of shadows created Explain how the position of the sun relative to the earth influences day and night.	**Presenting Field Trip Findings** Learners to present an illustration to describe the length and direction of the shadow formed from an object observed during the field trip. For example,  Retrieved from: https://images.app.goo.gl/Ev5sbFhWw9hv52uR9	**What are Learners Prior Ideas About Shadows** To connect with learners' prior knowledge on the topic, tell learners that some ancient civilizations used shadows to tell the time. Ask- What are shadows? How are they formed? Why do you think that this could be possible? Do you think that our shadows look different at different times of the day? *(shadows are dark areas created when an object blocks a light source, preventing light from reaching the surface behind the object. There appearance of shadows may change if the position of the light source changes)* Perform an activity where learners are to investigate how shadows are formed and the factors that affect their shape and size.

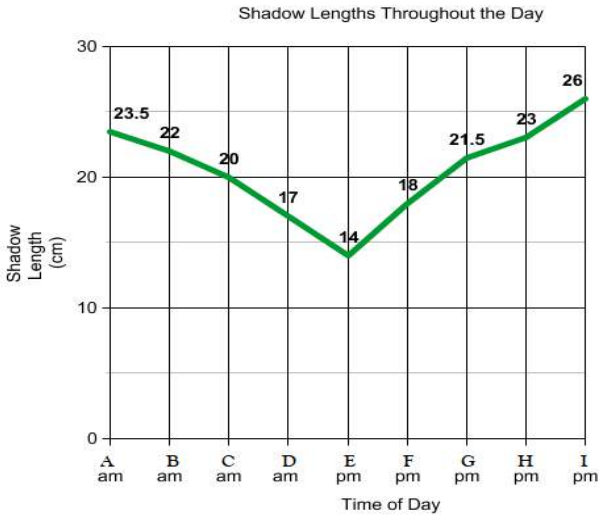
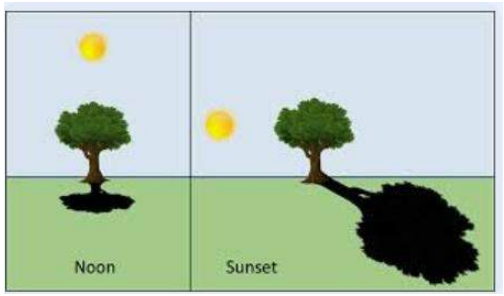
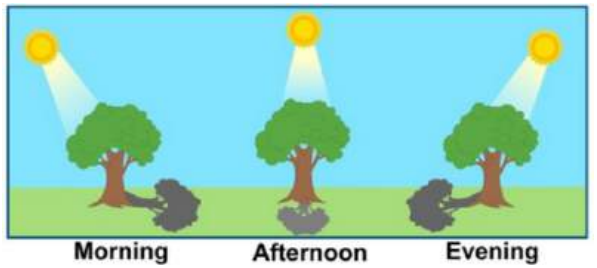
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Account for apparent changes in the position of stars throughout the year Show how graphical displays can represent data to reveal patterns of daily changes in length and direction of shadows, day and night and seasonal appearance of stars in the sky **<u>Skills</u>** Classify bodies in the solar system as stars, constellations, and planets Observe the change in the length of shadows at different times of the day Observe the change in the seasonal appearance of some stars in the sky Infer the relationship between the sun's position relative to the earth and the length and direction of shadows Construct a model to show how the earth's rotation affects the occurrence of day and night Construct a model to show how the earth's rotation affects the appearance of shadows	 Retrieved from: https://images.app.goo.gl/wX6SEpRFHgcbZykA8 *<u>Rubric:</u>* *- Correct position of:* *Sun = 30%* *Object = 30%* *Shadow/image = 30%* *- Neat and clear illustration = 10%* **Using Appropriate Vocabulary** Place the following words in the proper blank to complete a logical paragraph. (Shadow, rotates, longer, shorter, bigger, east, west, rotation, sun, orbit)	Instructions: -Ask learners where they have seen shadows and what creates them *(Shadows can be created anywhere, once there is a light source and an opaque object which blocks its light)* **Let Us Make Shadows** -Divide learners into groups and give each group a set of opaque objects, a flashlight, and a white sheet of paper -Learners are to place the paper on a wall or table, shine the light on the paper, and take turns placing various objects and their hands between the paper and flashlight. Can you make these images?  Retrieved from: https://www.reddit.com/r/coolguides/comments/f4thno/guide_for_hand_shadows/#lightbox

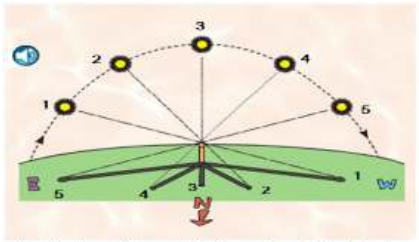
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Construct a graph to show the daily changes in the length and direction of shadows over a specified period Analyse graphical data representing daily changes in length and direction of shadows Analyse graphical data representing seasonal changes of stars in the night's sky Account for the change in the occurrence of constellations using a model of the earth's orbit around the sun. Track the change in constellations by journaling your nightly observations Explain how shadows and an understanding of the sun's behaviour can assist you in orienteering in the forest. **<u>Attitudes/Values</u>** Develop an interest in the mechanisms responsible for changing positions and sizes of shadows, day and night,	The sun is a star that provides the earth light and heat. Over 24 hours, the earth _____ so that we are only seeing the sun a part of a 24-hour day. To start our daylight hours, the sun rises in the _____ and at the end of the daylight hours it sets in the _____. When the sun is low in the sky, we tend to see _____ shadows of things like trees and power poles. At the middle of the day , when the sun is high in the sky and more directly overhead, we tend to see _____ shadows. We know from our torch experiments that the closer to the light source an object is, the _____ the shadow will be. This is because the object blocks more of the light. We see different stars and constellations in the night sky throughout the year because of the _____ of the earth as it _____ around the sun. **Teacher copy** The sun is a star that provides the earth light and heat. Over 24 hours, the earth rotates so that we are only seeing the sun a part of a 24-hour day. To start our daylight hours, the sun rises in the east and at the end of the daylight hours it sets in the west. When the sun is low in the sky, we tend to see longer shadows of things like trees and power poles. At the middle of the day, when the sun is high in the sky and more directly overhead, we tend to see shorter shadows. We know from our torch experiments that, the closer to the light source an object is, the bigger the shadow will be. This is because the object blocks more of the light. We see different stars and constellations in the night sky	**Distance & Direction of the Light Source Makes a Difference** -Have learners change the distance between the flashlight and the object and observe the change in the shadow's shape and size. -Learners should measure and record the lengths of the shadows and also the distances between the flashlight, object, and shadows. -Learners will then shine the light from above, the side, and at other angles and observe and record how the shadow's shape and position changes -Learners will discuss their findings explaining their observations of how distance and angle of light affect shadows. *When the light source is closer to the object the shadow is larger, when the light source is further from the object the shadow is smaller.* *When the light source is directly above the object, the shadow is short and directly below the object. When the light comes at an angle, the shadow is longer and faces the direction opposite the light source* Conduct a field trip in the school's compound or surroundings to observe and discuss shadows of objects or themselves. Have learners work in small groups.

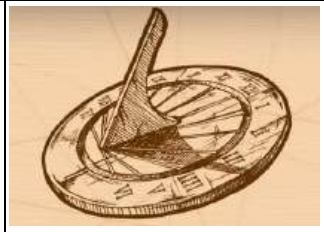
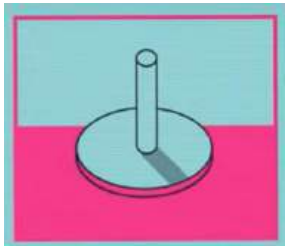
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
seasons and changing the appearance of stars Develop respect for evidence-based reasoning by valuing the importance of evidence and data analysis in coming to conclusions about the effects of the earth's rotation and orbit Work together to determine relationships between the rotation and orbit of the earth and their effects When conducting practical and group work, display sensitivity and help peers who may have physical or learning challenges. Participate actively in classroom discussions.	throughout the year because of the rotation of the earth as it orbits around the sun. **Orienteering** Two pieces of information can be very valuable if you get lost in the woods. Explain the significance of these types of information: a) As you entered the wooded area in the early morning, the sun was at your back. What direction were you walking? (*from east to west*) How will you know what direction to return home at the end of the day? (*the sun will set in the west so you should walk in a direction where the west -sun is at your back.)* *b)* While you didn't notice the time on your watch, you paid particular attention to the shadow of a tree as you entered a forest. After a few hours of walking about, you noticed the shadow of the tree was much smaller and then a few hours later it appeared to be larger again. What can you say about the period of time you witnessed in the forest? (*Before noon, the shadow would be relatively larger but as noon neared, the shadow would get smaller and then shortly after, gain in size again. You were probably spending time in the forest over the lunch-hour. At some point the sun would be very low in the sky, give a large shadow and it should begin to approach sundown (we call dusk))*	*Guiding questions for discussion:* - Look on the ground next to the object(s) you identified, what do you observe *(A shadow of the object)* - How are shadows formed? *(Shadows are formed when opaque objects block or prevent light from passing through them.)* - What is the source of light that resulted in the formation of the shadow(s) seen? *(Sun)* - In earlier grades, you would have learned cardinal points. Can you identify or locate your / the object's North, South, East and West? - What is the direction of the sun? *(West, East)* - In which direction is the shadow formed? *(West, East)* - Describe the length of the shadow in relation to its object. *(Taller, shorter, same size)* - Look at two or more shadows; do they all have the same length? Why? *(No. they are different because the objects which formed them have different heights.)* - Will the length or direction of the shadow change at any time during the day? Give a reason for your answer. *(Yes. The length and direction will change as time progresses during the day due to the different positions of the sun.)* - What movement of the earth may be responsible for this? *(Rotation of the earth on its axis from west to east)* In small groups of 4-6 learners investigate to determine the relationship between the time of the day and the direction of the shadows formed

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	Working With Your Shadow Data Present the completed **Shadow Worksheet 1A** showing length and direction of shadow formed five times during a day. Construct and present a bar graph *(using the data collected during the investigation)* showing the pattern of the changes in the length of the shadow five times during a day. **See Example below**  Retrieved from: https://images.app.goo.gl/vjue34m8LJ2HsAnW6	**Instructions** - Have learners select an object or use themselves to measure the height and note the direction of the shadow formed at various times in the day. - Select a spot in the school's compound/ yard and draw the cardinal points on the ground. *(Use this spot until the investigation is completed)* - Have a learner stand or place an object (large bottle, upright stick, etc.) in the centre of the cardinal points drawn on the ground. - Instruct learners to complete a worksheet by measuring the height of the shadow formed five times during the day. (Ensure to tell learners to stand in the same position and direction each time.) For example,

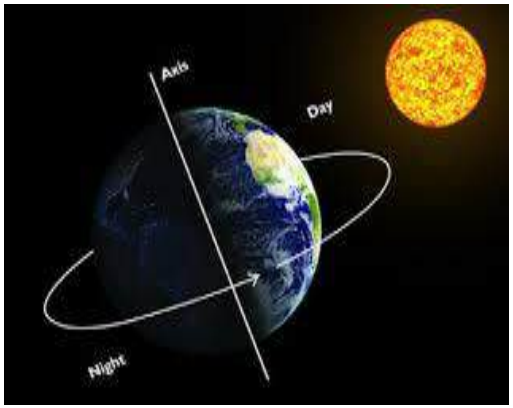
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	<u>*Rubric:*</u> *-Times of day correctly stated on the horizontal= 30%* *- Length of shadow correctly stated on the vertical= 30%* *- Bars drawn to height corresponding to length of shadow= 30%* *- Neat and clear graph = 10%* Have learners share their findings with the rest of the class. **Data Analysis Teacher's Closure Discussion** - In which direction is the shadow when the sun is in the east? (*west*) - How does the sun move across the sky?*(As the earth rotates from west to east, the sun appears to move from east to west)* -How does the length of the shadow change with the movement of the sun across the sky? *At sunrise, the sun is low in the eastern sky and the rays of light strike the earth at an angle that is almost parallel to it. The shadows are long. As the sun rises higher in the sky the shadow becomes shorter. At noon when the sun is the highest point the shadow is its shortest. As the sun goes down towards the western horizon the shadow become longer again* - When are shadows the longest/ shortest? *(Shadows are longest at sunrise and sunset and shortest at noon)* -What factors affect the length and direction of shadows? *(height of the object, angle and distance of light source)*	**Shadow Worksheet 1A** Name: _____ Class: _____ Science Date: _____ **Patterns of daily changes of length and direction of shadows** **Things needed:** Meter rule Pencil Worksheet/ book Sunshades **Object used:** **Height of object = _____ cm** **Time of day** | **Length of shadow in cm** | **Drawing showing direction of shadow in relation to the sun** 09:00 hrs. 10:00 hrs. 11:00 hrs. 12:00 hrs. 13:00 hrs. 14:00 hrs.

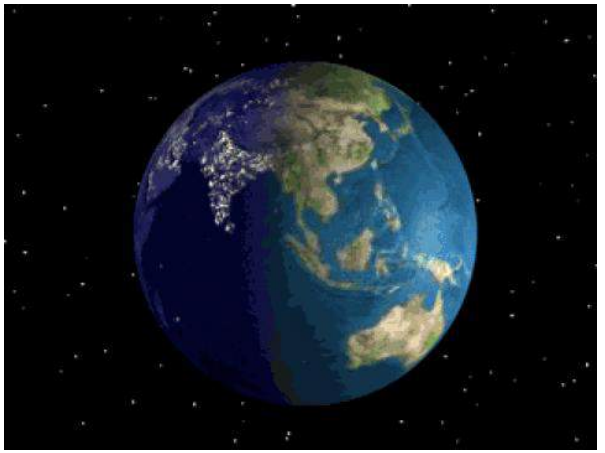
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	Interpreting Data Assign learners a group and have them work together to answer the following questions about the following graph:  Retrieved from: https://images.app.goo.gl/yTVwzpxeTVEGrXLx6 What would be the length of the shadow at B am? *(22 cm)* What is the possible time of day at **E** pm? Give reason for your answer. *(12pm, as the shadow it the shortest)* -If you are walking into the woods in the morning and the sun is above and behind you, where will it be in the late afternoon as you leave the forest on	**Expected Learner Findings to Review**  Retrieved from: https://www.sciencebuddies.org/teacher-resources/lesson-plans/shadow-play  Retrieved from: https://www.crestolympiads.com/topic/class-6-shadows **Using a Globe Model** To assist with understanding the directional aspects of the sun making shadows… • Use a model of the earth (globe), light source (torch light), and objects to demonstrate patterns of daily

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	the same path? (*the sun should be behind you once again- the sun rises in the east and sets in the west.)* Even though time B & H have the approximately the same length, how are the shadows different? (the shadows would be pointed in the opposite direction because the morning sun would be from the east whereas the afternoon sun would be from the west) **How Can We Use the Shadow to Tell Time?** ● Have learners watch the video*:* *https://www.youtube.com/watch?v=1SN1BOpLZAs (4:52 mins)* -Ask learners how ancient civilizations were able to use shadows of the sun for telling the time. (*direction and length of shadows change at different times of the day)* ● Tell learners that some ancient civilizations used an instrument called a sundial for telling time. This is an instrument that uses the position of the sun to tell the time of day. ● Have learners make a sundial for the school:-See: https://www.youtube.com/watch?v=SeSexM-wVzA (1:17 mins)	changes in the length and direction of shadows due to the rotational movement of the earth on its axis. **Instructions:** -Set up the globe on a flat surface -Place the flashlight at a distance from the globe, representing the sun. Position it so that it shines directly onto the surface of the globe. -Turn on the flashlight. -Choose one object. Place it at a specific location on the globe's surface. -Observe and mark the initial position of the shadow cast by the object on the surface. You can use markers or tape to mark this position for reference. -Rotate the globe slowly, representing the Earth's rotation on its axis. As you rotate the globe, observe how the position and length of the shadow changes. For example,  The Sun's position and the formation of the shadow of an object from sunrise to sunset.

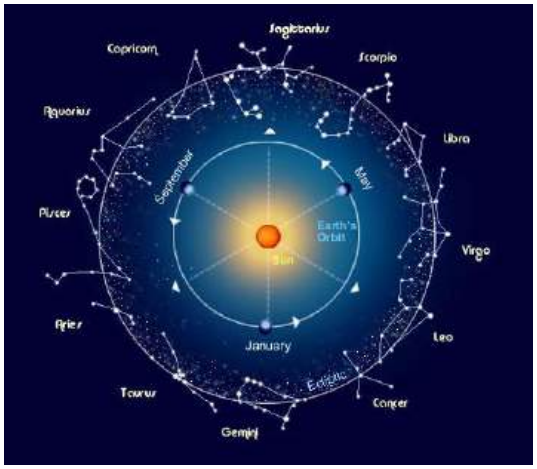
Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	  **Star Gazing Journal** Learners to create a star observation journal entry: Instructions: At night learners should go outside and observe the pattern of stars They should spend about 20 minutes quietly observing and record the patterns and any changes that they observe into their journals using the following format: *Date:* *Location of observation:* *Time; (start and end)* *Observations: Include sky conditions e.g. if it is clear or cloudy, take photos or video recordings of the stars, draw the appearance of stars, describe any changes over time, reflection on how this may have*	Retrieved from: https://images.app.goo.gl/hQCdv19GcRx9EhR8A **Technology Resource** If technology is accessible, show the following video to reinforce the ideas. ● Observe and discuss a video Shadows on earth - https://youtu.be/R8dLhdV6n00 (0:56 s) ● Generate whole class discussion through questioning and presentation of related information: - How does the position of the sun in the sky result in changes in the length and direction of shadows? Explain to learners that *as the earth rotates from west to east on its axis, the sun appears to rise in the East. Opaque objects on Earth block the path of sunlight thereby forming shadows. As the earth rotates the sun appears to move at different positions and heights in the sky. This movement of the earth results in the different lengths of shadows formed during the day with the shortest shadow at midday and the longer shadows at mornings and afternoons.* *While the position of the sun moves from East to west, the direction of the shadow changes from west to east.* **Why Do We Have Day and Night?** ● To determine and activate prior knowledge and possible misconceptions on issues related to day and night, ask learners to tell whether they believe that everyone on earth experiences day and night at the same time.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
	affected your understanding of changing appearance of stars in the night's sky *Rubric:* ➢ *Completed sections with detailed observations and reflections -4* ➢ *Accurate observations- 4* ➢ *Reflection demonstrating an understanding of the seasonal appearance of stars in the night sky 2* ➢ *Neat, well organized entries - 2*	• The teacher performs a demonstration to show the rotation of the earth on its axis and its influence on causing day and night. **Instructions:** -Let learners know that you are going to use a globe/model of the earth to represent the earth and a flashlight/lamp to represent the sun -Place the globe or model of the earth on an uncluttered table in good view of the class. -Turn off the lights in the room and close windows (if necessary) to create darkness. -Hold the flashlight away from the globe, straight across from its surface -Ask participants to observe which parts of the earth are illuminated by the "sun" (flashlight) and which parts are in shadow. -Rotate the globe slowly to simulate the earth's rotation on its axis, while keeping the flashlight in the same position relative to the globe. -As you rotate the globe, ask learners to state which parts are illuminated and which parts are in darkness. Ask learners to explain what they believe that the persons living in illuminated areas experience and what those living in darkness experience. What does that tell us about the rotation of the earth on its axis and day and night? *(As the earth spins on its axis different parts get*

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		illuminated at different times. Illuminated areas experience daytime and dark areas night time) ● Use the following picture to explain to learners how the rotation of the earth on its axis causes day and night:  Retrieved from: *https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcTwg_wMuZIoECpwC4_zYSPfU0JyR8ZGnnaJv0cB_3pFMgc&s* *The earth is constantly spinning, like a top. This spinning of the earth on an imaginary line called its axis is called the rotation of the earth. As the earth spins, the part of the earth facing the sun gets illuminated and experiences daytime. The part that faces away from the sun is in darkness and experiences nighttime.*

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Technology Resource: Animation of Day & Night ● Have learners watch the following animation and use it to explain how the rotation of the earth on its axis causes day and night  Retrieved from: https://media2.giphy.com/media/3YHzWhog1v3HBk3oXm/giphy.gif?cid=6c09b952idkxfkj5l9vi9rtt8go0ycofqtj7665umqbbg051&ep=v1_internal_gif_by_id&rid=giphy.gif&ct=g **Stars & Constellations Change During the Year** ● Ask learners 'Have you ever looked up at stars in the sky? What do the stars look like? Are they always the same? ● Learners to use the simulation tool *stellarium* to observe the appearance of stars at different times of the year

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Interactive Simulation Instructions: Visit: *https://stellarium-web.org* -Observe the appearance of patterns of stars in the night sky. -On the stellarium app, change the time/date and observe how the constellations change. Ask: Why do you think the appearance of stars changes as time changes? Teacher to explain that *constellations are groups of stars. They appear different at different times of the year. This is because the earth is moving (revolving) around the sun. As the earth revolves around the sun, we see different parts of the night's sky (similar to what happens when you are moving around in a vehicle and staring out the window and the scenery changes)* **OR** Learners will observe the following picture:  Retrieved from: *https://orionbearastronomysite.files.wordpress.com/2019/01/summer-winter.jpg?w=1230&h=768&crop=1*

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Ask learners: Why do stars appear different with different seasons? *If observed through the year, the constellations shift gradually to the west. This is* caused by **Earth's orbit** around our Sun. *In the summer, viewers are looking in a different direction in space at night than they are during the winter.*  Retrieved from: https://www.lpi.usra.edu/education/skytellers/constellations/ **Technology Resource to Support Star Changes** • Teacher to use the following video to explain the changing appearance of stars in the night's sky: *https://www.youtube.com/watch?v=U7yqx1hSqlw* (4:19 mins)

Additional Resources and Materials

https://htschool.hindustantimes.com/editorsdesk/knowledge-vine/from-sundials-to-modern-day-watches-how-clocks-evolved-through-ages
https://www.youtube.com/watch?v=N3EqcUNdIl8 **(Video)**
https://www.youtube.com/watch?v=hXZPRocjXsU **(Video)**
https://www.pinterest.com/pin/501588477241446060/?lp=true **(image)**
https://betterlesson.com/lesson/resource/3210509/guiding-questions **(Guiding research questions)**

Additional Useful Content Knowledge for the Teacher

The Big Dipper can be observed in the northern sky. It is useful because it helps you to locate the north polar star. Once you face the pole star (Polaris) you are facing the direction north. The other direction can then be found. The Big Dipper can be seen high in the sky between 7:00 p.m. and 9:00 p.m. (and later) between March and June. The stars of the Big Dipper which point to the north star are called the pointers.
Cassiopeia, shapes nearly like a W or an M, can usually be seen high in the northern sky early at night between October and February at a time when the Big Dipper is too low (on the horizon) to be easily seen. It can also be used to find the north star.

Orion is very too easy to locate in the sky. It would usually be seen between November and March first in the eastern sky and progressively in the western sky early at night.

The Pleiades (they are also called (Seven Sisters) appear as a small group of seven stars. They are easily seen high in the sky around Christmas or between November and January.

Phases of the moon
Phases of the moon are the different ways the moon looks from the earth over about a month. As the moon orbits the earth, the half of the moon that faces the sun will be lit up. The different shapes of the lit portion of the moon that can be seen from the earth are known as the phases of the moon.

Constellation
A group of stars which make up an imaginary outline or pattern in the night sky (the celestial sphere). Usually, they are said to represent an animal, mythological person, or creature in shape.

Opportunities for Subject Integration

Language Arts:
Interpret texts containing descriptions of changes in the daily appearance of shadows, day and night cycles or changing appearance of stars in the night sky
Mathematics:
Measure length and direction of shadows and represent graphically, interpret these graphs
Social Studies:
Explore how different cultures interpreted the appearance of the constellations and their changing appearance

Elements from Local Culture, Technology, TVET, Environment that are integrated

Use of binoculars for observing the night's sky
Use of the sundial for telling time
Evolution of modern-day clocks from the sundial

Engineering

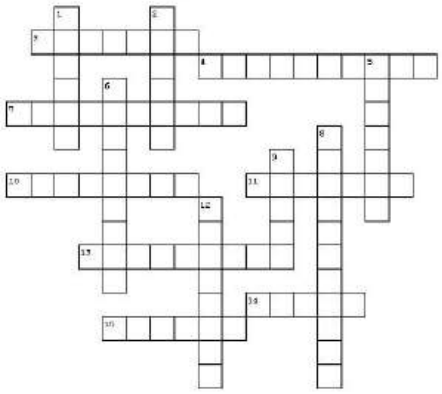
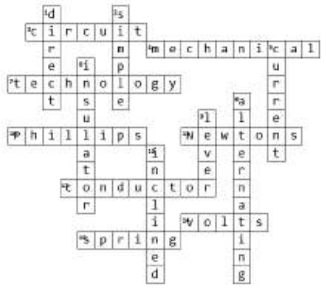
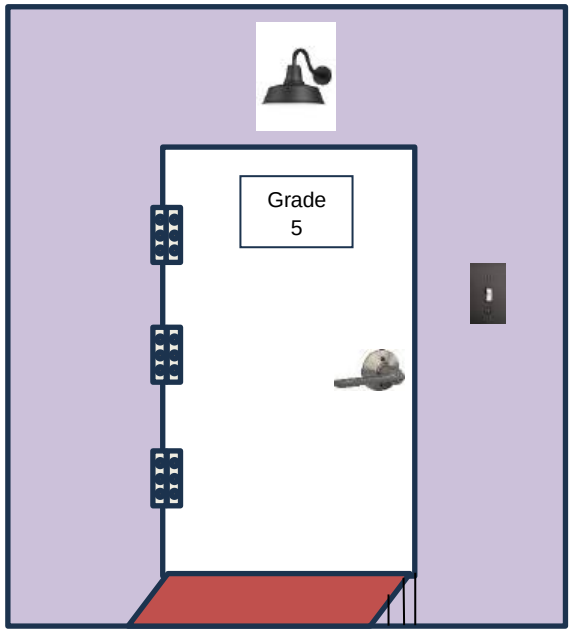
Introduction to the Subject

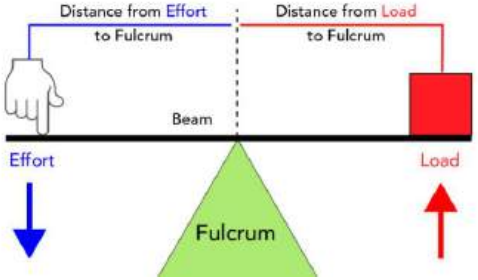
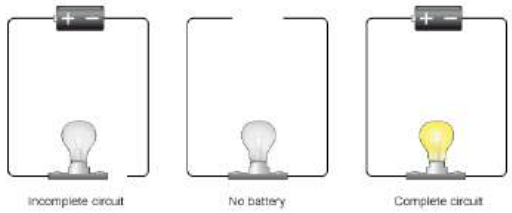
The study of science encompasses knowledge, processes and values. Scientifically literate persons will foster an attitude of caring not only for themselves, but as responsible citizens, for the world around them. Their decision making will be enhanced by a systematic study of the structure and behaviour of the physical and natural world through observation and experiment. In learning science, learners benefit from leveraging and evaluating available technological tools to study and therefore understand the world and their relationship to it.

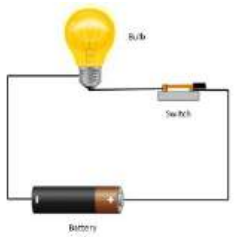
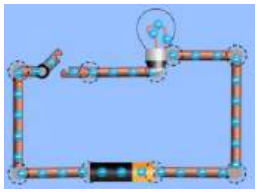
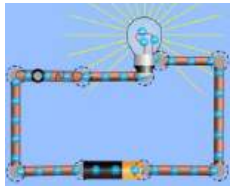
Essential Learning Outcome 1: Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

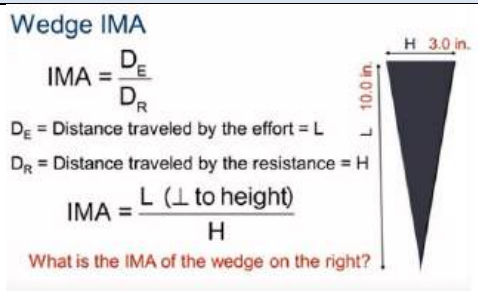
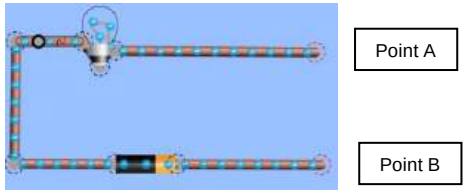
Grade Level Expectations: Refer to grade level expectations at the beginning of this curriculum document.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Learners are expected to: **<u>Knowledge</u>** Define the terms: • Technology • Volts • Potential • Electrical Circuit • Electric Current (electrons) • Direct Current (DC) • Alternating Current (AC) • Electric Switch • Conductor	**Practising Vocabulary** Learners should use the clues below to complete the crossword puzzle.	Human beings are very creative. They are constantly problem solving to make life better. Learners, I am sure you have heard the word technology before. Many people think technology is just computers. Actually, **technology** has been given a simple definition: "a way of adapting". *Learners, I want you to look at the following picture and see if you can identify technology. In other words, ways that humans have adapted their world to make life easier.*

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
• Insulator • Simple Machine • Lever • Mechanical Advantage • Effort Force • Class of Lever • Inclined Plane • Wheel • Spring Balance • Ideal Mechanical Advantage • Wedge • Screw • Hinge • Slot/Philips/Roberson/Allen • Stress • Geodesic Dome • Collar and Rafter Ties • Struts Demonstrate with a picture that they understand the difference between first-, second- and third-class levers. Compare electrical circuits that will generate light and those that won't. Give examples of devices that operate by alternating current. Give examples of devices that operate by direct current.	**Engineering 3**  **Across** 3. complete cycle of electricity 4. we say certain tools give us this type of advantage 7. a way of adapting 10. popular screw head with a cross on it 11. a unit used for measuring force 13. material that allows for electron flow 14. measurement of battery potential 15. this type of balance measures force **Down** 1. type of current from a battery 2. a type of machine that makes our work easier 5. flow of electrons 6. material that limits electron flow 8. type of current from house plugs 9. scissors are an example of this type of machine 12. type of plane the Egyptians used to build the pyramids **Teacher's Copy** 	 ***Teacher Notes*** Overhead light (Invention of Electricity) Hinges (Attached by Screws) Door latch (Example of a Lever) Light Switch (Electrical Circuit) Ramp (Example of an Inclined Plane) Let us look at each of these technologies.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Account for how a switch controls whether a device is able to operates by dc/ac. Explain with a diagram how a lever can solve a problem. Distinguish between insulator and conductor using examples. Give examples of common devices that make use of insulating materials. Identify and describe simple mechanical devices (hinges, screws, screw drivers) (ST 2 PS FMS 4) Realise the importance of safety in handling tools an making gadgets. (ST 2 TE NT 3) Formulate problems and do research in development of technological devices. e.g. construct models and gadgets. (ST 3 TE TM 1) Identify and explain the ways in which strengthening mechanisms are used to resist stress in structures under load. E.g. struts to resists compression, ties to resists tension. (ST 4 PS FMS 7) Identify and describe how forces can alter shapes of objects. E.g. bending, stretching, pulling, twisting. (ST 4 PS FMS 8)	Retrieved from: https://crosswordlabs.com **Electricity: One-page Response** Draw a picture of a complete circuit that includes a battery, a light and a switch. Explain how the switch works to control the light. (*preventing the flow of electrons to the bulb eliminates the glowing the accompanies electron flow in the filament)* **Insulators vs. Conductors** 1. Use examples to explain the typical characteristics of conductors and insulators. (*conductors often metallic*) 2. Do internet research to investigate and report to your peers on at least three examples of how humans have used insulators as a technology to make life better. (*jumper cables, pan handles, screwdriver handles)* **Lever: Calculations of Effort** (differentiated for stronger learners)  	**Electricity** Often to operate a flashlight or small radio we need a battery. What do we see written on the battery? (*some number of volts)* **Volts** are a measure of the **potential** for the battery to do work. If we take a copper wire and attached it to a battery and a light bulb, we can get the bulb to light but only if it is a closed loop. Below you can see that the first two arrangements would not light a bulb. The closed cycle in the third picture is referred to as an **electrical circuit.**  Retrieved from: https://www.edu.xunta.gal/centros/iesfontexeria/aulavirtual But what is happening in the wire? The wire and the tiny filament (wire) in the bulb have something in them called electrons. When we add a battery to a wire in a complete cycle, the battery makes the **electrons** move which we call **electric current**. When the electrons move through a thin wire (filament) in a bulb it causes the wire to heat up and glow. This type of current from a battery is called **direct current (**abbreviated **DC)**. The electricity in our homes is different. It doesn't come from a battery; it is generated elsewhere and brought into our houses with large wires. It is called **alternating current (**abbreviated **AC).** We can still put AC through a filament in a bulb and generate light.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
Explain how ties can be used in roof construction to mitigate the effects of strong winds. Identify and name parts of a simple circuit and demonstrate by setting one up. (ST 5 PS EN 1) Distinguish giving examples, the differences between conductors and insulators. (ST 5 PS EN 2) Name the instrument used to measure force and the unit in which it is measured. (ST 5 PS FMS 1) Identify a number of common levers and describe how they operate to make work easier. (ST 5 PS FMS 3) Name the points of a lever giving some common examples. (ST 5 PS FMS 4) Identify the main parts of a wheel and an axle giving examples and describing how the objects function. (ST 5 PS FMS 5) Define a simple machine, giving examples, and explaining how they make work easier. (ST 5 PS FMS 6) Infer that an incline plane decreases the force required to lift an object. (ST 5 PS FMS 8) Account for how a wedge is simply an example of an inclined plane and list	Retrieved from: https://www.twinkl.es/teaching-wiki/first-class-lever In this model, the following relationship can be proven out by experimentation: **Effort Distance x Effort Force =Load Distance x Load Force** Have learners fill in the following table (*and, if equipment invites, demonstrate their intuition about the numbers using a metre stick, fulcrum, masses and a force spring scale)* Effort Force (Newtons) / Effort Distance (cm) / Load Force (Newtons) / Load Distance (cm) ? (5) / 20 / 10 / 10 10 / 20 / 20 / ? (10) 10 / ? (15) / 10 / 15 15 / 30 / ? (10) / 45 **Draw a Picture** of the Three Classes of Levers. Give an example of each type of lever. **Calculating the Ideal Mechanical Advantage of a Wedge** (differentiated calculation for stronger learners)	**Switches Interrupt Electricity Flow** If you look at the diagram of a direct current circuit below, you see that we can break the cycle by putting in an **electric switch.** If the switch is opened, the electrons cannot complete the cycle by moving from one end of the battery to the other. Therefore, the filament will not glow and provide light. In our picture of the door above, you can see a light and a switch; both are important technologies (inventions.)  Retrieved from: https://scienceshifu.com/what-are-series-and-parallel-circuits/ Experiments If the teacher has the materials (wire, battery, light and switch they should have learners build the circuit by hand. If the teacher has access to the internet they should have learners build the circuit below using the PHET simulation at: https://phet.colorado.edu/en/simulations/circuit-construction-kit-dc  

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
examples of its use, explaining how they work. (ST 5 PS FMS 9/ ST 6 PS FMS 11) **Skills** Observe a picture and identify human inventions (door example) Use pictures and classroom materials to build simple circuits and explain how they operate to provide a lit bulb. Classify items which operate by direct current or alternating current. By experiment, distinguish conductors and insulators. By experiment, distinguish the effort force required for various configurations of the first-class lever. Measure the force to pull and object up an inclined plane using a spring balance. Measure the force to lift an object using a spring balance. Calculate the ideal mechanical advantage (IMA) of an incline plane. Describe the process by which a hinge can be properly installed on a door. Use drawings to explain how ties can be used in constructing a roof to resist high winds.	 *(IMA = 10/3 = 3.33)* Learners, what does this number mean? *(This means, that ideally, for an effort force of 1 directed down on the wedge you get an output force of 3.33)* **Build a Wind-Powered Car** Design retrieved from: MacKinnon, G. R. (2001). Mass production: Not at all beyond elementary school curriculum, *Technology and Children 5*(2), 3-8. Design Challenge The instructions below would invite a teacher/learners to build a model car. It is only meant as a possible starting design. Learners in groups would be expected to create a prototype car which a single learner would race down a hallway by blowing behind the sail. If the hallway is wide enough, several cars could be raced at once. If it is a narrow hallway, the teacher could establish a starting line and a finish line and record the time of	*Test 1*: what happens to the brightness of the bulb if you double the number of batteries in the circuit above? (*the light gets brighter*). Explain why this happens? (*with two batteries you have twice the potential to push electrons through the circuit)* *Test 2* What happens to the brightness if you pass the current through two bulbs one after the other? (*the bulbs will be dimmer*) Why does this happen? (*some of the energy from the electron flow is spent in each of the bulbs so that over the light is dimmer*) **What Materials Invite Electrons to Flow?** The teacher should set up a demonstration that resembles the diagram below  Questions for learners: If we place a copper wire between Points A & B, we know that the lightbulb will glow from electron flow. We would say that copper is a **conductor** of electricity. If we place a piece of wood (maybe a ruler) between Points A & B, the lightbulb will remain unlit. We would say that wood acts as an **insulator** because it does not invite electrons to flow. Let us predict whether the following bridging items will be conductors or insulators and then test them to confirm our predictions.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies

Perform calculations on effort force and load for a range of first-class lever.

Calculate ideal mechanical advantage for a wedge.

Evaluate, design and build a prototype wind car.

Use Fablab software to create three dimensional geometric figures that may assist with the design of stronger structures.

Having measured force acting on an object using a spring balance, design and use a simple device used to measure force. (ST 5 PS FMS 2)

Predict the force that will balance a lever with an off-centre fulcrum. (ST 6 PS FMS 4)

Research the use of a wheel in a variety of situations, citing their impact. (ST 6 PS FMS 5)

Examine the use of simple machines in simple devices in the home and community. E.g. openers, egg beaters, seesaws (ST 6 PS FMS 6)

Attitudes/Values

Identify and appreciate that the gadgets, tools and structures used in their homes and communities are made by humans. (ST 3 TE UT 1)

travel. To be a true "controlled" experiment to test the speed of the prototypes, the same person should supply the wind power for the trials.

The variables that learners can test for speed by design are:

- The shape and size of the sail
- The size of the cans used for the wheel assembly.
- The size of the rectangle frame

Beginning design

Materials needed:

Car Frame: (8mm x 8mm x18 cm) 4 per car (recommend precut for learners)

Cross Member Support for Mast (8 cm x 8cm x 21 cm) drill hole for upright mast

Corner Triangles: (4 cm x 4cm x 5cm) 8 triangles per car frame (recommend heavy stock paper)

White or Hot Glue: to affix paper corners on wooden frame.

Axle Dowels: (21cm x .64 cm) 2 per car

Mast Dowel: (22cm x 0.5 cm)

Soda Can circles (5.5 cm diameter Bristol board)

Material between A & B	Conductor or Insulator?
Aluminium foil	
String	
Plastic	
Rubber eraser	
Iron nail	
Pencil with exposed graphite ends	
Glass	
Paper clip	

Note: If the teacher has the materials, they may also try water and salt water. Conduction of the salt water can be explained by the fact that NaCl (salt) breaks up into sodium and chloride parts called ions that invite for electrons to flow.

Design Features That Rely on Conductors/Insulators
We use the property of conduction in our technology design if we want electricity to flow. A copper wire often has plastic or rubber coating. The copper wire we want to conduct the electricity but we know it will come in contact with other objects (including our hands) so we put an insulator on the outside so the electricity doesn't flow beyond the copper wire and give us a shock!

Learners have you ever seen one of these?

Retrieved from: https://www.electricaleasy.com/2016/10/insulators-used-in-overhead-power-lines.html

Often on older electrical poles we see glass pieces holding the high voltage wire. The glass acts as an insulator so that the

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Demonstrate interest/curiosity to design a better wind car. Demonstrate a spirit of inquiry as learners perform experiments. Demonstrate an appreciation for past cultures who exercised human ingenuity/inventiveness to gain mechanical advantage over enormous tasks. Demonstrate a spirit of collaboration & cooperation as learners worked together on experiments. Demonstrate an appreciation of the importance of safety as we construct things in our classroom and in the greater world. When conducting practical and group work, display sensitivity and offer assistance to peers who may have physical or learning challenges. Participate actively in classroom discussions.	***Rubber tubing (axle stops)***: (0.64 cm diameter) **Rubber bands:** 1 cm width- 6 per car **Sail:** standard 8.5 x 11 inch, sheets with holes punched for mast  	electricity only goes through the wire and doesn't jump to other objects. **Door Handles as Levers** In recent years, door handles have been redesigned to make doors easier to open especially by occupants that may have physical challenges grabbing a traditional round doorknob. Learners, have you ever seen somebody move a rock with a piece of wood and a pivot point (triangle in this picture). It might look something like this picture.  Retrieved from: https://www.twinkl.es/teaching-wiki/first-class-lever Why do you suppose they use this combination of objects when they could just lift the rock out of the way? (*it might be easier to use this approach*). It definitely takes less effort to lift the rock using this **simple machine** we call a **lever.** Have you ever heard the word advantage? Can you use it in a sentence? What does it mean in this sentence? Josephine crossed the finished line in the race because she had the advantage of longer legs. (*she was well-suited for running*). When we use simple machines like the lever, we do so because we are getting a **mechanical advantage**; it is easier to complete the task with the machine. For instance, humans invented the wheel for things like trolleys and wheelbarrows because it took less effort to move heavy items than simply carrying them by hand. Where else do see the mechanical advantage of a wheel used? (*bicycles, cars, prams, pianos, medical stretchers*)

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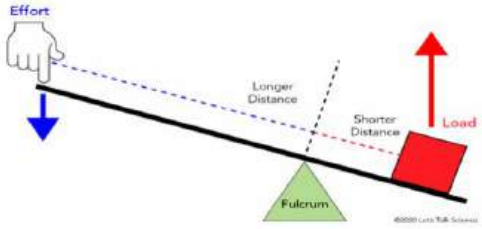
	 As car prototypes are compared for speed, learners should make note of the features that promote the fastest designs. The learners should submit a report that responds to the following rubric: ➢ Statement of the design challenge: 2 marks	**Problem With Levers** Which arrangement of a lever do you think would take the least effort to lift the stone (load) by applying an **effort force** downward at the red arrow? Why?  Our intuition is that the second lever arrangement would require the least effort force downward. Try it with a ruler, eraser and book!  Retrieved from: https://letstalkscience.ca/educational-resources/backgrounders/simple-machines-levers This is one type of lever called a first-class lever. In a first-class lever, the fulcrum is located between the load and the effort. When the fulcrum is closer to the load, then less effort is needed to move the load.

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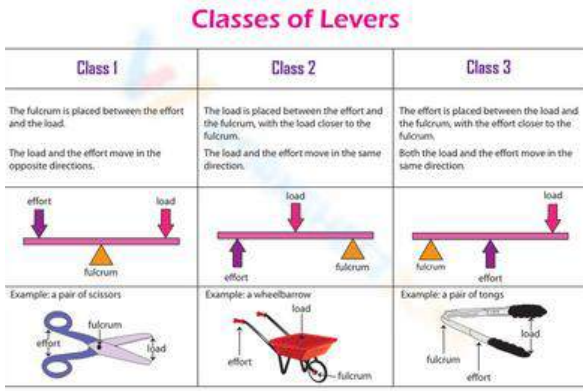
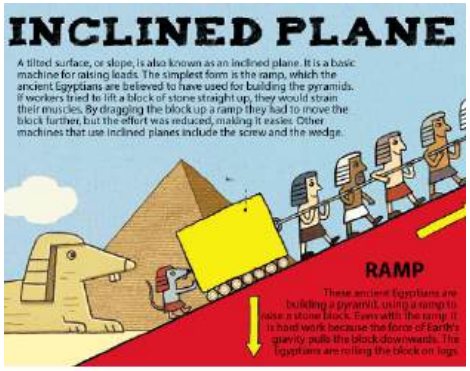
	➢ Sketch with dimensions: 5 marks ➢ Materials list: 3 marks ➢ 'Recorded data from trials in a neat table (com paring group designs:5 marks ➢ Discussion of best designs and the rationale for the features that seemed to promote the fastest cars: 5 marks ***NOTE: In assembly of prototype wind cars, learners should exercise caution as they use tools to cut wood and bore holes in wood and metal*** **Extension Activity-** **1) Integration of Mathematics and Strength of Objects** The teacher may download the following FABLAB software and with the aid of a printer, learners can construct geometric shapes that contribute to strength in the design of gadgets. See: https://fablab-modelmaker.software.informer.com/ **2) Integration with Language Arts Design technology:** **See The Boy Who Harnessed the Wind**	Other types of levers help us solve practical problems.  Retrieved from: https://worksheetzone.org/the-three-classes-of-levers- **More Simple Machines That Give us Mechanical Advantage**  Retrieved from: https://steemit.com/technology/@ghostgtr/how-stuff-works-machines-and-energy

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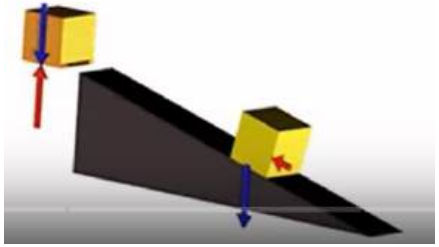
	https://www.youtube.com/watch?v=_YL9a-LOq-8&list=PL8VcP9QsZOJ42LQZHuyABBb01DOFQZL2L (2:32 mins)	The inclined plane is a simple machine that has helped humans a very long time. A good example is the building of the pyramids in Egypt. These structures were made of large stones and it was near impossible for the workers to lift the stones but…they had the necessary effort force to slide it on a ramp that we call an **inclined plane**.  Retrieved from: https://www.youtube.com/watch?v=QuwUiaMag9Y (20.50 mins) They also would place logs under the stone to help it roll up the plane. This demonstrates human problem solving in that the logs were an early version of the **wheel,** yet another simple machine. ➢ What re the parts of a wheel? (*axle, spokes, circumference)* ➢ How is the mechanical advantage of wheels used for devices in our world today? (*wheelbarrow, carts, cars, bicycles, pulleys, water wheels*) 

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		Retrieved from: https://pixabay.com A video resource to teach about the wheel and axle if the teacher has access to technology. https://www.youtube.com/watch?v=FT_5lICNVtw (1:25 mins) The teacher can pose the following questions to learners before they watch the video: a) what are 5 examples of the wheel and axle in the video. (well wheel, steering wheel car and boat, hand drill, rolling pin, bike pedal) b) How does the wheel and axle apply mechanical advantage? (*larger wheel with less effort turns smaller wheel many times*) **Measuring Forces With A Spring Balance** Let us see the difference in effort force by using a force meter (called a **spring balance**) to measure the force necessary to: a) Lift a mass (marbles in a bag) directly upward against gravity. What is the force measure? b) Pull the same bag of marbles up a ramp. What is the force measure?

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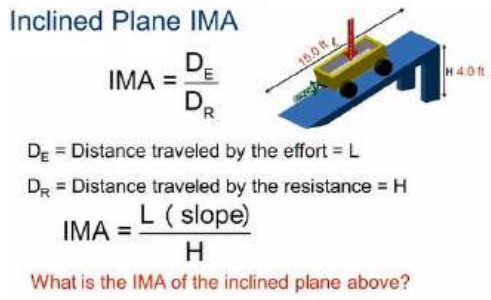
		It should look like this:  Retrieved from: https://www.youtube.com/watch?v=Gc4rY_n3n0Y You may pull the marbles a longer distance than a direct lift but, you will find that the effort force is less. The inclined plane gives us a **mechanical advantage.** **Calculating the Ideal Mechanical Advantage.(IMA)**  **Retrieved from**: https://www.youtube.com/watch?v=QuwUiaMag9Y (20.50 mins)

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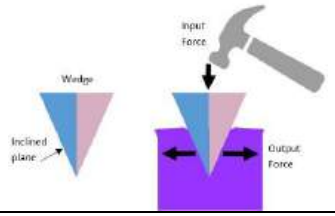
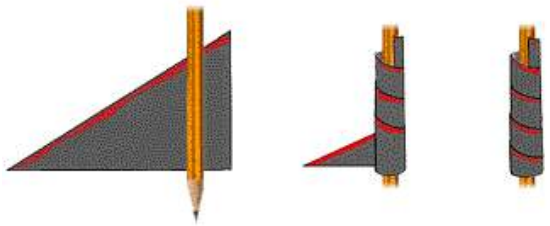
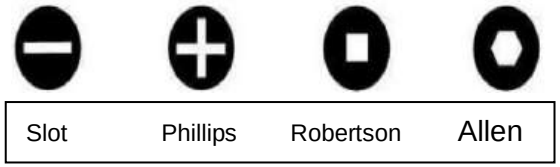
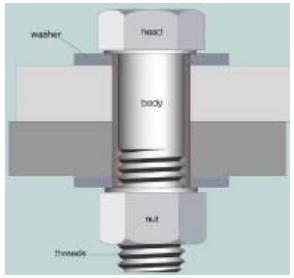
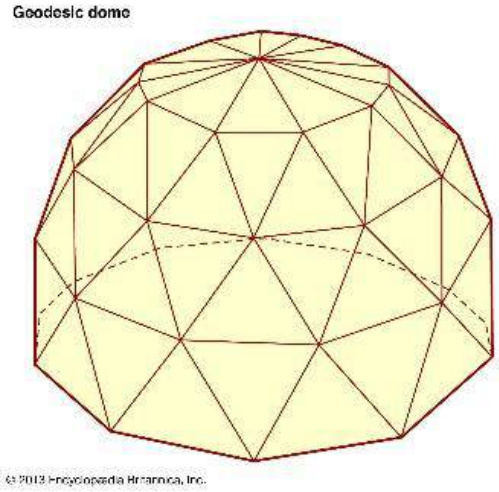
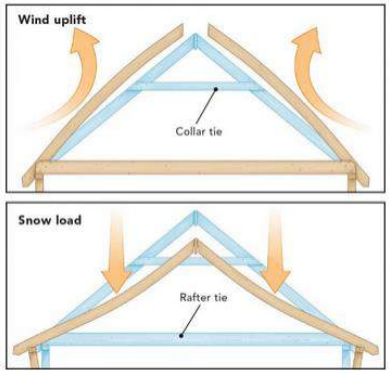
		I M A = 15/4 = 3.75 This is saying that ideally using the ramp to lift this car is almost 4 time easier than lifting the cart from the floor to the top of the ramp. But if you use a spring balance to actually measure the ratio of the Force to lift the cart versus the Force to drag the cart up the plane you will get a number for mechanical advantage smaller than 3.75 (maybe 3.25) in other words, the Actual Mechanical Advantage A M A). *The AMA is always smaller than the IMA!* Learners, why do you think we don't get quite as much mechanical advantage as we thought? (friction between the load and the surface of the ramp) In our picture at the beginning of class we see a ramp leading up to the door. Particularly for a learner in a wheelchair, the effort force to cruise up the ramp is less than lifting the chair from the ground to the door sill, something that would not be possible for a person confined to a wheelchair. **More Examples of Inclined Planes: Wedge& Screw** The shape of an inclined plane is special. If we turn it to face the point down, it resembles another important simple machine called a **wedge**. Learners, can you tell me some examples of where we use a wedge? (*door-stop, closing up cracks in wood floors, splitting wood*). 

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Retrieved from: https://inventorsoftomorrow.com/2016/10/12/wedges-2/ If you look closely at a **screw**, you will see that it is really just an inclined plane wrapped around a centre cylinder. The example below is a paper inclined plane wrapped around a pencil.  **Retrieved from**: https://www.geocities.ws/jaywilliams.geo/simmach.html Learners, what problem does the screw solve for us; how are they used? (*fasteners for wood and metal*). Did you notice the **hinge** on the door in our first picture? It is a very useful technology for inviting a door to swing open and closed but…it needs to be fastened to the door and the casing surrounding the door in order to operate. That is where a screw is useful. Keep in mind, that as the screw is inserted into wood, it exerts great force on the wood. How do you suppose a screw is used to fasten a hinge on a door? (*we use a screwdriver as a tool to insert the screw).* Screws have different head impressions, so we have to choose the correct screwdriver. Can you tell me the shape on the screw heads you have observed?

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		 In early days carpenters only had access to slot screws. Why did humans invent more head designs? (*the slot screwdriver would slip out of the slot when great twisting motion (**torque**) was applied. The new heads reduced the slippage.*) So, to place a hinge on the door, we would: • select wood screws of a length that could hold our heavy door. • choose a good screw head design to reduce slippage. • keep the wood from splitting, by marking the screw holes in the hinge (while it was held to the door in the right position) and drilling small holes where the screws will be inserted. • Turn the screw in a clockwise motion until it pressed the hinge hard against the door. Nuts and bolts are also useful fasteners that make use of a spiral thread like the screw. We can fasten items together by holding the bolt tightly with a wrench and turning the nut clockwise to tighten, counterclockwise to loosen.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		 **Retrieved from:** https://www.britannica.com/technology/bolt-fastener **Technological Designs That Enhance Structural Support** You will notice in our initial door picture that the inclined plane has supporting structures that serve to strengthen the ramp. If those supports were not in place, what might happen to the ramp? *(it could collapse under stress)* Humans have developed many supporting structures/inventions to resist the **stress** that large forces put on the object. *Learner investigation on the internet* Identify and describe how forces can alter shapes of objects. E.g. bending, stretching, pulling, twisting Human beings have done much work to create stronger structures. A bridge for example or **geodesic dome** use triangles to improve strength.

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		 **Retrieved from**: https://usbridge.com/bridges/ Geodesic Domes are particularly strong. They use to be used for enclosing radar for tracking airplanes at airports.  **Retrieved from:** https://www.britannica.com/technology/geodesic-dome

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Scaffolding for building construction is another example of how stress forces can be reduced by structural ties.  Retrieved from: https://superiorscaffoldingauckland.co.nz/metal-frame-scaffolding/ **Ties Are Used to Support Housing Structures** Depending on the force that is placed on a roof, **collar ties and rafter ties** help to maintain the structure from collapsing. 

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Retrieved from: https://www.finehomebuilding.com/project-guides/framing/how-it-works-collar-and-rafter-ties **Struts to Reduce Compression** Struts are used in airplanes to strengthen the wheel assembly against violet bumps as the airplane lands.  **Retrieved from**: https://en.wikipedia.org/wiki/Strut Struts are used in automobiles to reduce abrupt bumps in the road. 

Specific Curriculum Outcomes	Inclusive Assessment Strategies	Inclusive Learning Strategies
		Retrieved from: https://image.slidesharecdn.com/final-191112194440/75/members-under-compression-concept-of-columns-and-struts-concept-of-buckling-3-2048.jpg?cb=1669134382 Ask learners where they have seen struts used? (*motorcycles, jet airplanes, bicycles, ATV's, minivan rear window supports*)

Additional Resources and Materials

Conductors/Insulators: https://www.youtube.com/watch?v=pr0VC0o3uqQ (6:05 mins)
Inclined planes: https://www.youtube.com/watch?v=sTOWiDDgTIk (2:55 mins)

Levers:
https://www.youtube.com/watch?v=fzljPiPy9nw (2:43 mins)
https://www.youtube.com/watch?v=MWHRVnQ9O4I (3:24 mins)
https://www.youtube.com/watch?v=A0y_2b8SSbs (6:16 mins)

Wheel and Axle: https://www.youtube.com/watch?v=FT_5lICNVtw (1:25 mins)

Additional Useful Content Knowledge for the Teacher

More examples of Simple Machines :
https://www.youtube.com/watch?v=fvOmaf2GfCY (6:11 mins)
https://www.youtube.com/watch?v=tk9iUjMEnaY (5:41 mins)

Mechanical Advantage Calculations:
https://www.youtube.com/watch?v=wIaHQsxGj78 (8:02 mins)
https://www.teachengineering.org/lessons/view/cub_simple_lesson04

Opportunities for Subject Integration

Extension Activities:

1) **Integration of Mathematics and Strength of Objects**
   The teacher may download the following FABLAB software and with the aid of a printer, learners can construct geometric shapes that contribute to strength in the design of gadgets.
   See: https://fablab-modelmaker.software.informer.com/
2) **Integration with Language Arts**
   Design technology:
   See The Boy Who Harnessed the Wind
   https://www.youtube.com/watch?v=_YL9a-LOq-8&list=PL8VcP9QsZOJ42LQZHuyABBb01DOFQZL2L (2:32 mins)

Elements from Local Culture, Technology, TVET, Environment that are integrated

- Understanding variables in science experiments helps us design problem solving tools (technologies) to improve the human condition.
- Use of tools and the design loop
- Island's participation in FIRST Global Robotic Challenge.

Participants get to build prototype robots to execute a task/challenge. https://first.global/fgc/
The 2024 challenge https://www.youtube.com/watch?v=VoT_eVi7vQ0&t=20s

Saint Lucia https://first.global/2023-nations/saint-lucia-2023/
https://first.global/2024-nations/saint-lucia-2024/

Grenada https://first.global/2023-nations/grenada-2023/
https://first.global/2024-nations/grenada-2024/

Saint Vincent https://www.stvincenttimes.com/svg-robotics-team-placed-67th-at-first-global-challenge-2023/
https://first.global/2024-nations/saint-vincent-and-the-grenadines-2024/

Dominica https://first.global/2024-nations/dominica-2024/

Items of Inspiration

This ELO purposely included practical everyday knowledge around the use of simple machines