Science

Teacher Guide

Grade 6

Standards Based

Papua New Guinea
Department of Education

Science

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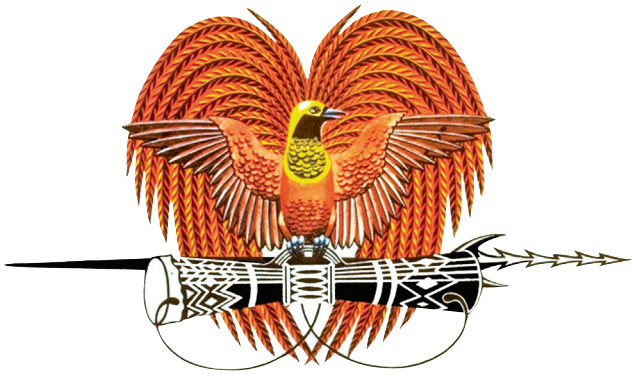

Papua New Guinea

Department of Education

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Contents

Secretary's Message

The Papua New Guinea Department of Education embraced the challenge of creating Standards Based Curriculum in response to the Cuba Report and the Task force Recommendations 2012.

The Grade 6 Teacher Guide has been realigned, repositioned and replaced with standards based statements to improve knowledge, skills and competency in all domains of science including Life Science, Physical Science and Earth and Space.

It has been designed with a view of making the students understand the basic scientific knowledge and skills in accordance with daily experience and prior knowledge about the environment and understanding of what is around them in a simple way thus will become the foundation of learning science at Grade 6.

Teachers are encouraged to read this teacher guide book carefully and become familiar with the content prior using it so that they can be confident to try out new concepts and strategies and to teach the content well. They can also adjust to suit the needs of their students learning effectiveness.

Teachers are also encouraged to make reference to the National Science Textbooks to effectively plan and teach their lessons.

I wish every Grade 6 teachers in Papua New Guinea, every success in their teaching of Science.

I commend and approve this Grade 6 Science Teacher Guide to be used in all primary schools throughout Papua New Guinea.

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DR. UKE W. KOMBRA, PhD
Secretary for Education

Introduction

The Grade 6 Science Teacher Guide is developed as a support curriculum material for the Science Syllabus at Grades 6, 7 and 8 level. The information and guidelines provided in this book are translated from the content standards and benchmarks prescribed in the Grades 6, 7 and 8 Primary Science Syllabus into teachable activities. The suggested teaching and learning ideas provided are to assist you to plan quality science lessons and how to use benchmarks in relation to the attainment of standards.

The content of this guide features the following sections:

- key features of the subject
- planning and programming
- unit content background information for the teaching contents
- guided lesson samples of the subject
- knowledge, skills, attitudes and values (KSAVs) for teachers to plan and teach
- assessment and reporting of the subject
- resources
- appendices.

Purpose

The main purpose is to implement the Grade 6 Science content as prescribed in Syllabus to teach students in the classroom. This Teacher Guide must be used in conjunction with the Grades 6, 7 & 8 Syllabus.

This teacher guide is intended to provide Grade 6 teachers with guiding information about:

- interpreting and translating the prescribed content into teachable program plans
- planning and developing teaching and learning activities for the achievement of Content Standards and Benchmarks
- how to use the suggested teaching and learning content to plan quality science lessons
- how to prepare active and interactive teaching and learning environment using science teaching and learning strategies
- creating assessment plan with rubrics to achieve identified content standards and benchmarks.

How to use the Teacher Guide

Teachers are encouraged to use this Teacher Guide as the main reference to plan and implement the Grade 6 contents as prescribed in the Grades 6, 7 and 8 Primary Science syllabus.

Teachers should do the following before and when using this guide:

- Read this teacher guide very carefully to understand the content and what will be required for your classroom teaching.
- Read the syllabus and become familiar with strands, units, content standards and benchmarks which are further expanded in this book.
- Take note of science teaching and learning strategies, process and skills; and content background information to improve and upskill your teaching pedagogy and content knowledge when teaching in the classroom.
- Read and understand the structure and content of sample guided lessons.
- Read and understand how the assessment plans and tasks are structured so that you can design appropriate assessment plans.

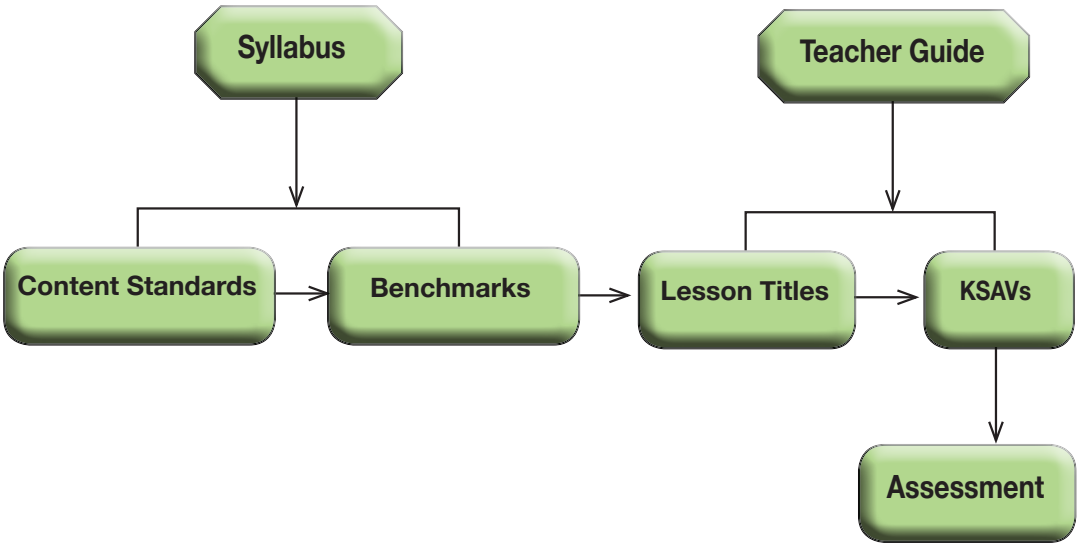


Figure 1.1: The organization chart above illustrates the link between the science syllabus and the teacher guide.

Key Features

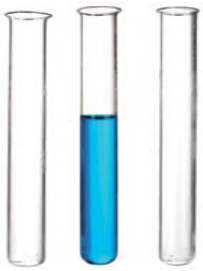
The key features outlined in this section are identified as unique to Science are important in the planning and teaching of Science. The key features of Grades 6, 7 and 8 Science Curriculum emphasizes recommended knowledge and skills and processes and provide ideas on how to teach practical science and its theories with and without a laboratory and practical Science.

1. Working in a laboratory

1.1 Laboratory equipment

In the Science laboratory, there are many different pieces of equipment. Before students can begin experiment they need to be able to identify these items and know what they are used for. Students also need to be able to spell their names correctly, and draw them when they write report of experiments.

COMMON LABORATORY APPARATUS AND EQUIPPMENT



Test Tubes

It is a cylindrical glass tube whose one end is open while the other closed end is curved outwards. There are different types of test tubes made of different types of glasses. Test tubes are available in different sizes. Test tubes are used for heating and boiling small quantities of chemicals.

Test tube stand or rack

A test tube stand or rack is made up of steel, plastic or wood. It is used to keep test tubes. It has bars and holes to keep the test tubes in inverted or upright position respectively.

Test tube holder

It is a metallic rod with plastic or wooden handle at one end and a clamp at the other end. It is used to hold a test tube either while heating a substance or when strong chemicals like acids or alkalis are poured into another apparatus.

Beaker

It is an open glass container, cylindrical in shape, with a flat bottom and a lip for pouring. Beakers are available in a wide range of sizes and are made of different types of glasses. There are beakers with and without graduations. Beakers are used for stirring, mixing and heating solutions.

Round-bottom Flask

It is a glass container with spherical bottom and a narrow cylindrical neck. It is generally used for heating solutions. The round bottom of the flask allows uniform heating and/or boiling of solutions. Round-bottom flasks are available in many sizes.

Conical Flask

A conical flask is also known as Erlenmeyer flask. It has a flat bottom, conical body and a cylindrical neck. It has markings on its outer surface to indicate the approximate volume of contents. It is often used to heat solutions and for titration experiments.

Glass Tubing/Tube

It is a hollow piece of glass and is open at both the ends. It can be bent by heating to red hot over a non-luminous Bunsen flame, to transfer gases from one vessel to another.

Glass Rod

It is also known as stirring rod. It is a solid glass tube. It is used to stir solutions in flasks and beakers.

Funnel

A funnel has a conical-shaped mouth and a long tapering neck. It is used to pour liquids or channel fine grained substances into containers with a small mouth. It is available in various sizes and is usually made of glass or plastic.

China dish

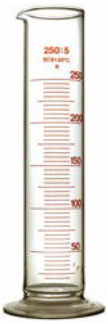
It is also called an evaporating dish. It is made of porcelain. It is used to evaporate liquids by heating.

Pipette

It is a long narrow tube with a nozzle at one end and a bulb in the middle. Nowadays, pipette with a rubber vacuum bulb is also available. A pipette is used to transfer a measured volume of liquid.

Measuring Cylinder

It is also called graduated cylinder. It is a cylindrical graduated glass or plastic vessel with a flat bottom and lip for pouring. A measuring cylinder is used to measure a fixed volume of liquid.



Retort Stand

It has a long iron rod fixed on a flat base. Clamps can be attached on the iron rod. It is used for holding apparatus such as round-bottom flasks or test tubes in a specific position.

Tripod Stand

It has three legs and a triangular base in the middle. It is made of iron. A tripod stand is used for supporting apparatus while heating.

Asbestos Wire Gauze

It is an iron wire mesh with thin asbestos in the middle. It is placed over the tripod stand to provide a stage for a glass apparatus while heating. It helps in even distribution of heat from the burner to the glass apparatus.

Pestle and Mortar

A pestle is a heavy baseball bat-shaped stick whose end is used for pounding and grinding. A mortar is a bowl in which the substance to be grind, crush or mix is kept. Pestle and mortar are made of porcelain, stoneware, marble and wood. They are used to crush, grind and mix solid substances.

Spirit Lamp

It is a device used for heating purposes. It burns alcohol or other liquid fuel. It has three parts—tank, neck and cap. The fuel is filled in the tank. A cotton wick that is immersed in the fuel passes through the neck. The cotton wick soaks up the fuel and burns when lighted. The flame of the spirit lamp is extinguished by carefully covering it with the cap (cover).

Note: A spirit lamp should never be extinguished by blowing air from the mouth.

Bunsen Burner

These days spirit lamps are replaced by another heating device called Bunsen burner. It consists of a mixing tube in which gas and air are mixed. The gas comes from the nozzle and air comes from the air holes. When ignited, it burns with a blue flame on top of the burner. The flame can be adjusted by opening or closing the adjustable air holes.

Spatula

It is like a spoon. It is used to take small quantities of solid chemicals.

Dropper

It is a long tube made up of glass or plastic with a vacuum bulb at one end. A dropper is used for drawing a liquid and releasing a very small quantity of it at a time.

Watch Glass

It is a circular, slightly concave piece of glass. It is used to evaporate a liquid, to hold solids while being weighed or as a cover for a beaker.

Reagent Bottle

It is a container used to hold liquid chemicals. It is usually made up of glass and has a lid which should be replaced immediately after withdrawing chemical from the bottle.

Gas Jar

It is a glass container with a broad base and broad opening. It is used for collecting gas during experiments.

Besides these equipment, there are other like test tube brush, beehive shelf, cork borer, etc. that are used in a chemistry laboratory.

Test tube brush

Beehive shelf

Cork borer

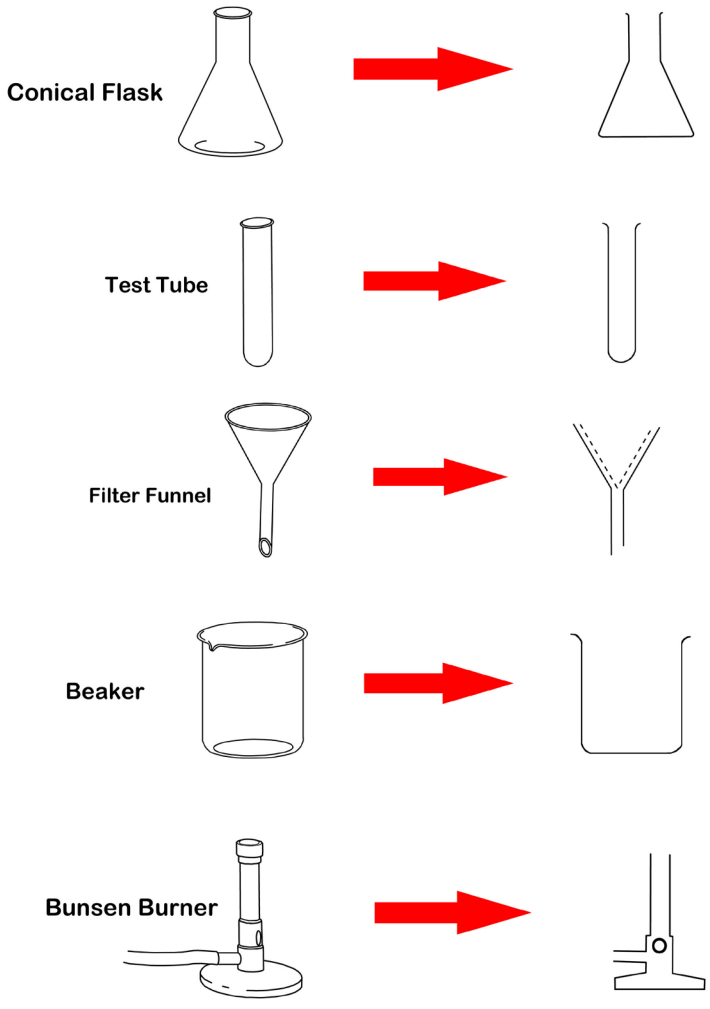
1.2 Drawing science equipment

It is best to keep drawings of science equipment simple. The ones on the left are three-dimensional and have been drawn by an artist. The simple two-dimensional views are the ones on the right, and this is how students should draw equipment for their science investigations. Note how much simpler the right-hand drawings are. For example, there is no line across the mouth of the test tube, beaker or flask.

When science equipment is put together for a purpose, such as heating water in a flask, it is called apparatus. When students are drawing apparatus like this they should:

- Use a pencil, for ease of correction if they make a mistake.
- Label the drawing using label lines.
- Use a ruler for all straight lines, and.
- Not use shading or coloring.

Diagrams of science equipment in three-dimensional and two-dimensional views.



Note: There are plastic templates available for drawing scientific apparatus.

1.3 Safety in the laboratory

A laboratory is a place for doing things. Students should enjoy working there. However, to make the laboratory a safe place for everyone. There are two main rules students should follow.

1. Know what they are doing in the laboratory – read instructions carefully before they start.
2. Always think of others and behave sensibly.

If students follow the safety rules then accidents will not happen. Many accidents can be avoided by keeping alert and using common sense. These are types of accidents that can occur and how to avoid them. And if an accident does occur, it is the responsibility of the students to report it to their teacher.

Eye injuries can be caused by liquids splashing into students eyes during investigations.

- Always wear safety glasses whenever there is a chance of liquid splashing into their eyes, especially when heating things.
- Always wear safety glasses when they see the safety glasses symbol on investigations lessons.
- Never point a test tube towards themselves or anyone else. If they get a chemical in their eyes, wash it immediately with lots of water, and tell their teacher. Some laboratories may have a special eye bath to make this easier.

Poisoning can be caused by breathing in fumes during an investigation, by tasting chemicals or by spilling them on their skin. Students should:

- Never taste anything, and never bring food drink in the laboratory.
- Check the labels on chemicals before they use them.

Cuts are caused mainly by broken glass. Students should:

- use gloves, a brush and shovel or dustpan to clean up any broken glass and put it into the special bin.

Burns can be caused by touching hot equipment, or by spilling hot liquid. Students should:

- Treat these types of burns with cold running water for about 10 minutes.
- Tell their teacher immediately if more serious burns occur when using a Bunsen burner.

Fires are always possible when using burners. Therefore students should do the following:

- Don’t use paper to light a burner, and never place burning things in rubbish bins.
- If they have long hair, it is essential you tie it back whenever you are using a burner.

- If there is a fire, stay calm and call for help. If a person's hair or clothing catches fire, remember three rules: stop, drop and roll. The person must stop moving around, drop to the floor and roll. While the person is rolling, a fire blanked should be quickly wrapped around the person to smother the flames.

Damage to clothing and skin can occur when chemicals, especially corrosive liquids such as acids and alkalis, are spilt. Students should:

- Wear a lab coat or other protective clothing when doing investigations.
- If there is a spill, wash the area immediately with lots of water and send someone to tell the teacher.
- In serious cases it may be necessary to use the safety shower.

SAFETY SIGNS AND SYMBOLS IN THE LABORATORY

1.4 Science is investigating

Scientists plan their investigations carefully and make many observations. An observation is something students can find out with their senses. We mainly use our sense of sight, but students can also feel the texture of an object or whether it is hot or cold. Scientists also take measurements during investigations and record them in data tables.

Writing reports

A report is important because other people can find out what the students did and what they discovered.

A report is organized using the seven headings.

Title – the name of the investigation, students', groups' name and the date.

Aim – students say why they did the investigation. Sometimes this is a question.

Materials – a list of equipment and chemicals you used in the investigation.

Method – students say what they did in the investigation in numbered steps. Whenever possible include a large, neat diagram of the apparatus.

Results – you record the data. Data includes qualitative observations (words) and measurements (numbers). Usually these are recorded in a data table. This makes the data easier to read.

Discussion – students try to explain their results, and list any problems that they experienced. They might also explain how they could improve the investigation.

Conclusion – students answer the questioned posed on the aim.

Sometimes in the conclusion, students can write a general statement or generalization-one that seems true in most cases. For example, a student investigating the stopping distances of toy trucks concluded: The heavier the truck is, the longer it takes to stop.

Students will not always be able to make a generalization like this, and in some cases it may not be possible to make a conclusion at all.

2. Science process skills

Science is the process of becoming aware of oneself, other living things, and your surroundings through your senses and exploration. Teaching science to children involves more than teaching facts and concepts of science. Children need concrete experiences to understand facts and concepts. The process approach to teaching science is based on what a scientist does and the tools a scientist uses to discover the facts and concepts of science. What a scientist does are the science skills.

These skills are:

- Observing
- Communicating – writing objectively
- Classifying
- Measuring
- Estimating
- Collecting data
- Relating objects in space and time
- Predicting
- Inferring
- Controlling variables
- Defining operationally
- Interpreting data
- Hypothesizing
- Making models
- Experimenting

2.1 Inferring and Predicting

These two statements are called *inferences.* An inference is an explanation of an observation. Inferring is an important skill in science, and it is very important to remember three things about inferring.

Making inference:

- Students can usually make several different inferences from the same observation.
- Observations are correct, provided the observer (student) has been careful and honest in reporting the observations. However, inferences made from these observations can be incorrect. They can be tested by further observations.
- It is important not to confuse observations and inferences. Otherwise students may think something is a ‘fact’ when it is only an ‘educated guess’.

Making predictions

Another important skill is *predicting.* This is making a forecast of what the future observation may be. Predictions are based on students' observations and what they already know. For example, if students have been observing the Moon for a number of nights they can confidently predict whether there will be a full Moon tonight. Otherwise students can only guess, and they will probably be wrong.

2.2 Measuring

There are two different types of observations. One is a description in words, such as the color of a car or the smell of a flower. These observations are said to be qualitative. The other type of observation involves measurements, for example, a 80 kg person or 30 cm tail of a dog. These measurements involve numbers, and are said to be quantitative.

Note that measurements are made up of a number and unit. For example, a person's height might be 170 centimeters. Centimeters are the units used. Without the units the number has no meaning.

Some measuring instruments have digital readouts, eg digital watches. Other instruments have a scale with numbers on it and a pointer which moves along the scale. To read these instruments you must estimate the position of the pointer against the scale. Reading a scale is simple if students follow the five steps below.

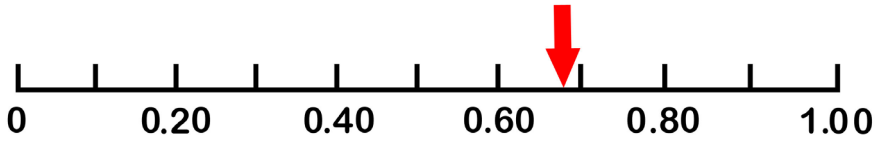
How to read a scale

1. Decide which way the scale reads – up, down, or left to the right.
2. Work out what each division on the scale stands for.
3. Find the closest numbered division before the pointer.
4. Count the numbered division to the pointer. Calculate their value.
5. Add the value of these divisions to the numbered division.

Quantity	Instrument	Common Units
Length	Meter rule or tape measure	Millimeter mm (1/1000m) Centimeter cm (1/100m) Meter m Kilometer km (1000m)
Mass	Balance	Gram g (1/1000kg) Kilogram kg Tonne t (1000kg)
Time	Watch or clock	Seconds s Minute min Hour h
Temperature	Thermometer	Degree Celsius ^{0}C
Volume (liquids)	Measuring cylinder	Millimeter mL (1/1000L) Litre L

Estimating readings

When reading a scale, students will often find that the pointer lies between two lines. In these cases they have to estimate the reading. For example, on the scale below the pointer is between the 0.6 and the 0.7 position, but not exactly in the middle. The reading is more than 0.65 but less than 0.7. It can be estimated at 0.67.



Accuracy

Remember - students cannot get better measurement than their measuring instrument allows. All measuring instruments are accurate only within limits. Scales used on any instrument are marked off into smaller and smaller divisions. The smallest division determines the accuracy of the instrument.

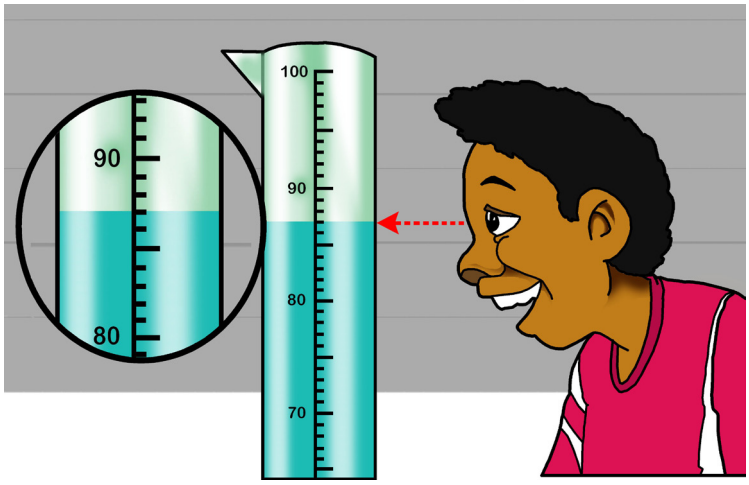
Errors

It is difficult to say measurement is exact. Mistakes or errors occur in all measurements. These errors can occur when students make a mistake reading a scale or writing down the measurement. They can occur because an instrument is not working properly or because students are not using it correctly.

Parallax error

Parallax error occurs when students do not look straight over the pointer. They need to look square onto a measuring instrument.

The student on the left will be able to make an accurate measurement, but the student on the right will have parallax error in his measurement.



Reading the bottom of the meniscus

To avoid errors when measuring liquids in measuring cylinders, always read the bottom of the meniscus – the curved water surface. Students should keep their eye level with the meniscus. The volume of water below is 87 mL, not 88 mL.

2.3 Displaying data

Another important part of an investigation is displaying your data in a graph, diagram or chart.

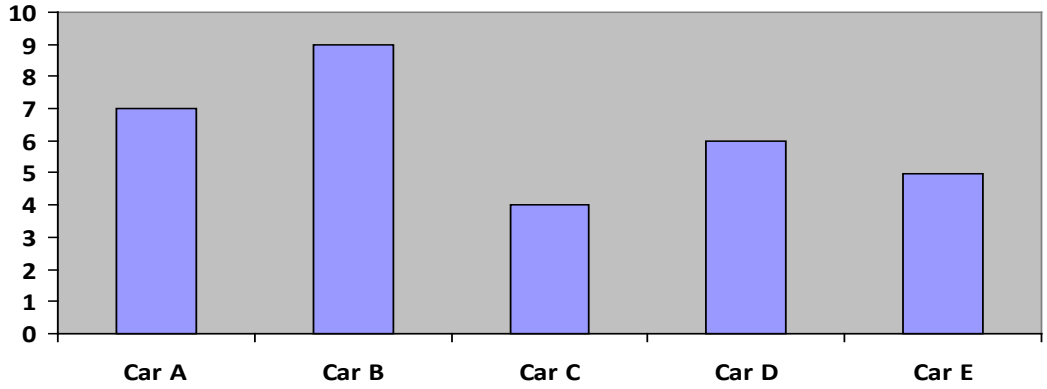
Bar graphs

Suppose students were investigating how long it took different model cars to travel down a wooded ramp. Here are the results:

Model car	A	B	C	D	E
Average time to travel down a ramp (seconds)	7	9	4	6	5

A very useful way of comparing data is to draw a *bar graph* (sometimes called a bar chart). In this case, the time (in seconds) is on a vertical or y-axis of the graph, and the type of car on the horizontal or x-axis.

Time taken for cars to travel down ramp



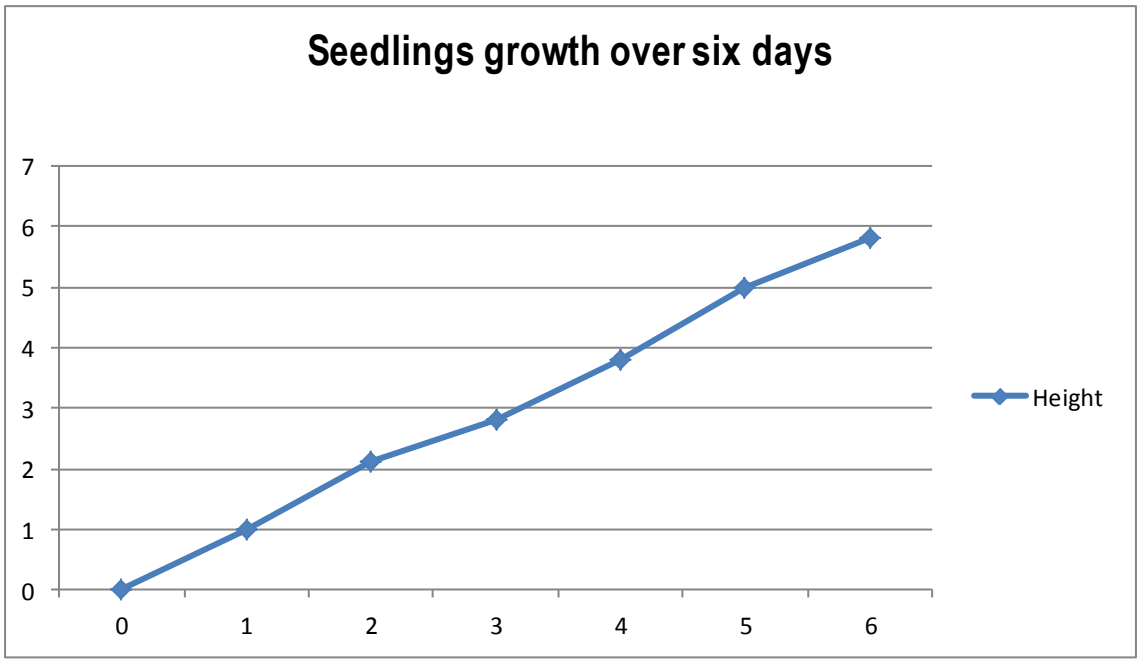
Line graphs

Sometimes students may want to show the relationship between two things being measured. In this case they would draw a line graph of the data. For example, a group of students was investigating the growth of seedlings every day. Here are the results:

Time (days)	Height (cm)
0	0
1	1.0
2	2.1
3	2.8
4	3.8
5	5.0
6	5.8

Before students can start on their line graph, they have to decide which measurement goes on which axis. On a line graph the *independent* measurement goes on the horizontal axis. The *dependent* measurement goes on the vertical axis. In this case, time is the independent measurement, and *height* is the dependent measurement. Height is the dependent because the height the seedlings grow depends on how many days (time) students let them grow.

Seedlings growth over six days



2.4 Experimenting

Students have probably heard about scientists doing experiments and then wondered what the difference is between an experiment and an investigation. These terms mean much the same thing – scientist carefully planning laboratory or field work to show that something is true (or not true).

An *experiment* always involves designing tests to answer a question or solve a problem. For example, when students cut an apple and leave it for few hours, the white flesh inside starts to turn brown. Students have an idea that it is something in the air that causes the apple to go brown. So their aim might be: *If cut apple is covered to exclude air, it won't go brown.*

Designing experiments

The important thing to remember about designing experiments is that students' aim must be a statement or question that is able to be tested. For example, the statement *'Plants grow better in white light than blue light',* is easy to design tests for.

When planning experiments and writing reports, students should use the same headings as they did for writing report. In other words, students start with a *title.* Then write an *aim,* list the *materials* they will need and write the *method* so that others can follow it. Students then collect results, write their *discussion* and finally their *conclusion.*

Students with Special Needs

Many students have special needs. This includes students who are gifted and those who are disadvantaged. Gifted students should be given opportunities to extend their learning. Students with physical or intellectual impairments and emotional or learning difficulties need special support in the classroom. Teachers have a responsibility to ensure that the learning needs of these students are met. All students are individuals and all have the right to quality education in order to reach their full potential.

Learning disabilities impact the way children are able to process and understand information; they are neurological disorders that might manifest themselves as difficulty listening, thinking, writing, speaking, spelling, or doing mathematical calculations. Dyslexia, dyscalculia, dysgraphia, dyspraxia, visual perception disorders, auditory processing disorders, and language disorders fall under the umbrella of learning disorders.

An idea teachers must understand is that students with special needs such as learning disabilities need to be taught differently or need some accommodations to enhance the learning environment. Not everyone learns in the same way, and you can follow some tips to create a well-rounded learning atmosphere.

1. Maintain an organized classroom and limit distractions.

For students with special needs, maintaining a healthy balance of structure and unstructured processes is important. For example, on each student's desk, have a place for everything that is clearly labeled (use words or colors, for instance). Also consider using checklists and help students keep their notebooks organized; teach them how to do so on their own, but also check at the end of each day and offer suggestions for keeping it more organized. On the unstructured side of things, allow students with special needs to change their work area while completing homework or studying and assign tasks that involve moving around the room. For students with special needs and learning disabilities, hearing instructions or following directions can be made difficult if there are too many distractions. Schedule breaks throughout the day and seat students with special needs in an area of the classroom that limits distractions; for example, do not sit these children by a window, in front of an open door, or by the air conditioner, as people walking by or additional noises might be too distracting.

2. Use music and voice inflection.

When transitioning to an activity, use a short song to finish up one task and move to another. Many of us have sung the "clean up" while cleaning up before the next activity; use a similar approach in the classroom. Students with special needs might also respond well to varied voice inflection and tone, so use a mixture of loud, soft, and whisper sounds. Using proper pronunciation and sometimes slightly exaggerating proper speech will help a child model the same principles.

3. Break down instructions into smaller, manageable tasks.

Students with special needs often have difficulty understanding long-winded or several instructions at once. For children with learning disabilities, it is best to use simple, concrete sentences. You might have to break down a step into a few smaller steps to ensure your students with special needs understand what you are asking. You might even want to put the directions both in print and saying them verbally. Ask your students with special needs to repeat the directions and ask them to demonstrate that they understand. Do not give further instructions until a student has completed the previous task.

4. Use multi-sensory strategies.

As all children learn in different ways, it is important to make every lesson as multi-sensory as possible. Students with learning disabilities might have difficulty in one area, while they might excel in another. For example, use both visual and auditory cues. Create opportunities for tactile experiences. You might need to use physical cues, such as a light touch, when a student might get distracted or inattentive. Get creative with your lesson plans, and students with special needs will appreciate the opportunity to use their imaginations or try something new; use a balance of structure and familiar lessons with original content.

5. Give students with special needs opportunities for success.

Children with learning disabilities often feel like they do not succeed in certain areas, but structuring lessons that lead to successful results is a way to keep them motivated. Provide immediate reinforcement for accomplishments, be consistent with rules and discipline, correct errors and reward students when they make these corrections themselves, explain behavioral expectations, and teach and demonstrate appropriate behaviors rather than just expecting students with special needs to pick them up.

While these suggestions are ideal for classroom settings, parents of students with special needs can also implement these principles. Helping children with learning disabilities both in and out of the classroom is the best way to help your students with special needs achieve success.

Teaching and Learning Strategies

Learning Strategies For Science

Metacognitive strategies:

Students plan, monitor, and evaluate their learning of science concepts and skills.

Advance Organization	What is the students' purpose for solving this problem or doing the experiment? What is the question? What will students use the information for?
Selective Attention	What is the most important information to pay attention to?
Organizational Planning	What are the steps in the scientific method students will need to follow?
Self-monitoring	Does the plan seem to be working? Are students getting the answer?
Self-assessment	Did students solve the problem/answer the question? How did students solve it? Is it a good solution? If not, what could students do differently?

Cognitive strategies:

Students interact with the information to be learned, changing or organizing it either mentally or physically.

Elaborating Prior Knowledge	What do students already know about the topic or type of problem? What experiences students had that are related to this? How does this information relate to other information?
Resourcing	Where can students find additional information about this topic? Encyclopedia? Science book? Library?
Taking notes	What is the best way to down a plan to record or to summarize the data, table or list?
Grouping	How can students classify this information? What is the same and what is different?
Making inferences	Are there words that students do not know that I must understand to solve the problem?
Using images	What can students draw to help them understand and solve the problem? Can students make a mental picture or visualize this problem?

Social/Affective strategies:

Students interact with other to assist learning, or use attitudes and feelings to help their learning.

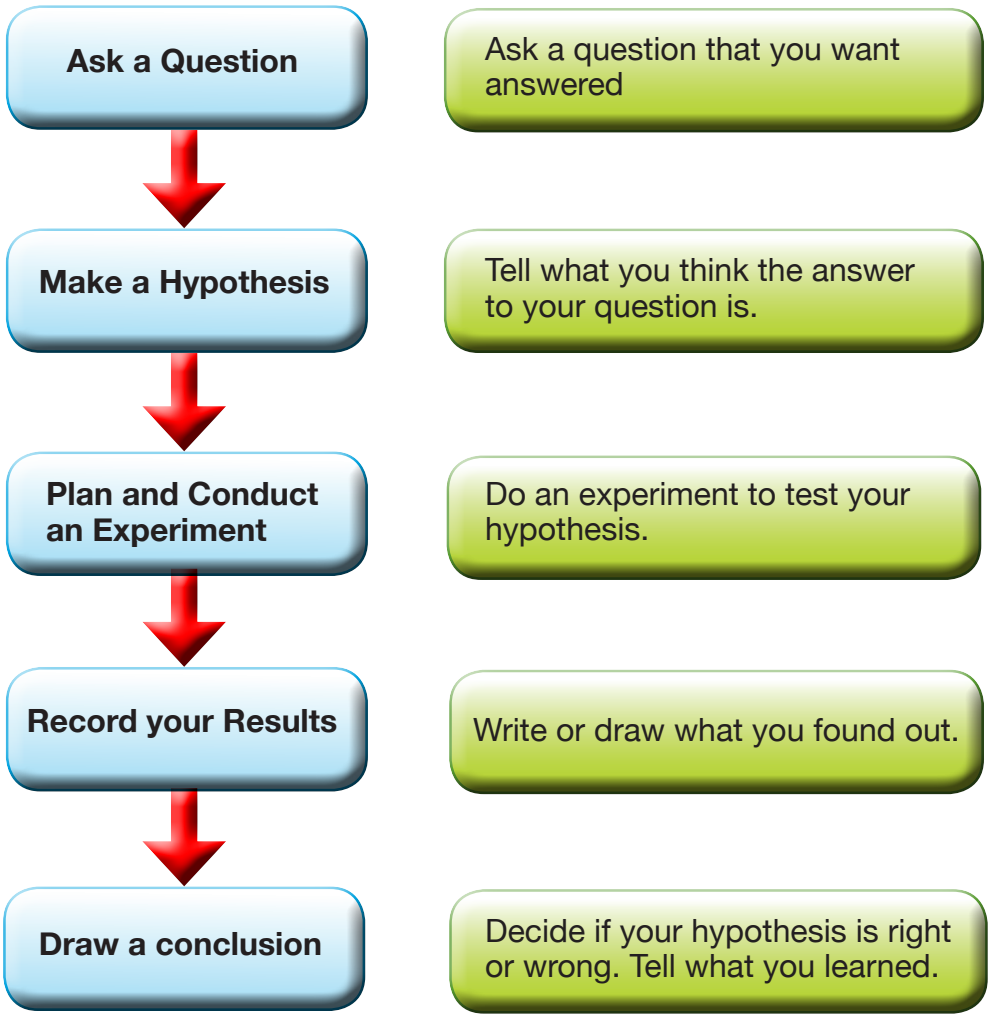
Questioning for	What help do students need? Who can they ask? Who should they ask?
Cooperating	How can students work with others to answer the question or solve the problem?
Self-talk	Yes, students can do this task – what strategies do they need?

Source: http://carla.umn.edu/cobaltt/modules/strategies/lstrategies/CALLA_Table9-3.pdf

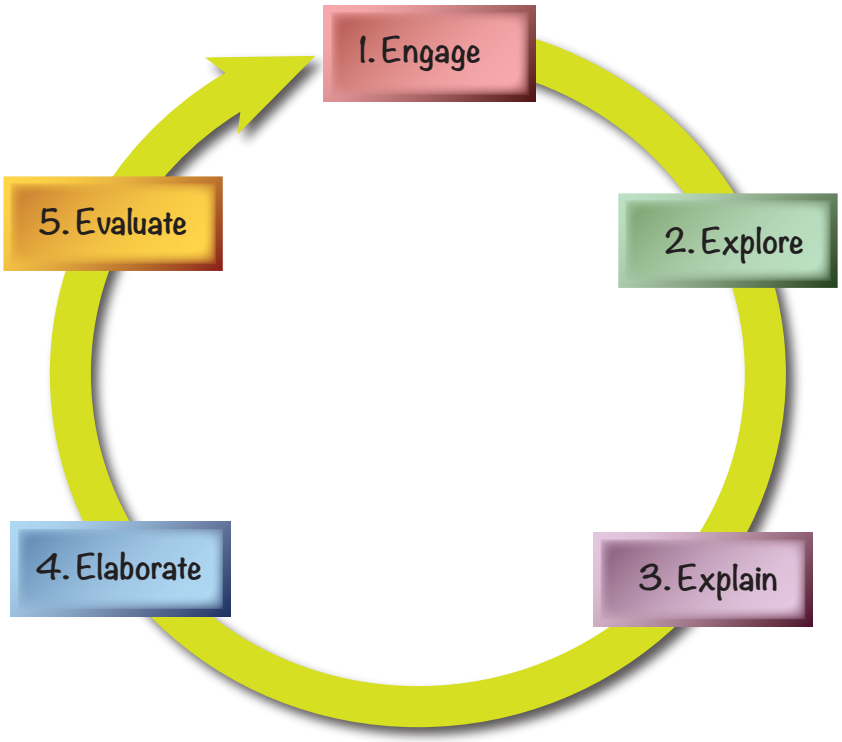
Applying learning strategies to Science

The Scientific Method

Science Problem-solving steps



5 Learning Cycle



1. Engage

Activity which will focus student's attention, stimulate their thinking, and access prior knowledge.

- KWL (Know already ~ Want to know ~ Learn) This is the "elicit" part
- Brainstorming

Student asks questions such as:

1. Why did this happen?
2. What do I already know about this?
3. What have I found out about this?
4. Shows interest in the topic.

2. Explore

Activity which gives students time to think and investigate/test/make decisions/problem solve, and collect information.

- Perform an Investigation
- Read Authentic Resources to Collect Information
- Solve a Problem
- Construct a Model

3. Explain

Activity which allows students to analyze their exploration. Student's understanding is clarified and modified through a reflective activity.

- Student Analysis & Explanation
- Supporting Ideas with Evidence
- Structured Questioning
- Reading and Discussion
- Teacher Explanation
- Thinking Skill Activities: compare, classify, error analysis

4. Elaborate

Activity which expands and solidifies student thinking and/or applies it to a real-world situation.

- Problem Solving
- Decision Making
- Experimental Inquiry
- Thinking Skill Activities: compare, classify, apply

5. Evaluate

Activity which allows the teacher to assess student performance and/or understandings of concepts, skills, processes, and applications.

- Any of the Previous Activities
- Develop a Scoring Tool or Rubric
- Performance Assessment
- Produce a Product
- Journal Entry
- Portfolio

Methods teachers use to support the learning cycle should:

- Create interest
- Generate inquisitiveness
- Raise questions and elicit responses
- Facilitate cooperative learning
- Refer to and include previous experiences as they relate to new concepts
- Incorporate alternative assessments

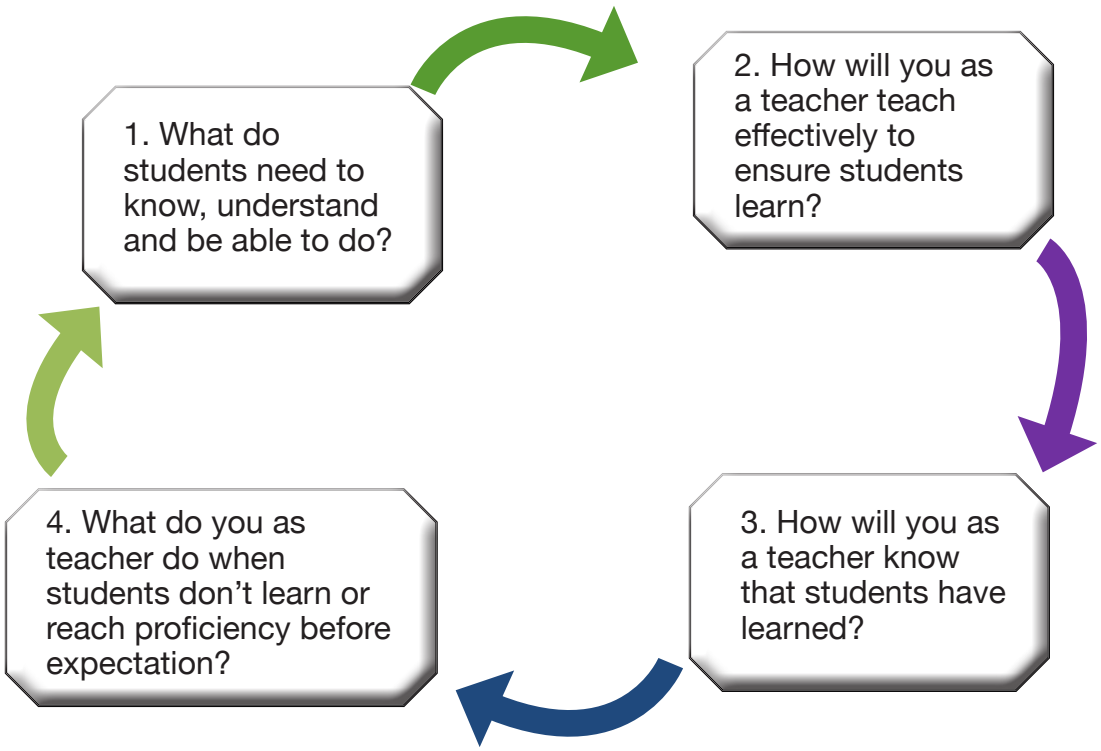
Teaching methods should allow students to:

- Show interest by asking questions
- Use inquiry to explore or investigate new concepts
- Form predictions and hypotheses
- Formulate experiments with alternatives
- Record ideas and observations
- Use various resources to seek explanations
- Make connections between prior knowledge and new concepts
- Self-evaluate

Standards Based Teaching and Learning

Being standards-based means that every teacher in every classroom everyday through this continuous teaching and learning cycle ensures that students learn the national standards and benchmarks to proficiency.

Continuous Cycle of Students Learning



1. What do students need to know, understand and be able to do?

Students and parents should know and understand what students are expected to learn and how they should be able to demonstrate that learning. To be fully engaged in learning, students need to be able to understand the purpose and rationale for what they are learning and make connections to prior learning, daily life, higher education, the adult world and career. It is also important for students to know how they are expected to demonstrate their learning and reach proficiency. As stated earlier, this means that students must have descriptions and examples of proficient performance for the benchmark concepts and skills they are expected to learn.

2. How will you as a teacher teach effectively to ensure students learn?

Instruction needs to be purposefully designed for students to learn essential concepts and skills. Consequently, before planning lessons, teachers must be clear on the concept or skill they expect students to learn and what proficiency looks or sounds like. Then, teachers should have a plan for students to demonstrate what they have learned through some type of assignment or assessment. With those outcomes identified, instruction can then be effectively and purposefully planned and delivered.

Teaching to standards means that learning is continually monitored through a variety of measurements and assessments. Instructional strategies should be designed or modified according to the information (data) provided by those assessments. By continually evaluating information about what or how students are learning, the focus, intensity, efficiency and effectiveness of instruction is enhanced. Additionally, objective evidence that students are progressing and learning helps teachers know instruction is yielding the intended learning results.

3. How will you as a teacher know that students have learned?

In a standards-based curriculum, both formative and summative assessments should be tightly aligned with essential benchmarks to ensure they validly measure those same concepts and skills. This implies that assessments are designed based on the unique elements of the concept or skill students are being asked to demonstrate.

Assessments should also be aligned with instructional strategies that provide students with meaningful ways to demonstrate proficiency. This suggests the performance expectations of assessments should be understood by teachers and clearly explained to students as part of instruction.

Scoring guides or rubrics describe student performance on standards-based learning tasks by providing various types of descriptions or rating systems to differentiate levels of performance. These descriptions allow students to understand what type of proficient work is desired and receive feedback about their performance based on that description. Scoring guides can be used to assess a variety of concepts and skills.

If student learning is regularly assessed through a variety of methods using consistent and reliable scoring or ratings of performance, it is only logical that the same information derived from those assessments should be used to report student performance to those students, their parents and to various stakeholders.

In standards-based schools, grades are replaced with, or augmented by, achievement reports that indicate levels of performance on essential benchmarks. Such reporting systems can provide more validity and reliability in communicating student progress and attainment of proficiency in those concepts and skills.

4. What do you as a teacher do when students don't learn or reach proficiency before expectation?

Students are provided multiple opportunities to learn, both in the classroom and beyond the classroom, through interventions, supplemental programs or other support systems. Such supplemental learning opportunities are provided both to students who are not reaching proficiency and/or who are performing above proficiency.

In standards-based schools, students are provided more than one opportunity to learn and perform at proficient levels. This means that teachers continually provide learning scaffolds for students to build on previous learning to reach proficiency. This also means that individualization and differentiation strategies are provided to students based on their learning characteristics, needs and current levels of performance. Strategies might include changes in the learning setting, amount of time provided to learn or complete tasks, changes in instructional strategies or adaptations in the ways students can respond.

Characteristics of standards-based teaching and learning

There are seventeen *characteristics of Standards-Based Teaching and Learning. These characteristics are divided into sections focused on:*

a. Organization of the classroom.
b. Instructional design and delivery.
c. Student ownership of learning.

A. Organisation of the Classroom	
1. *Classroom climate* is catogorised by respectful behaviours, routines, tones and discourse	
Examples of practice	
• There is an expectation that all students will participate, collaborate, and contribute during lessons. • Behavioral expectations are posted and communicated to students. • Positive, respectful language and relationships (teacher-to-student[s], student[s]-to-teacher, and student-to-student) are evident. The teacher models “people first language”. • Students demonstrate respect for property and materials. • Students requiring specialized support services participate equitably in classroom routines, and there is evidence of their full membership in the class (e.g., work displayed, name on posted class list). • Classroom instruction promotes risk-taking in learning. • The physical environment optimizes learning for all students (space for individual and collaborative work, minimization of distractions). • Classroom practices and instruction honor the diversity of interests, needs, and strengths of all learners.	
2. *Learning objectives* (not simply an agenda or an activity description) for the day’s lesson are evident. Applicable language objectives are evident for English language learners.	
Examples of practice	
Teacher	**Students**
• The teacher explains and posts the standards-based lesson objective(s) in age-appropriate, student-friendly language. • The teacher relays the objective(s) of the lesson, connects objective(s) to one or more big ideas from previous learning, provides students with a rationale for learning, and revisits lesson goals at the end of the lesson. • The teacher ensures that all components of the lesson (e.g., learning activities, assessment, homework) contribute to the lesson objectives and to student mastery of the standard(s).	• Students easily locate learning objectives (e.g., an agenda, poster, handout, audio tape), understand the objective(s), and work toward meeting the objective(s). • Students are able to express their understanding of a lesson’s learning objectives.

3. *Learning time* is *maximized* for all students

Examples of practice

Teacher	Students
• The teacher establishes a purposeful and well-paced lesson structure with multiple ways for students to enter and engage in the lesson (e.g., activators to open the lesson; summaries for closure; exit tickets for assessment; breaks during learning time). • The teacher scaffolds smooth transitions between learning activities. • The teacher accommodates variability in the amount of time different students need to complete learning tasks.	• Students follow classroom routines well enough that minimal time is spent on listening to instructions and organizational details (such as attendance-taking or distribution of class materials). • Students begin work when the class is scheduled to begin.

B. Instructional Design and Delivery

4. Instruction activates students' *prior knowledge* and experience, and supplies *background knowledge.*

Examples of practice

Teacher	Students
• Instructional strategies (such as pre-teaching, cueing, use of multimedia, vocabulary review) activate prior knowledge and maximize accessibility for all students. • The teacher connects current student learning with objectives and concepts from previous lessons, and draws on existing knowledge (e.g., highlighting big ideas, patterns and relationships, activating or supplying background knowledge).	• Students respond to opportunities provided by the teacher to make connections between the lesson and personal experience.

5. *Materials* are aligned to students' varied *educational and developmental needs.*

Examples of practice

- The teacher supports diverse student learning needs by using varied materials (e.g. manipulative, visuals, adapted text, graphic organizers, multimedia, audio, kinesthetic).
- Assistive technology is utilized where appropriate.
- Print materials are customized (color, font size, audio component) to meet students' needs.

6. Presentation of *content* is designed to meet students' varied *educational and developmental needs.*

Examples of practice

Teacher	Students
• The teacher knows the variability of students' abilities, readiness, and learning styles, and appropriately designs learning opportunities. • The teacher provides all students with entry points into lessons, supporting students' vocabulary, language needs and conceptual framework. • Content is revised to maximize access through adaptations, accommodations, and/or modifications (e.g., written text and assessments are accessible through books-on-tape). • The teacher models planning, goal-setting and strategy development.	• Students engage in activities that are appropriate in terms of complexity and pacing for their current level of knowledge and skill, and challenge them to the next level of proficiency.

7. Depth of *content knowledge* is evident throughout the presentation of the lesson.

Examples of practice

- All content explained and/or demonstrated throughout the lesson is accurate.
- The teacher explains concepts and ideas in multiple ways to facilitate student understanding (e.g.,sequencing critical features of a concept, information processing strategies).
- Connections are made across ideas and strands.
- The teacher identifies and corrects misconceptions through exploration and discussion.

8. Instruction includes a *range of techniques,* such as direct instruction, facilitation, and modeling.

Examples of practice

- Varied instructional strategies target learning objectives.
- Varied instructional approaches anchor the lesson in prior knowledge and build content vocabulary.
- Lesson design includes means for all students to gain access to lesson content through support from the teacher, other adults in the classroom or peer interactions.
- All students learn thinking and reasoning skills and strategies through think-alouds and other meta-cognitive approaches modeled by the teacher.
- Appropriately scaffolded instruction makes use of manipulatives, technology, or other means to support student understanding.
- All students engage in small group work or activities that align to grade-level standards and learning objectives.

9. *Lesson tasks and guiding questions* lead students to engage in a process of *application, analysis, synthesis, and evaluation.*
Examples of practice
• Probing questions/tasks challenge students to explore concepts/big ideas. • Classroom discourse and assignments engage all students. • In response to questions, activities and assignments, students express opinions and defend their reasoning with evidence while using appropriate content language or visual representations. • Students engage in application, analysis, synthesis, and evaluation. • Strategies support students in formulating their thoughts in response to questions (e.g., adequate wait time, peer sharing, quick-write). • Students are provided multiple options for expressing what they know (e.g., verbal, written, physical action, use of technology). • Student responses direct discussions and set the context for teachable moments. • Student responses to questions prompt re-teaching to address misconceptions when necessary. • Students pursue ideas that are essential to the lesson. • Oral and written questions align to grade-level standards and objectives.
10. The teacher *paces the lesson* to ensure that all students are *actively engaged.*
Examples of practice
• Wait time is utilized to allow for responses from all students. • The pacing of the lesson leaves options for student interests, choice and collaborative work.
11. Students *articulate* their *thinking and reasoning in science.*
Examples of practice
• Students consistently and appropriately use scientific language and terms that are specific and relative to the task. • Students construct an argument showing how available data or evidence support their claim(s). • Students identify strengths and weaknesses in explanations (their own or those of others). • Students are prompted to ask questions to identify the premise of an argument, request further elaboration, refine a research question or engineering problem, or challenge the interpretation of a data set. • Students engage in a range of collaborative discussions (one-on-one or in groups). • Students are asked to make predictions and explain their thinking about scientific phenomena and concepts. • Students have opportunities to share their ideas and possible misconceptions that are addressed in the lesson. • Students use representations (such as drawings, graphs, or models) to convey ideas or proposed explanations.

12. When working in *pairs or small groups,* all students are *inquiring, exploring, or problem solving collaboratively.*

Examples of practice

Teacher	Students
• The teacher holds all students accountable for their contributions to group work. • The teacher provides clear guidelines, scaffolding, modeling and expectations for group work (e.g., embedded prompts, checklists, planning templates, defined student roles such as recorder or reporter). • There is a gradual release of responsibility from teacher to students for the lesson and its outcomes.	• Students are engaged in sustained interaction, often in small groups, in order to complete carefully designed academic tasks that include speaking, listening, reading, and writing or other means of expression. • Students use multiple means of expression (e.g., discussion, debate, data, demonstration, multimedia) to share their ideas and defend their positions. • Students pose questions and/or respond to material in ways that indicate their understanding of and reflection on concepts.

13. Opportunities for students to *apply new knowledge and content* are embedded in the lesson.

Examples of practice

- Application of learning is integrated into lesson design.
- Application of new knowledge in problem-solving situations (not just skills/procedural knowledge) is evident in student performance and work products.
- Students are given the opportunity to construct and express their understanding to the teacher or peers through multiple means.
- Students generalize learning to solve unfamiliar problems or to approach unfamiliar tasks.
- Student performance and work products demonstrate progress toward mastery of concepts.
- There is evidence of student-initiated learning (e.g., students pose new problems to be considered and/or extend knowledge through further research, students generate conclusions).

14. On-the-spot formative assessments *check for understanding* to inform instruction.

Examples of practice

- Quick, on-the-spot written, recorded or visual assessments (e.g., thumbs-up/thumbs-down, exit tickets, teacher/student interactions, clicker response to interactive board quiz) are used to gauge student understanding.
- Students demonstrate understanding of concepts through multiple means of expression (written, recorded, visual).
- Students receive immediate and specific feedback (from the teacher or other students) during individual, small group, and/or whole group work to guide their understanding of important concepts, ideas, and vocabulary.
- The teacher documents students' level of understanding and utilizes that data to modify or re-teach, as appropriate.

15. *Formative feedback* to students is *frequent, timely, and informs* revision of work.
Examples of practice
• The teacher uses formative assessments to gauge what each student knows/is able to do. • Students receive and understand specific, frequent and timely documented feedback (e.g., written, recorded, visual) regarding their progress toward meeting the standard(s). • Feedback encourages students to reflect on their learning. • Standards-based rubrics frame feedback to students. • Students revise work on the basis of feedback. • Students design rubrics using clear, standards-based criteria with assistance from the teacher or peers. • Feedback to students encourages perseverance and fosters efficacy and self-awareness. • Feedback to students emphasizes effort and improvement, as opposed to competition.

C. Student ownership of learning

16. Students *demonstrate* how *routines, procedures, and processes* support their thinking and learning.
Examples of practice
• Students explain or demonstrate the routines, procedures, and processes they use, and how these enhance their learning. • Students use descriptions, rubrics, and/or exemplary work to define what constitutes a high-quality product. • Students demonstrate self-regulation (motivation, coping skills and strategies, and self-assessment).
17. Students *express or demonstrate what they are learning and why,* in relation to the standards**.**
Examples of practice
• Students understand the critical elements of the standards being taught and the expectations for mastery. • Students are aware of what they are learning and why. • Students can articulate what standards they have mastered, and in what areas they require additional work.

Planning and Programming

Planning and Programming is organizing the content from the syllabus into a teachable plan for delivery in the classroom using the approaches such as long, medium, short term plans. For example:

- yearly overview is a long term plan
- termly overview is medium term plan and
- weekly and daily plans are short term plans.

Yearly Plan

When planning an instructional program, we begin with the yearly plan. The yearly plan is organised by terms in a school year. The main or key information that forms the content of the plan are provided in the syllabus. These are the:

- strands
- units
- content standards.

Weekly Plan

A weekly plan of the program of instruction is a plan of an instruction program for teaching and gives the teacher a specific outline of the units, content standards and performance standards for instruction (teaching) which the teacher follows in a term. This guides the teacher to organize the teaching program for the number of weeks in each term.

To compile a plan for a week's program teachers will need to organize the plan using the:

- units
- content standards
- benchmarks
- lesson titles.

Teachers should use the term overview to see the order of units organised, and then use this order to plan the weekly program. The weekly plan is implemented through a timetable that is planned for the subjects in the Grades 6, 7 and 8 levels.

Content Overview

This is an overview of the content scope of learning for Grade 6 students given in the Grades 6, 7 and 8 Science Syllabus. The broad learning content concepts are:

- Life
- Physical Science
- Earth and Space respectively.

These broad learning concepts are known as *strands.* From these strands the units are developed and drawn from the units are the topics followed by sub-topics. The scope below will help you understand processes in identifying and scoping the content of learning – strands, units, topics and sub-topics. The topics and sub-topics are translated and expanded into content standards and benchmarks.

Content scope of learning for Grade 6

Grade	Grade 6		Grade 7		Grade 8	
Strand 1: Life						
Unit	**Topic**	**Sub-topic**	**Topic**	**Sub-topic**	**Topic**	**Sub-topic**
1. Plants	**Reproduction and heredity of plants**	• Reproductive parts and their functions of flowers • Process of reproduction in flowering plants • Reproduction in non-flowering plants • Heredity	**Groups of plants**	• Flowering and non-flowering plants	**Gas exchange system**	• Respiration of plants • Photosynthesis • Gas exchange system in plants
	Pathway of water in plants	• Paths of water in stem, root and leaves			**Cells**	• Properties of cells • Plant cells
2. Animals	***No contents prescribed for this grade***		**Groups of animals**	• Vertebrates and invertebrate • Classification of vertebrates	**Cells**	• Properties of cells • Animal cells
3. Human Body	**Respiratory System**	• Breathing	**Digestive System**	• Nutrients • Digestion		***No contents prescribed for this grade***
	Circulatory System	• Circulation				
4. Interaction and relationship in the environment	**Paths of energy in food**	• Food chain • Food web • Population in food chain • decomposers	**Living Together**	• Ecosystem • Population • community	**Changes in the environment**	• Environmental changes by human activities • Pollution • Conservation of the environment

Grade	Grade 6		Grade 7		Grade 8	
Strand 2: Physical Science						
Unit	**Topic**	**Sub-topic**	**Topic**	**Sub-topic**	**Topic**	**Sub-topic**
1. Energy	**Energy**	• Forms and uses of energy • Sources of energy • Energy conversion	**Electricity**	• Circuits and electric current • Electric current (voltage and resistance) • Static electricity	**Electric current and magnetic field**	• Magnetic field and Magnetic forces • Magnetic fields around electric current • Force received by electric currents within magnetic field • Electromagnetic induction and power generation • Application of electromagnets
	Electromagnet	• Properties of electromagnet • Conditions to strengthen an electromagnet	**Light and Lens**	• Light • Lens		
2. Force and motion	**Earth's gravity**	• Weight • Gravity • Mass	**Pressure**	• Pressure	**Force and work**	• Work and Power
	Force	• Types of forces • Forces	**Density**	• Properties of density		
3. Matter	**Mixtures and Solutions**	• Observing solutions • Properties of solutions • Mixture and substance • Separation of mixtures	**Properties of solutions**	• Properties of solutions • Acid, alkaline, and neutral solutions • Solubility	**Chemical changes**	• Chemical changes • Chemical changes and mass of substance
			Atoms, molecules and compounds	• Atoms • Molecules • Compounds	**State changes**	• State change and Heat

Grade	Grade 6		Grade 7		Grade 8	
Strand 3: Earth and Space						
Unit	**Topic**	**Sub-topic**	**Topic**	**Sub-topic**	**Topic**	**Sub-topic**
1. Our Earth	**Formation and change of land**	• Soil layers • Sedimentary rocks • Change of land	**Earth's structure**	• Composition and structure of the Earth • Plates and Earthquake	**Volcano and Igneous Rocks**	• Volcano • Igneous rocks
			Natural Resources	• Natural resources	**Rock Cycle**	• How rocks form • How rocks change
2. Weather and climate	***No contents prescribed for this grade***		**Weather Change**	• Atmosphere • Cloud and Fog • Weather in Papua New Guinea	**Weather and Climate**	• Climate • Climate changes
3. Space	**The Moon**	• Moon in motion • Moon phases	**Earth's motion**	• Motion of the Earth • Day and Night • Seasons	**Exploring space**	• Space • Solar system • Galaxy
	Stars	• Properties of stars • Motion of stars • Constellation in Papua New Guinea night sky				

Yearly Overview

The yearly overview is a plan designed to organise the learning content for Grade 6 students. It is a plan developed from the content overview of learning given in the Grades 6, 7 and 8 Science Syllabus. The syllabus is translated into a delivery plan for use in the classrooms for a school year. The plan also promotes sequencing of the learning content from strand, unit and topic.

<table>
<tr><th>Week</th><th>Term 1</th><th>Term 2</th><th>Term 3</th><th>Term 4</th></tr>
<tr><td>1</td><td>Orientation
Revision Work</td><td>Revision Work</td><td>Revision Work</td><td>Revision Work</td></tr>
<tr><td>2</td><td rowspan="2">Life

Unit 1: Plants

Reproduction and hereditary of plants</td><td rowspan="2">Life

Unit 1: Plants

Pathway of water in plants</td><td rowspan="2">Life

Unit 4: Interaction and relationship in the environment

Paths of energy in food chain and food web</td><td rowspan="2">Physical Science

Unit 3: Matter

Mixtures and Solutions</td></tr>
<tr><td>3</td></tr>
<tr><td>4</td><td rowspan="3">Life

Unit 3: Human Body

Respiratory system
Circulatory system</td><td rowspan="2">Earth and Space

Unit 1: Our Earth

Formation and change of land</td><td rowspan="3">Earth and Space

Unit 3: Space

The Moon 1

Stars</td></tr>
<tr><td>5</td><td rowspan="4">Physical Science

Unit 1: Energy

Energy
Electromagnet</td></tr>
<tr><td>6</td><td rowspan="2">Physical Science

Unit 2: Force and Motion

Earth’s gravity
Force</td><td rowspan="2">Physical Science

Unit 3: Matter

Mixtures and Solutions</td></tr>
<tr><td>7</td></tr>
<tr><td>8</td><td rowspan="2">Assessment & report writing</td></tr>
<tr><td>9</td><td rowspan="2">Testing and compiling of assessment</td><td rowspan="2">Speech Day preparation</td></tr>
<tr><td>10</td></tr>
</table>

Termly Overview

The term overview outlines the content that is to be delivered in a term. It contains the weeks, strands, units, topics and lesson titles with suggested number of periods per lesson.

Term 1: Overview

Week	Strand	Unit	Topic	Lesson Title	Periods (40 Mins)
Week 1 - Orientation and revision work					
2 3 4	Strand 1: **Life**	Unit 1: Plants	Reproduction and hereditary of plants	Reproductive parts of a flower	1
				Pollination process in a flower	1
				Fertilization process in a flower	1
				Life cycle of a non-flowering plant - Fern	1
				Hereditary Characteristics in plants	1
				Topic Review	2
5 6 7	Strand 2: **Physical Science**	Unit 1: Energy	Energy	Sources of energy 1: From the Sun	1
				Sources of energy 2: From moving water	1
				Sources of energy 3: From moving air	1
				Sources of energy 4: From fuel	1
				Forms of energy	1
				Changes in energy form	2
				Uses of energy in daily life	1
				Topic Review	2
8 9			Electromagnet	Characteristics of electromagnet	1
				How do we strengthen electromagnet? (1)	2
				How do we strengthen electromagnet? (2)	2
				Uses of electromagnets in daily life	1
				Topic Review	2
				Unit Review	2
Week 10 - Testing and compiling of assessment					

Term 2: Overview

Week	Strand	Unit	Topic	Lesson Title	Periods (40 Mins)
Week 1 - Revision work					
2 3	Strand 1: **Life**	Unit 1: Plants	Pathway of water in plants	Paths of water transport system in plants	1
				Where does water in plants pass through? Roots	1
				Where does water in plants pass through? Stem	1
				Where does water in plants pass through? Leaves	1
				Transpiration in plants	2
				Topic Review	2
				Unit Review	2
4	Strand 1: **Life**	Unit 3: Human Body	Respiratory system	Structure of lungs	1
				Organs of the human respiratory system	1
				Mechanism of breathing	1
				Topic Review	2
5 6			Circulatory system	Structure and function of the heart	1
				The Heart: Measuring pulse at rest and after work	1
				The Heart: Movement of the blood	1
				Organs of the human circulatory system	1
				Heart and Lung	1
				Topic Review	2
				Unit Review	2
7 8 9	Strand 2: **Physical Science**	Unit 2: Force and Motion	Force	Different types of force	1
				Frictional force	1
				Gravitational force	1
				Elastic force	1
				Uses and effects of forces in daily life	1
				Describing force	1
				Topic Review	2
			Earth's gravity	Earth's gravity	1
				Measuring weight	1
				Characteristics of weight	1
				Characteristics of mass	1
				Finding gravity around us	1
				Topic Review	2
				Unit Review	2
Week 10 - Testing and compiling of assessment					

Term 3: Overview

Week	Strand	Unit	Topic	Lesson Title	Periods (40 Mins)
Week 1 - Revision work					
2	Strand 1: **Life**	Unit 4: Interaction & Relationship in the Environment	Paths of energy in food chain and food web	Food chain in different environment 1: Land	1
				Food chain in different environment 2: Ocean	1
				Roles of organisms in a food chain	1
				Food web in different environment 3: Land	1
				Food web in different environment 4: Ocean	1
				Roles of organisms in food web	1
3				Population size in food chain	1
				Causes and effects of changes in population	1
				Functions of decomposers in food chains and food webs	1
				Topic Review	2
				Unit Review	2
4	Strand 3: **Earth and Space**	Unit 1: Our Earth	Formation and change of land	Formation of soil layers	1
				Types of sedimentary rocks	1
5				Formation of rocks: Sedimentary Rocks	1
				Erosion	1
				Weathering	1
6				Volcanoes and Earthquake	1
				Natural disasters	1
7				**Topic Review**	2
				Unit Review	2
8	Strand 2: **Physical Science**	Unit 3: Matter	Mixtures and Solutions	What are solutions?	1
				Solubility 1: Volume of water	2
				Solubility 2: Temperature of water	2
9				Solubility 3: Size particle	2
				Comparing weight of water and water solutions	2
				Topic Review	2
Week 10 - Testing and compiling of assessment					

Term 4: Overview

Week	Strand	Unit	Topic	Lesson Title	Periods (30 Mins)
Week 1: Revision Work					
2 3	Strand 2: **Physical Science**	Unit 3: Matter	Mixtures and Solutions	Saturated solutions	2
				Unsaturated solutions	2
				Components of different types of mixtures	2
				Solutions and suspensions	2
				Separation of water Solution 1: Filtering	2
				Separation of water Solution 2: Evaporation	2
				Topic Review	2
				Unit Review	2
4 5 6 7 8	Strand 3: **Earth and Space**	Unit 3: Space	Moon	Movement of the Moon around the Earth	1
				Causes of Moon phases	1
				Lunar and Solar eclipse	1
				Moon and Tides	1
				Topic Review	2
			Stars	What are stars?	1
				Observing stars: Movement of stars	1
				Constellation in PNG	1
				Traditional knowledge of the night sky	1
				Topic Review	2
				Unit Review	2
Week 9 - Assessment and report writing					
Week 10 - Preparation for Speech Day					

Yearly Lesson Overview

The yearly lesson overview outlines the suggested lesson titles for the subject. The lesson titles outlined are created from the benchmarks given in the syllabus. The lessons are organized and numbered according to the yearly overview and termly overview. They are recommended for delivery in Grade 6 classrooms in the schools.

Strand	Unit	Topic	Sub-topic	Lesson No.	Titles
Strand 1: **Life**	Unit 1: Plants	Reproduction and Heredity of Plants	Flowering and Non-flowering plants	1	Reproductive parts of a flower
				2	Pollination process in a flower
				3	Fertilization process in a flower
				4	Life cycle of a non-flowering plant - Fern
				5	Hereditary characteristics in plants
				6	**Topic Review**
Strand 2: **Physical Science**	Unit 1: Energy	Energy	Sources of energy	7	Sources of energy 1: From the Sun
				8	Sources of energy 2: From moving water
				9	Sources of energy 3: From moving air
				10	Sources of energy 4: From fuel
			Forms of energy	11	Forms of energy
			Energy conversion	12	Changes in energy form
			Uses of energy	13	Uses of energy in daily life
				14	**Topic Review**
		Electromagnet	Properties of electromagnet	15	Characteristics of electromagnet
			Conditions to strengthen an electromagnet	16	How do we strengthen electromagnet? (1)
				17	How do we strengthen electromagnet? (2)
				18	Uses of electromagnets in daily life
				19	**Topic Review**
				20	**Unit Review**
Strand 1: **Life**	Unit 1: Plants	Pathway of water in plants	Pathway of water in root, stem and leaves	21	Paths of water transport system in plants
				22	Where does water in plants pass through? Roots
				23	Where does water in plants pass through? Stem
				24	Where does water in plants pass through? Leaves
				25	Transpiration in plants
				26	**Topic Review**
				27	**Unit Review**

Strand	Unit	Topic	Sub-topic	Lesson No.	Titles
Strand 1: **Life**	Unit 3: Human Body	Respiratory system	Breathing	28	Structure of lungs
				29	Organs of the human respiratory system
				30	Mechanism of breathing
				31	**Topic Review**
		Circulatory system	Circulation	32	Structure and function of the heart
				33	The Heart: Measuring pulse at rest and after work
				34	The Heart: Movement of the blood
				35	Organs of the human circulatory system
				36	Heart and Lung
				37	**Topic Review**
				38	**Unit Review**
Strand 2: **Physical Sciene**	Unit 2: Force and Motion	Force	Types of forces	39	Different types of force
				40	Frictional force
				41	Gravitational force
				42	Elastic force
			Force	43	Uses and effects of forces in daily life
				44	Describing force
				45	**Topic Review**
		Earth's gravity	Weight	46	Earth's gravity
				47	Measuring weight
				48	Characteristics of weight
			Mass	49	Characteristics of mass
			Gravity	50	Finding gravity around us
				51	**Topic Review**
				52	**Unit Review**
Strand 1: **Life**	Unit 4: Interaction and Relationship In The Environment	Paths of energy in food	Food chain	53	Food chain in different environment 1: Land
				54	Food chain in different environment 2: Ocean
				55	Roles of organisms in a food chain
			Food web	56	Food web in different environment 3: Land
				57	Food web in different environment 4: Ocean
				58	Roles of organisms in food web
			Populations in food chains	59	Population size in food chain
				60	Causes and effects of changes in population
			Decomposers	61	Functions of decomposers in food chains and food webs
				62	**Topic Review**
				63	**Unit Review**

Strand	Unit	Topic	Sub-topic	Lesson No.	Titles
Strand 3: **Earth and Space**	Unit 1: Our Earth	Formation and change of land	Soil layers	64	Formation of soil layers
			Sedimentary rocks	65	Types of sedimentary rocks
				66	Formation of rocks: Sedimentary Rocks
			The change of land	67	Erosion
				68	Weathering
				69	Volcanoes and Earthquake
				70	Natural disasters
				71	**Topic Review**
				72	**Unit Review**
Strand 2: **Physical Science**	Unit 3: Matter	Mixtures and solutions	Observing solutions	73	What are solutions?
			Properties of solutions	74	Solubility 1: Volume of water
				75	Solubility 2: Temperature of water
				76	Solubility 3: Size particle
				77	Comparing weight of water and water solutions
				78	**Topic Review**
				79	Saturated solutions
				80	Unsaturated solutions
			Mixture and substance	81	Components of different types of mixtures
				82	Solutions and Suspensions
			Separation of mixtures	83	Separation of water solution 1: Filtering
				84	Separation of water solution 2: Evaporation
				85	**Topic Review**
				86	**Unit Review**
Strand 3: **Earth and Space**	Unit 3: Space	Moon 1	Moon in motion	87	Movement of the Moon around the Earth
			Moon Phases	88	Causes of Moon phases
				89	Lunar and Solar eclipse
				90	Moon and Tides
				91	**Topic Review**
		Stars	Properties of Stars	92	What are stars?
			Motion of Stars	93	Observing stars: Movement of stars
			Star Patterns	94	Constellation in PNG
				95	Traditional knowledge of the night sky
				96	**Topic Review**
				97	**Unit Review**

Content Background Information

The background information provided will assist teachers who are not familiar with the content of a particular unit or topic to enhance his or her planning and to teach with confidence in the classroom. As most primary teachers are generalist and not specialist in subject matter, it is important that for each unit in the syllabus, there is content background information for the teachers to use. You are also encouraged to use other resources to enhance your teaching. Secondly, most primary schools in Papua New Guinea are situated in the remotest parts do not have other resource books, most teachers will depend on the Teacher Guide to develop daily teaching plan mainly in terms of content delivery to the students in the classroom.

Strand 1: Life

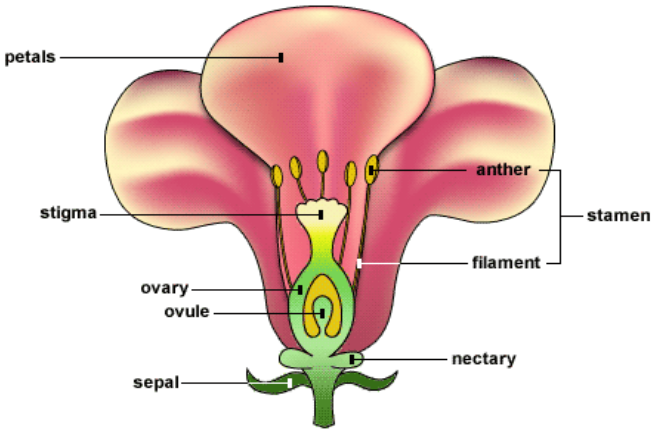
Unit 1: Plants

Topic: Reproduction and Heredity of Plants

Parts and their functions of Flower

The flower is the reproductive organ of many plants.

Structure of a flower



Structure	Function
Sepals	Protect the unopened flower
Petals	May be brightly colored to attract insects
Stamens	The male parts of the flower (each consists of an anther held up on a filament)
Anthers	Produce male sex cells (pollen grains)
Stigma	The top of the female part of the flower which collects pollen grains
Ovary	Produce the female sex cells (contained in the ovules)
Nectary	Produce a sugary solution called nectar, which attracts insects

Processes of reproduction in Flowering plants

Pollination

Pollination is a very important part of the life cycle of a flowering plant. It is part of the sexual reproduction process of flowering plants, which results in seeds that will grow into new plants. Flowers are the structures of flowering plants that contain all the specialised parts needed for sexual reproduction.

Plants have gametes, which contain half the normal number of chromosomes for that plant species. Male gametes are found inside tiny pollen grains on the anthers of flowers. Female gametes are found in the ovules of a flower. Pollination is the process that brings these male and female gametes together.

Pollen can't get from the anthers to the ovules on its own, so pollination relies on other things to move the pollen. The wind or animals, especially insects and birds, pick up pollen from the male anthers and carry it to the female stigma. Flowers have different shapes, colours and smells, and often sugary nectar and nutritious pollen, to encourage animals to visit and pollinate them. Wind-pollinated flowers are shaped to make it easy for the wind to pick up or deposit pollen.

Many flowers can be pollinated by their own pollen – a process called self-pollination. However, this does not always result in the genetic variation needed for species to survive. Many plants have ways to make sure they are only pollinated by pollen from a flower on a different plant, which is called cross-pollination. Some have the male and female parts in separate flowers on the same plant, while others have male and female flowers on different plants. Many have the stigmas and anthers ripening at different times to prevent self-pollination.

Figure 1: Flax flower with pollen

Figure 2: Bee pollinating a flower

Seed Dispersals

Like pollen, plant seeds are also dispersed by different means.

Wind - dandelions, orchids, and other plants have small, light seeds the winds easily carry. The seeds of the black maple trees are covered by thin, dry fruits that act as propellers.

Water – some plants seeds and fruits are spread by water. These fruits and seeds contain air chambers that help them to float. The large fruit of the coconut palm, for example can float great distances on ocean currents. This is why coconut palms often grow on small tropical islands.

Animals – burrs are fruits that stick to the fur of animals. As an animal moves around, it spreads the seeds to new locations. Many animals are attracted to the sweet taste of many fruits. As the animal eats the fruit, it may disturb some of the seeds. The seeds drop to the ground where they may grow into new plants.

Animals can also spread seeds by eating fruits. Some seeds pass through an animal intact, and thus become part of its waste. Fruit eating birds often spread plant seeds this way.

Fertilisation

Only after pollination, when pollen has landed on the stigma of a suitable flower of the same species, can a chain of events happen that ends in the making of seeds. A pollen grain on the stigma grows a tiny tube, all the way down the style to the ovary. This pollen tube carries a male gamete to meet a female gamete in an ovule. In a process called fertilisation, the two gametes join and their chromosomes combine, so that the fertilised cell contains a normal complement of chromosomes, with some from each parent flower.

The fertilised ovule goes on to form a seed, which contains a food store and an embryo that will later grow into a new plant. The ovary develops into a fruit to protect the seed. Some flowers, such as avocados, only have one ovule in their ovary, so their fruit only has one seed. Many flowers, such as kiwifruit, have lots of ovules in their ovary, so their fruit contains many seeds.

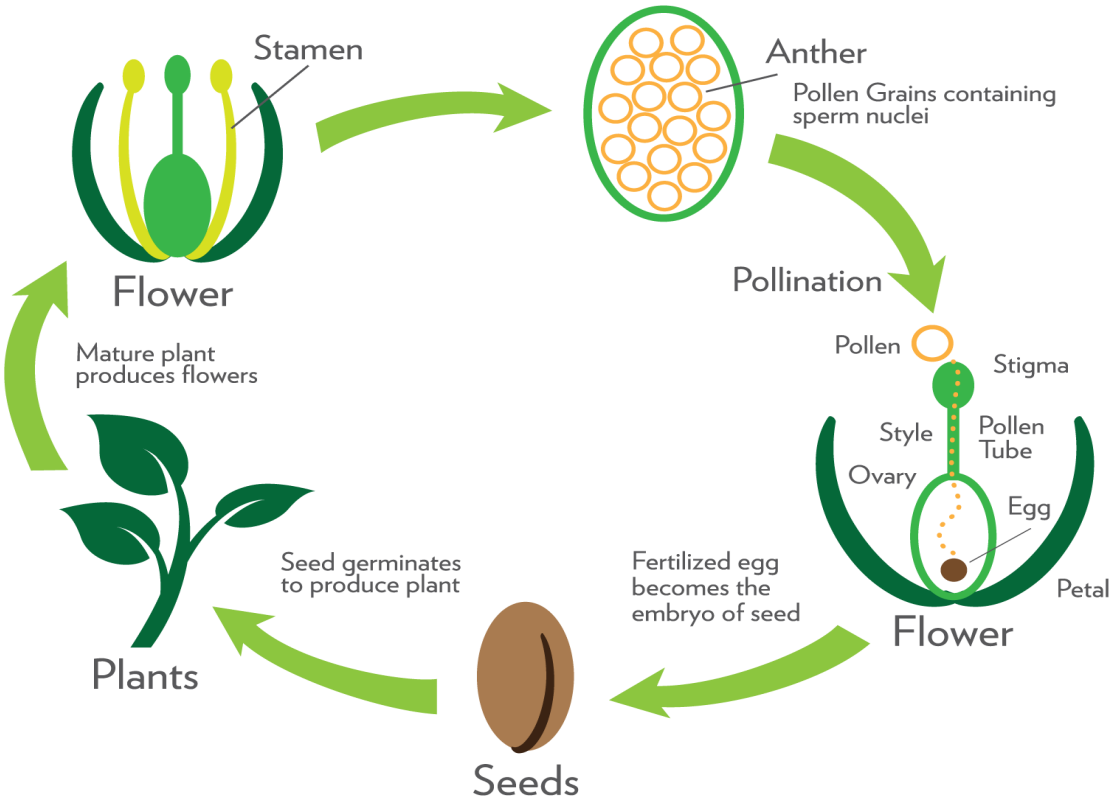


Figure 1: Life cycle of a flowering plant

Reproduction in Non-flowering plants

Some plants don't produce flowers and seeds. Plants such as ferns and mosses are called nonflowering plants and produce spores instead of seeds. There is also another group called the Fungi, that include mushrooms, and these also reproduce by spores. We often think of these individuals as "non-photosynthetic plants" when in fact they belong to their very own group or kingdom. Spores are microscopic specks of living material. Ferns produce their spores on the undersides of the leaves (fronds). You may have seen them. They are the brown "spots" or "pads" on the bottom of the leaves. If you have access to a microscope, use it to look at the spores. You will find them to be a variety of shapes and unique to each kind of fern. Plants from parts are a form of asexual or vegetative propagation. This process is sometimes called cloning because every new plant is exactly like the parent. One type of cloning uses cuttings--parts of plants that grow into new plants. Both stems and leaves can be used as cuttings. Another kind of cloning is grafting - the joining together of two plants into one. Other kinds of cloning use bulbs or tubers - underground parts that make new plants.

Non-flowering plants reproduce by releasing large numbers of tiny spores. These minute organisms consist of one or a few cells inside a tough coat. Many non-flowering plants rely on wind to carry their reproductive spores as far away as possible. This reduces competition with the parent plant for light, water, and important nutrients. If a spore lands in a damp place, it germinates (sprouts) and grows into a new plant.

Ferns are plants that reproduce with spores instead of seeds and flowers - they are different from gymnosperms and angiosperms. They have a life cycle called the alternation of generations which has a diploid sporophyte phase and a haploid gametophyte phase. The dominate phase is the sporophyte phase.

1. The sporangia produces haploid spores through the process of meiosis.
2. In suitable conditions, the spores grow into small heart-shaped, haploid gametophytes by mitosis.
3. Each gametophyte has a female and male sex organ, which are called the archegonium and the antheridium, respectively. They produce gametes - sperm and eggs - through mitosis.
4. The sperm uses the flagella to swim from the antheridium to the archegonium, where the eggs are, and fertilizes them, forming a zygote.
5. The zygote is now a diploid, and grows by mitosis into a fern (a diploid sporophyte). The new sporophyte grows out from the archegonium.
6. The cycle repeats as the sporangia from the new sporophyte once again produces haploid spores.

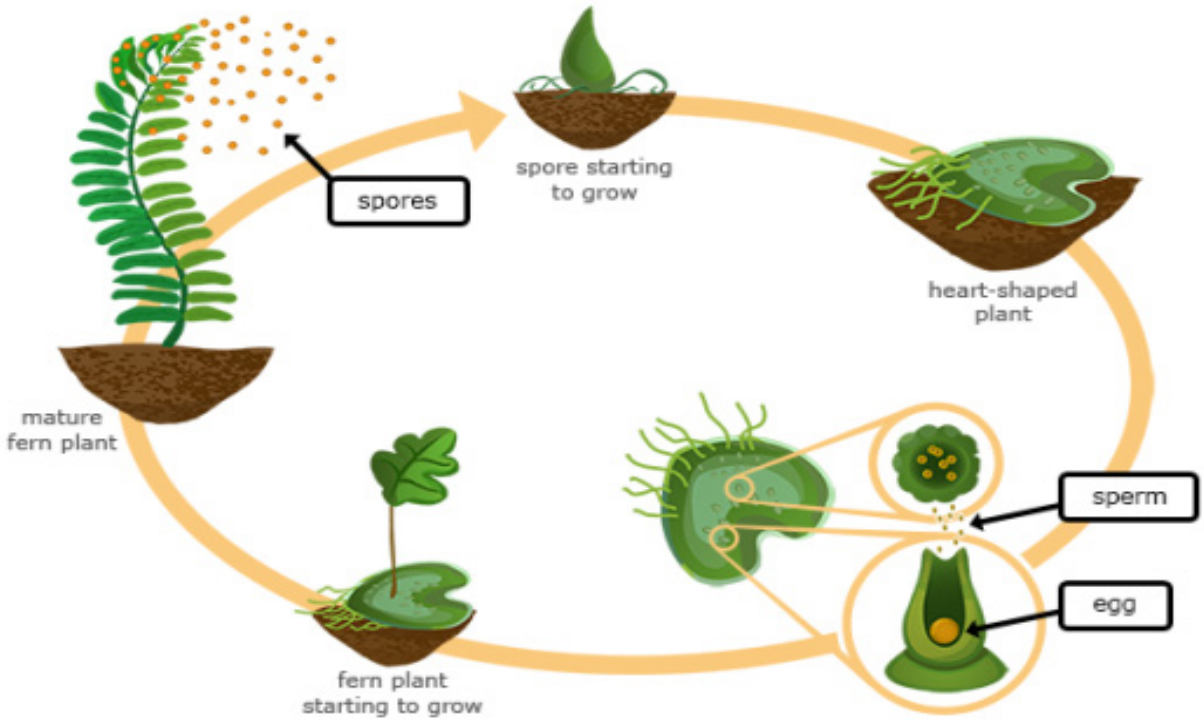


Figure 1: Life cycle of a fern

Heredity in plants

Heredity is the passing on of traits from parents to their offspring, either through asexual reproduction or sexual reproduction; the offspring cells or organisms acquire the genetic information of their parents.

Inherited characteristics are the characteristics that make plants with what they are. These characteristics are passed down from generation to generation. The amazing thing about these characteristics is that they can change over time. This is known as adaptation. This means that the plant has evolved in such a way that is better suited to live in its environment. These types of changes get passed down to offspring of that plant and help the new plant survives better.

Plants are a simple organism to start off with when learning about characteristics. Why is this? Because plant characteristics can easily be seen if you are holding a flower in your hand. For example look at the picture of the flower and notice how many petals it has and the color of the whole flower.

Below are images that show two different plants. Look at both images carefully and see what is different between both plants. The difference you see are due to the plants inherited characteristics.

Figure 1: Showing the similarities and differences in flowers

Unit 2: Plants

Topic: Pathway of water in plants

Paths of water in roots, stem and leaves

Water enters a plant through the hair on the root, and moves across the root cells into the xylem, which transports it up and around the plant. That, and solutes are moved around by the xylem and the phloem, using the root, stem and plant. Water enters the root through the root hair, and then takes one of three paths (apoplast, symplast and vacuolar) to the xylem vessel.

Soil to root hair

A root hair is a simple extension of the epidermis of a root cell. It reaches into the soil to absorb water by increasing the surface area and therefore the rate at which water can be absorbed. Some plants have fungi which act like fine roots, absorbing nutrients from the soil for the plant. Water moves into the root hair cells by osmosis because it is moving down a water potential gradient, since a root cell has a relatively low water potential due to its inorganic ions and organic substances. Water enters through the membrane and into the cytoplasm and vacuole.

Root hair to Xylem

From the root hair cells, water again moves by osmosis down a concentration gradient toward the xylem, and can take one of three paths - apoplast, symplast, or vacuolar. The apoplast pathway is where water takes a route going from cell wall to cell wall, not entering the cytoplasm at any point. The symplast pathway is where water moves between cytoplasm/vacuoles of adjacent cells. However, the apoplast pathway can only take water a certain way; near the xylem, the Casparian strip forms an impenetrable barrier to water in the cell walls, and water must move into the cytoplasm to continue. This gives the plant control over the ions that enter its xylem vessels, since water must cross a plasma membrane to get there. The vacoular pathway moves molecules through the vacuoles only of the plant.

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Xylem vessels

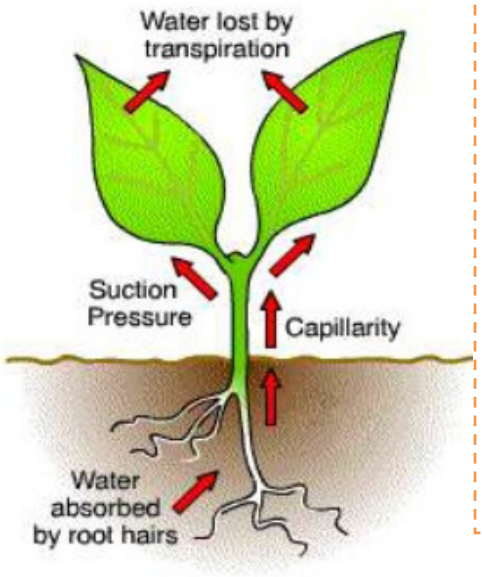
These vessel elements make up the xylem - and are many elongated cells laid end to end, and normal plant cells have walls strengthened by lignin - a complex organic polymer deposited in the cell walls of many plants, making them rigid and woody, a hard strong substance that is impermeable to water, and is designed to provide structure and strength to the plant. When these plant cells are strengthened by lignin, the cell inside dies, leaving a space inside. However, in some plasmodesmata, there was no lignin laid down and these appear as gaps in the xylem vessel, known as pits. These have permeable unthickened cellulose cell wall. Thus, a continuous tube is formed, known as the xylem vessel. Xylem vessels are huge.
They are used to transport the minerals and water and provide support to the plant.

Xylem to leaf

As water evaporates from the leaf, a constantly occurring process, more water is taken in to replace it. The removal of water reduces the hydrostatic pressure (pressure exerted by a liquid). Since this pressure becomes lower at the top of the xylem vessel than at the bottom, this pressure difference causes water to move up the xylem vessels, just as in a straw. This process is known as mass flow - as long with the fact that water molecules move together as a body of water - aided by water's property of being cohesive, and attracted to the lignin in the walls of the xylem vessels, known as adhesion. Once water is in the leaf, it can be lost through the stomata, if there is a concentration gradient that it can go down, which small pores are in direct contact with the air outside. This process is known as transpiration.

Root pressure

Plants can also increase the hydrostatic pressure at the bottom of the vessels, changing the pressure difference. They do this by cells surrounding the xylem vessels to use active transport to pump solutes across their membranes and into the xylem, lowering the water potential of the solution in the xylem, thus drawing in water from the surrounding root cells. The influx of water at the bottom of the xylem increases the pressure.



There are three forces that move water upwards in the xylem:

1. **Root pressure** – a force that pushes water up the xylem (produced by the continuous movement of water through the root cells).
2. **Capillary action** – a force that pushes water up the narrow xylem vessels
3. **Transpiration pull** – a force that pulls water up the xylem (produced by evaporation of water from the leaves).

Unit 3: Human Body

Topic: Respiratory System

Breathing

The respiratory system brings oxygen into the body and removes wastes.

You could not live very long without breathing in and breathing out. Organs that work together to take air into the body and push it back out makes the respiratory system. When you inhale, or breathe in, you take air into your nose or mouth. The air moves into the trachea, which connects the throat to the lungs. In the chest, the trachea divides into two tubes. These tubes enter the lungs, the main organs of the respiratory system. Each tube divides into smaller and smaller tubes. At the ends of the smallest tubes are millions of tiny air sacs. In the air sacs, oxygen is transferred to the blood. Blood carries oxygen to all your cells. At the same time, carbon dioxide waste from cells transferred from the blood to the air sacs. When your exhale, or breath out, your body gets rid of carbon dioxide. The diaphragm is a dome-shaped muscle that helps your breathe. When the diaphragm contracts, it moves down in your chest, and you inhale. When the muscle relaxes and moves up toward the lungs, you exhale.

Nose
The nose cleans, moistens, and warms the air that is inhaled.

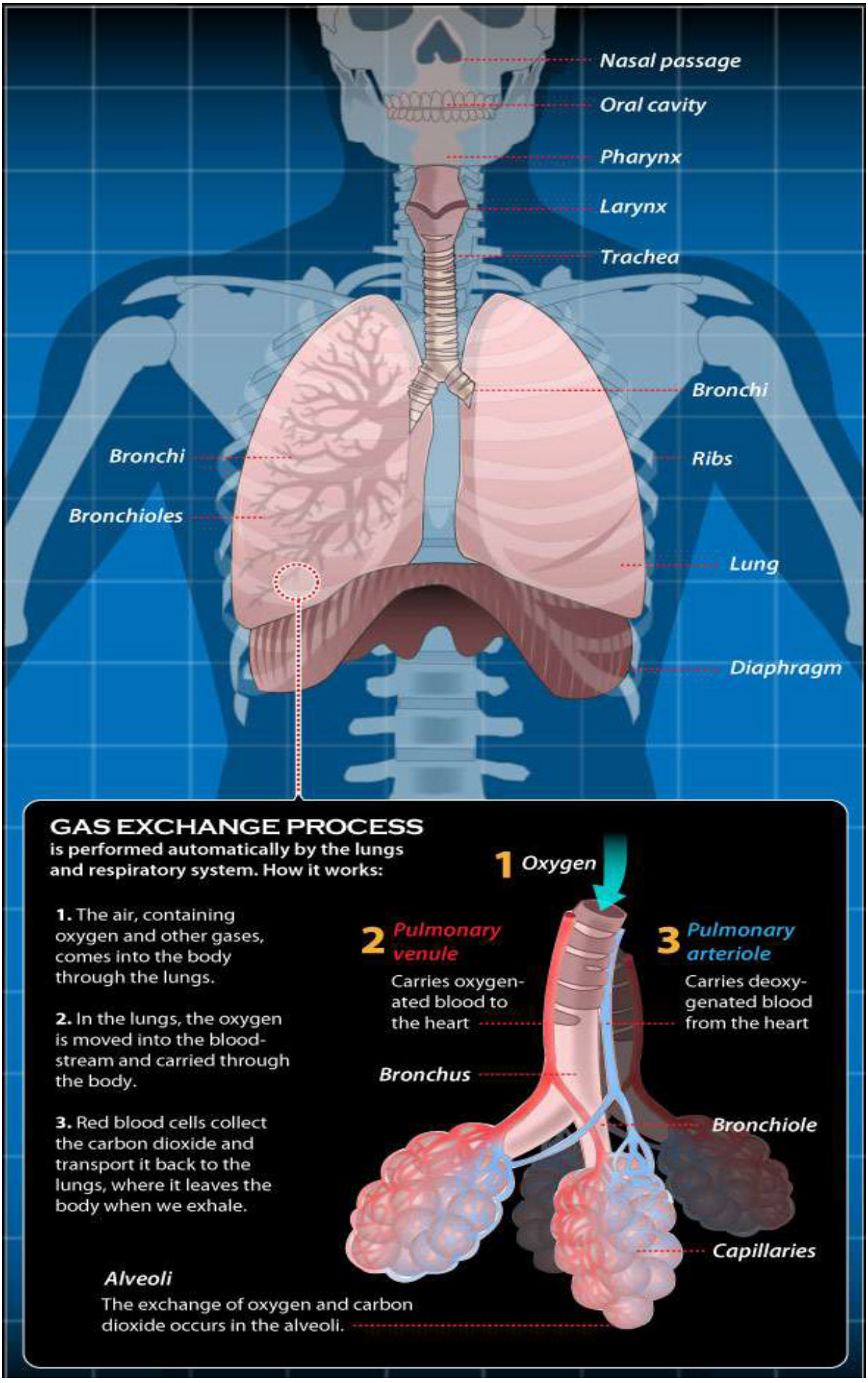
Trachea
The trachea is also called a wind pipe.

Air sacs
Oxygen and carbon dioxide pass through the thin walls of the air sacs into the blood.

Lungs
The lungs are the main organs of the respiratory system.

Diaphragm
The diaphragm is the most important muscle of respiration.

The primary organs of the respiratory system are the lungs, which function to take in oxygen and expel carbon dioxide as we breathe.



https://www.livescience.com/26825-human-body-system-respiration-infographic.html

Unit 3: Human Body

Topic: Circulatory System

Circulation

Blood not only brings oxygen to the cells and takes away carbon dioxide. It also transport nutrients and water to the cells. The job of the circulatory system is to transport oxygen, nutrients, water, and wastes. The respiratory and circulatory systems work closely together. Blood flows through the blood vessels. You can think of the blood vessels. You can think of the blood vessels as the highways of your body. The heart is a muscular pump that pushes the blood through the highways. Follow the path of the blood after it picks up oxygen from the lungs. This oxygen-rich blood flows into the heart and is pumped to all parts of the body through arteries. An artery is a blood vessel that carries blood away from the heart to capillaries. A capillary is a tiny blood vessel that connects arteries and veins. The capillaries pass oxygen to the cells. A vein carries blood back to the heart. The blood in veins has little oxygen. It enters the heart and goes to the lungs to pick up more oxygen. The solid parts of blood are suspended in a liquid. This liquid, called plasma, carries nutrients and water to the cells and carries away wastes. The solid parts of the blood include red blood cells, white blood cells, and platelets. Red blood cells are disc shaped. They pick up and carry oxygen from the lungs. White blood cells are larger than the red blood cells. White blood cells help the body fight disease. Platelets are small pieces of cells. They help to heal cuts and other injuries by forming blood clots, or thickened, solid masses.

The circulatory system is made up of the heart, blood and blood vessels known as arteries, capillaries and veins. The heart pumps blood throughout your body through the blood vessels. Blood delivers oxygen and nutrients to cells and carries away carbon dioxide and other waste materials.

The right atrium receives blood coming from the body and the left atrium collects blood coming from the lungs.

The ventricles are underneath the atria (plural for atrium) and are the chambers that pump blood out of the heart.

The right ventricle has a thin wall because it only needs to pump the blood around the lungs at low pressure.

The left ventricle has a much thicker wall because it generates the high pressure needed to push blood to the head and body.

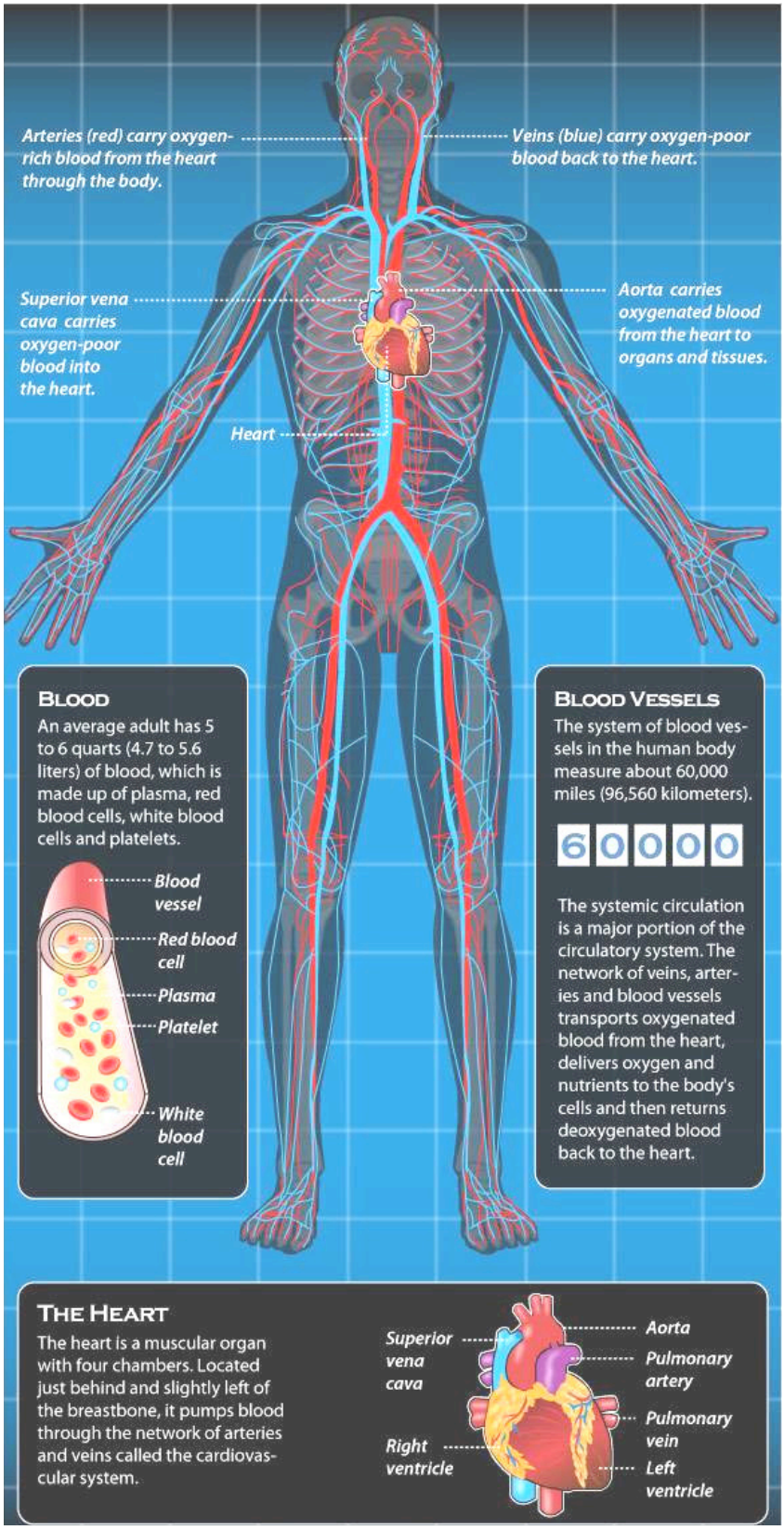
The right side of the heart collects oxygen-poor blood from the body and pumps it to the lungs.

The left side of the heart collects oxygen-rich blood from the lungs and pumps it to the body.

Heart
The heart is a pump about the size of your fist.

Arteries
The arteries carry blood away from the heart.

Veins
The veins carry blood to the heart.



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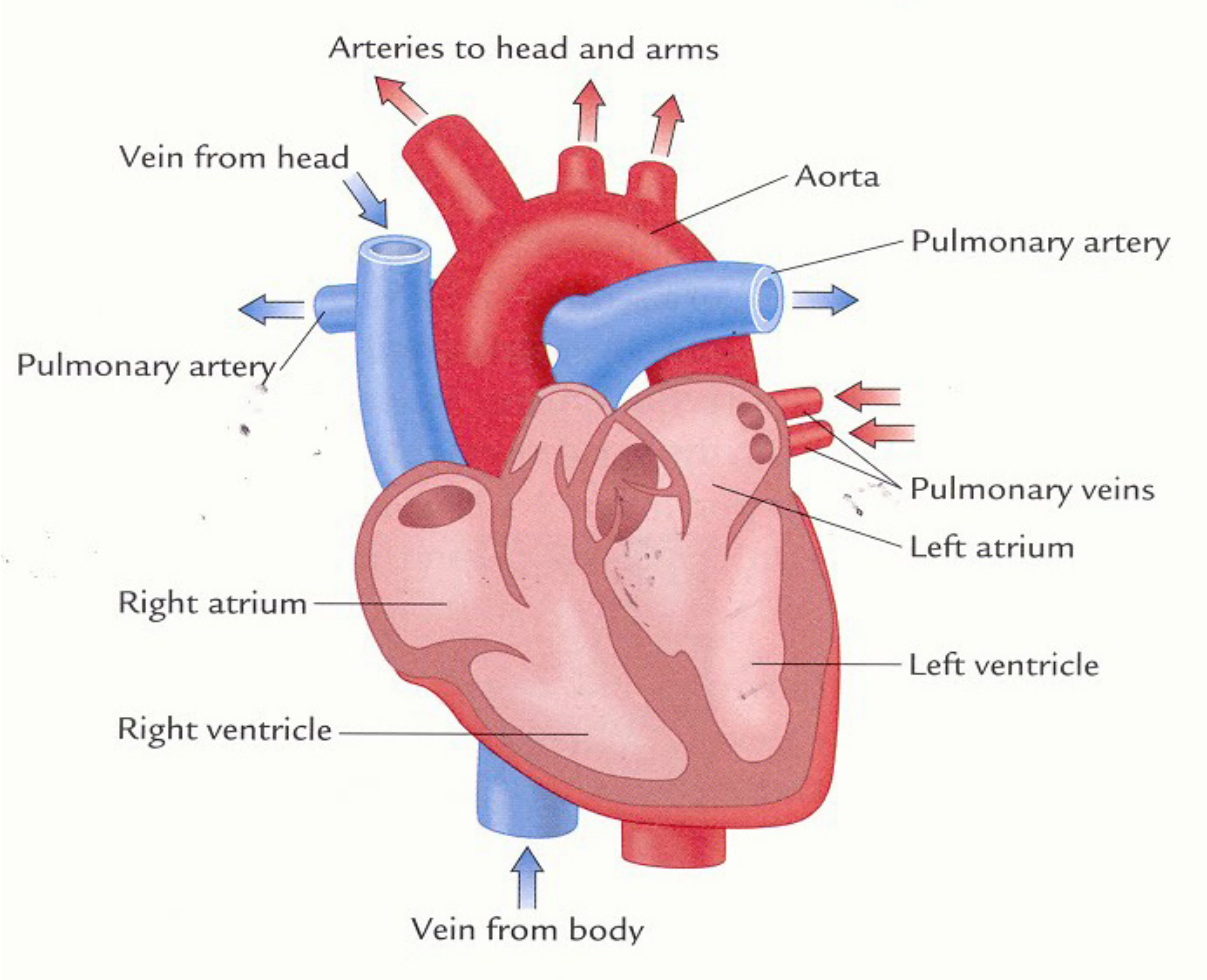


Figure 1: Structure of the heart

Unit 4: Interaction and Relationship In the Environment

Topic: Paths of energy in food chain and food web

Food Chain

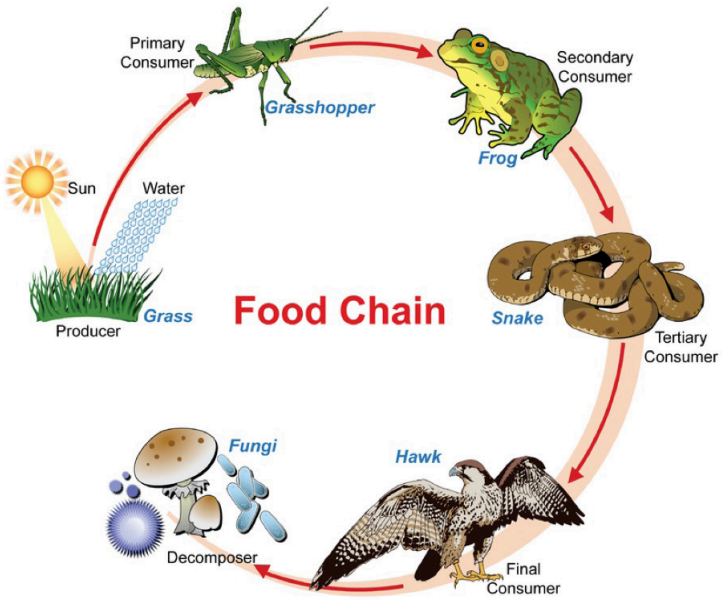
When one animal eats another animal or eats a plant, it becomes part of the flow of energy in a food chain.

A *food chain* is the path that energy takes through a community as one living thing eats another. All animals depend on plants for their energy. When an insect eats a plant and the frog eats that insect, energy is passed from organism to organism. The plant produced its own food using the energy in sunlight. Some of the Sun's energy captured by the plant passed to the insect and then go to the frog.

No matter what organisms are parts of a food chain, the Sun is always the first link in the chain. Plants are the second link. A plant is called a *producer* because it produces its own food. An animal is a *consumer.* A consumer is an organism that eats other living things in order to get energy. Consumers are classified by their food source. An animal that eats only other animals is a carnivore. Lions, hawks, and spiders are *carnivores.* An animal such as a zebra, horse, or deer eats only plants is an *herbivore.* An animal that eats both plants and animals is an *omnivore.* Most humans are omnivores, although some people are vegetarians. That means they don't eat meat. Producers, carnivores, herbivores, and omnivores are all parts of a food chain.

Animals live in many different places, or habitats. Tide pools are the habitat of some ocean animals. A tide pool is an area at the edge of the ocean where water collects in spaces and rocks. A tide pool is kind of *aquatic habitat.* An aquatic habitat is a place where organisms live in or on water. In tide pools, seaweed and algae are the producers. Like producers on the land, they use the energy from sunlight to make food. An aquatic habitat is also home to herbivores, carnivores, and omnivores.

People live in terrestrial habitats. A terrestrial habitat is a place where organisms live on land. A desert is one kind of *terrestrial habitat.* Desert regions usually get little rainfall, so they are very dry. Organisms that live in the desert are adapted to the dry conditions there. Desert producers include grasses, wildflowers, and cactuses. Cactuses store large amounts of water in their cells. Desert herbivores include insects and small animals like rabbits. Desert herbivores that eat cactus are able to get both energy and water from the plants they eat.



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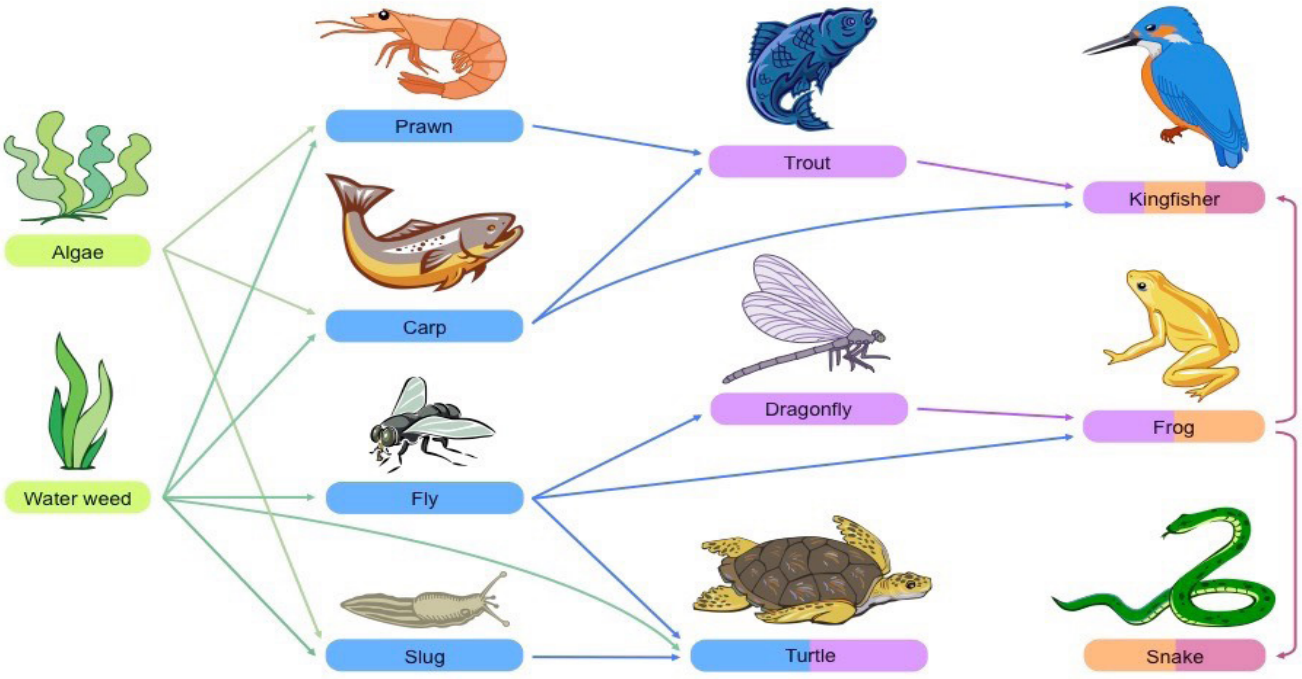
Food Webs

Most ecosystems contain many different kinds of plants and animals. Each plant or animal is part of more than one food chain. When two or more food chains overlap, they form a food web. In a food web, at least one plant or animal from each food chain is part of another food chain. For example, the clover, grasshopper, woodpecker, and owl form a food chain. They are also part of a food web. In the food web shown, the grasshopper is not only prey for the woodpecker. It is prey for the snake, too. The grasshopper is part of a second food chain that contains the snake. The snake and woodpecker may compete with each other for this food resource.



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Population in Food Chains

Organisms rarely live alone. A number of organisms of the same kind that live in a certain area is called a *population.* Each animal or plant has its own particular habitat, and generally a number of different populations live in the same habitat. For example on a coral reef you will find populations of brittle stars, anemone fish and coral sharks. The different groups of organisms that live together in a particular habitat are called a community. Each of the organisms in a community relies on other organisms in that community for food and sometimes for protection. Communities are usually named after the type of habitat in which they are found. For example, the organisms that live on a coral reef are called a coral reef community. Organisms that live on or under the leaf litter on a forest floor belong to a forest floor community. Sometimes a community is named after the dominant or most noticeable type of organism. For example, a mangrove community or eucalypt community.

In nature we never see so many flies develop. There are certain factors in ecosystems that control populations. Populations in an ecosystem are affected by non-living factors, called physical factors such as the weather, availability of water and soil conditions. They are also affected by biological factors such as availability of food, number of predators and competitors, and the presence of disease organisms.

Scientists can divide the organisms in an ecosystem into trophic levels, or groups based on how they get their energy:

- Producers are the base of the ecosystem. They are usually plants, but can be any organism that can make their own food, like some bacteria.
- Primary consumers are herbivores that eat the producers.
- Secondary consumers eat the primary consumers.
- Tertiary consumers are the top predators, eating both the primary and secondary consumers.
- Within each trophic level there are different populations, or a group of organisms of the same species living in the same place at the same time.
- Although the populations of species in each trophic level may seem separate, everything in an ecosystem is intertwined. Scientists represent relationships between organisms in a food web, a diagram that shows who eats who in an ecosystem.
- When all the populations are in balance, the ecosystem is at homeostasis. However, altering just one population can have catastrophic effects on the rest of the ecosystem and disrupt homeostasis. Let's look at three examples, changes in producers, secondary consumers, and top predators.

Changes in Producer Populations

Producers form the base of the food web, providing food and energy for all other levels of the food web.

Recently, deforestation has become a problem, especially in the rainforest environment. Rainforests are being cleared for livestock and farming, removing the producers of the environment in the process.

Without the producers, there is less food for the primary consumers like bugs and rodent species. Without the primary consumers, secondary consumers like small birds or snakes have less food. With fewer secondary consumers, the top predators like hawks won't have enough food either. This type of consequence where all feeding (trophic) levels can die out is called a

population crash, and a common occurrence with man – made disturbances in the environment.

It is clear that altering the main source of energy for the food web, the producers would cause problems. But the food web is a delicate balance of all the species involved.

Even secondary consumers are important (give examples).

Here is an example:

In a tropical rainforest food web a very important secondary consumer is in jeopardy: the wild pigs, the wild pig is a keystone species essential for maintaining balance in an ecosystem. The wild pig eats snails. Without this control on the forest snail population, they grow out of control in a population boom, eating all the green plants and causing a population crash.

Here again, humans are causing problems. Clear cut logging has decreased the food source for deadly pythons. Deadly pythons in turn are eating wild pigs. As the wild pig population's decrease, the snail's population increases and the green plants population falls. As these producers die off, the food web undergoes a population crash since there is no feeding (trophic) level to provide energy for the rest of the food chain.

Decomposers (recycling matter in Ecosystems)

Some organisms get food energy by eating the remains of dead organism. These organism are an important part of an ecosystem.

All organism die. You already know that some dead organisms are eaten by scavengers (a scavenger is an animal that feeds on the remains or wastes of other animals) but some are not. Instead, after death, their bodies decay, or break down into simpler materials. Decomposers help this process. A decomposer is a living thing that breaks down the remains of dead organisms. All food chains end with decomposers. A fallen tree, or log, is a good place to find decomposers. Decomposers found there include, worms, fungi, bacteria, and insects such as termites. By helping the wood decay, decomposers help new plants grow. Nutrients that were in the wood are released back into the soil by decomposers. This recycling, or process of breaking down materials into a different form that can be used again is important to an ecosystem.

Decay happens much faster in warm, moist conditions than in cold, dry conditions. An animal that died atop a cold mountain might not decay for a long time. If that same animal died in a warm, rainy area, the body would decay rapidly! Decomposers help the environment. They keep it from becoming crowded with the remains of dead plants and animals. They also recycle valuable nutrients. Much of this “cleaning” and recycling is done by decomposers called microorganisms. A *microorganism* is a tiny living thing that can only be seen with the aid of microscope. As you’ve learned, bacteria help in the decay of dead plants and animals. Nutrients released from these remains enrich the soil. Many kinds of plants in an ecosystem benefit from this enriched soil.

Decomposition is the process of breaking down dead matter into simpler substances such as mineral salts, water and carbon dioxide.

Oxygen is required for decomposition to take place. The process of decomposition is summarized in the diagram below.

Strand 2: Physical Science

Unit 1: Energy

Topic: Energy

Forms and Uses of Energy

Energy is the ability to cause motion or other changes in matter. There are many forms of energy.

You use energy to ride a bike. A stove uses energy to cook food. A car uses energy to travel. How can energy do all these things? Energy is the ability to cause movement or to cause matter to change in other ways. There are many forms of energy. Each form of energy changes matter, but in a different way. For example, a bike is a matter. The energy you use to ride a bike causes that matter to move. Food is matter. The energy used to cook food causes that matter to heat up.

There are six forms of energy, these include;

1. **Electrical Energy**
   Electrical energy of charged particles. It is used to run appliances and other machines.
2. **Mechanical Energy**
   Mechanical energy is the energy of moving things; It is used to move people and objects from place to place.
3. **Sound Energy**
   Sound energy is energy you can hear. It moves as waves through air or other matter. It is used to hear music.
4. **Light Energy**
   Light energy is energy you can see. It moves as waves through space or clear matter. It allows you to see books and other objects.
5. **Thermal Energy**
   Thermal energy is the energy of tiny moving particles of matter. It is used to heat food and warm homes.
6. **Chemical Energy**
   Chemical energy is energy that is stored in substances. It is found in food, fuel, and batteries.

Some energy involves motion. For example, a bowling ball rolling down an alley has energy of motion. Energy of motion is also called kinetic energy. Other energy does not involve motion. For example, chemical energy is a form of stored energy. Stored energy is also called potential energy because of their position. A diver standing on a diving board above a pool has a potential energy because of the substances they contain. For example, a battery has potential energy because of the chemicals inside it.

Energy resource is a source of supply of energy that can be used to generate electrical power to meet people's needs.

Solar Energy

Solar power harvests the energy of the sun through using collector panels to create conditions that can then be turned into a kind of power. Large solar panel fields are often used in desert to gather enough power to charge small substations, and many homes use solar systems to provide for hot water, cooling and supplement their electricity. The issue with solar is that while there is plentiful amounts of sun available, only certain geographical ranges of the world get enough of the direct power of the sun for long enough to generate usable power from this source.

Wind Energy

Wind power is becoming more and more common. The new innovations that are allowing wind farms to appear are making them a more common sight. By using large turbines to take available wind as the power to turn, the turbine can then turn a generator to produce electricity. While this seemed like an ideal solution to many, the reality of the wind farms is starting to reveal an unforeseen ecological impact that may not make it an ideal choice.

Geothermal Energy

Geothermal energy is the energy that is produced from beneath the earth. It is clean, sustainable and environment friendly. High temperatures are produced continuously inside the earth's crust by the slow delay of radioactive particles. Hot rocks present below the earth heats up the water that produces steam. The steam is then captured that helps to move turbines. The rotating turbines then power the generators.

Geothermal energy can be used by a residential unit or on a large scale by a industrial application. It was used during ancient times for bathing and space heating. The biggest disadvantage with geothermal energy is that it can only be produced at selected sites throughout the world. The largest group of geothermal power plants in the world is located at The Geysers, a geothermal field in California, United States.

Fossil Fuels (Coal, Oil and Natural Gas)

When most people talk about the different sources of energy they list natural gas, coal and oil as the options – these are all considered to be just one source of energy from fossil fuels. Fossil fuels provide the power for most of the world, primarily using coal and oil. Oil is converted into many products, the most used of which is gasoline. Natural gas is starting to become more common, but is used mostly for heating applications although there are more and more natural gas powered vehicles appearing on the streets. The issue with fossil fuels is twofold. To get to the fossil fuel and convert it to use there has to be a heavy destruction and pollution of the environment. The fossil fuel reserves are also limited, expecting to last only another 100 years given are basic rate of consumption.

Energy exists in different forms. It also changes from one form to another.
Some of these forms can exist as potential and kinetic energy. Energy can change from one form to another. A change of energy from one form to another is known as energy transformation.

Examples of energy transformation are shown in the chart below:

Energy Transformation.

- Electrical energy changes to light and thermal energy.
- Mechanical energy changes to electrical energy
- Chemical energy to mechanical energy.

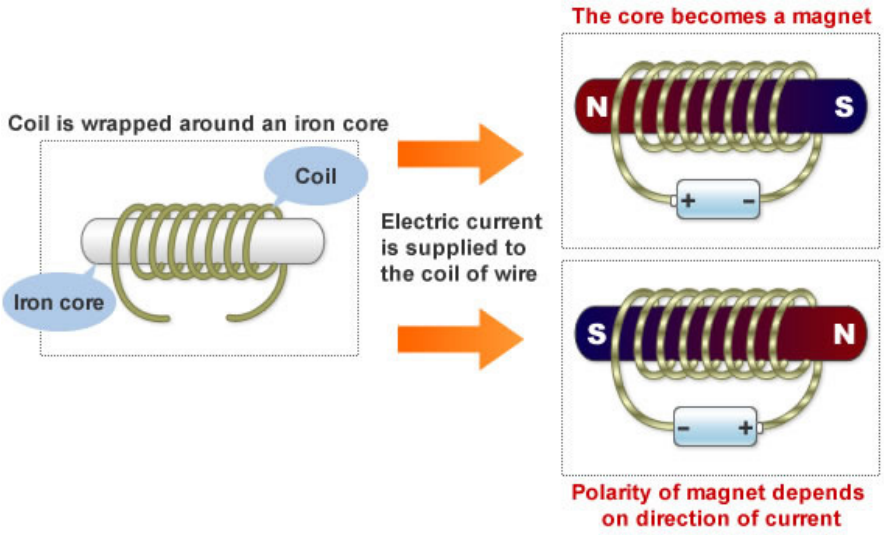
Properties of electromagnet

An electromagnet becomes a magnet when an electric current passes through an insulated wire that is wrapped around an iron core (nail). These are the properties of an electromagnet:

Polarity
Attraction
Repulsion
Strength

Electromagnet is a temporary made by placing a piece of iron inside a current carrying coil of wire.

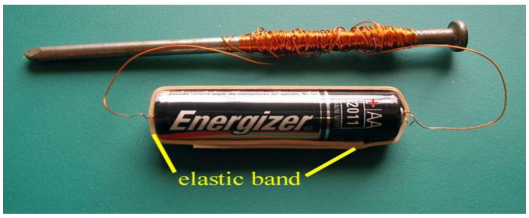
- Magnetic field is present only when current is flowing in the wire coil.
- Increase strength of the magnetic field by adding more turns to the wire coil or increasing the current passing through the wire.
- Magnetic properties of electromagnets can be controlled by changing the electric current flowing through the wire coil.
- Converts electrical energy into mechanical energy to do work



http://zakopianskie.info/poles-in-electromagnets/

Conditions to strengthen electromagne

One of the important discoveries of 19th-century physics was that a changing electric field produces a magnetic field, and vice versa. This phenomenon, known as “electromagnetic induction,” makes it possible to construct an electromagnet using a piece of metal, a length of conducting wire and a source of electricity. In principle, the procedure is to coil the wire around a metal core and connect the wire to a power source, such as a battery. The magnetic field inside the coil, produced when current is flowing, magnetizes the bar. You can increase the strength of the magnet in several ways.



Increase the number of coils to increase the strength of the magnet. According to Ampere’s Law, the strength of the magnetic field is directly proportional to the number of coils; doubling the number of coils doubles the field strength.

Pass more current through the wire. Ampere’s Law also tells us that the strength of the magnetic field is proportional to the current, and you can increase the current by increasing the voltage of the power source. If you’re using batteries, connect more by wiring them in series with the originals. To wire batteries in series, connect the negative terminal of one to the positive terminal of the other and put the load across the other set of terminals. The electrical resistance of the wire limits this method of increasing magnetic field strength; the wire will overheat if you increase the voltage too much.

Make the core out of soft iron. Iron is a magnetic material, and it amplifies the field produced by the electromagnet. If you have to use a steel item, such as a nail or bolt, avoid hardened or stainless steel. Neither of these materials are magnetic.

Bend the core into a C-shape. Reducing the distance between the poles of the electromagnet reduces the distance that the magnetic lines of force have to travel through air to complete the magnetic circuit. Air has a high reluctance to the flow of magnetic energy -- reluctance is analogous to electrical resistance -- while metal has low reluctance. The closer together you bring the poles of the magnet, the stronger the field will be.

Tip

Increasing the cross-sectional area of the wire reduces resistance and allows you to increase the voltage to strengthen the magnetic field, but you can’t wind as many coils around the core if you use thicker wire. The conductance of the wire matters. If you make the coil from steel wire, the magnetic field won’t be as strong as it will be if you use copper wire. The spacing between individual turns in the coil has no effect on the strength of the magnetic field.

Warning
When the coil becomes electrically charged, you can get a shock if you touch it. If you want to pick the magnet up, be sure to wear gloves made from an electrical insulator, such as rubber.

Electromagnets are very widely used in electric and electromechanical devices, including:

Motors and generators.
Transformers.
Relays.
Electric bells and buzzers.
Loudspeakers and headphones.
Actuators.
Magnetic recording and data storage equipment: tape recorders, VCRs, hard disks.
MRI machines.

Unit 2: Force and Motion

Topic: Earth's gravity

Weight

Spring balances and scales actually measure the force of attraction between an object and the Earth. This is what weight is. The weight of an object is the downward force exerted by this object when gravity pulls on it. The weight of an object is different from its mass. The weight of objects depends on the mass of the object and the strength of the gravitational force acting on it. An object with a larger mass has a larger weight.

Technically, metric weight is measured in Newtons, but usually it is just expressed as *kilograms of mass.* Weight is a force — the force of *mass* pushing down due to gravity. The normal metric unit of force is the Newton, and weight could be measured and expressed in Newtons.

Using a Spring Scale

1. Hook the spring scale to the object that will be used to take the measurement.
2. Lift the scale and object with a smooth motion-do not jerk the object upward.
3. Wait until the spring stops moving, and then read the force on the scale.
4. You can measure the weight of objects that will not fit on the hook. Place the object in a light weight plastic bag and hang the bad on the hook.

Gravity

Gravity is a force that pulls objects toward the center of Earth. It causes objects to fall to the ground and water to flow downhill. Gravity exists between all objects, not just between Earth and other objects. Gravity acts on objects without touching them. For example, Earth's gravity pulls on object in space, such as space shuttle or the Moon. The strength of gravity depends on the mass of each object. There is more gravity between objects that have greater mass, so there is a strong pull between Earth and other objects near it. An object's weight is a measure of how strongly Earth's gravity pulls on the object. Objects with greater mass are heavier than objects with less mass.

Gravity is a force of attraction between any two masses. It is not only an attraction between an object and the earth; it is an attraction between all masses in the universe.

Mass

The mass of an object is the amount of matter. Here's a table the compares the differences between mass and weight. For the most part, if you're on Earth and not moving, the values for mass and weight will be the same. If you change your location with respect to gravity, mass will remain unchanged, but weight will not. For example, your body's mass is a set value, but your weight is different on the Moon compared with on Earth.

Comparison of mass and weight	
Mass is a property of matter. The mass of an object is the same everywhere.	Weight depends on the effect of gravity. Weight varies according to location.
Mass can never be zero	Weight can be zero if no gravity acts upon an object, as in space.
Mass does not change according to location	Weight increases or decreases with higher or lower gravity.
Mass is a scalar quantity. It has magnitude.	Weight is a vector quantity. It has magnitude and is directed toward the center of the Earth or other gravity well.
Mass may be measured using an ordinary balance.	Weight is measured using a spring balance.
Mass is usually measured in grams and kilograms.	Weight is measured in newton, a unit of force.

Unit 2: Force and Motion

Topic: Force

Types of forces

There are different types of forces, such as the gravitational force, frictional force, spring force and magnetic force.

Gravitational Force

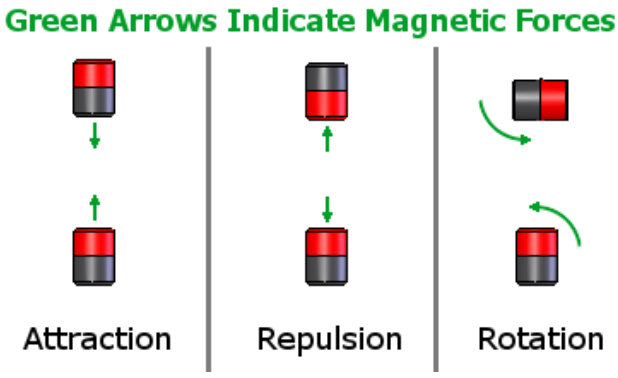
Gravitational force is the pulling force which the Earth exerts on all the subjects on earth. The pull of Earth's gravity prevents objects from floating off into space.

If an object is thrown into the air, the downward pull of the gravitational force causes it to fall back down. Gravitational force is a non-contact force because it exists between objects even when they are not touching. The gravitational force between the Earth and the Moon keeps the Moon in orbit. Similarly, a gravitational force keeps satellites in orbit around the Earth, and all the planets on orbit around the Sun. Gravitational forces can act over huge distances of space; for example, between stars and between galaxies.

Magnetic Force

A magnetic force exerted by a magnet can be a push or a pull, depending on the object it acts on. Magnetism is a force that pushes or pulls objects made of iron or nickel. It has little effect on objects made of other materials. All magnets have two poles: North Pole and South Pole. Unlike poles pull toward each other. When the north pole of one magnet is brought near the south pole of another magnet, the magnets pull together. Like poles push away from each other. A magnet's force is strongest at the poles. Like gravity, magnetism can act on an object without touching it.

- If a magnet is near another magnet, unlike poles will attract and pull the magnets together.
- Like poles will repel and push the magnets apart.
- If a magnet is near an object that can be magnetized, it will attract the object.
- Objects can be magnetized are made from iron, steel, nickel and cobalt.
- A magnet cannot attract and repel objects that are not made of magnetic material.



https://www.kjmagnetics.com/blog.asp?p=magnetic-forces

The nearer a magnet is to a magnetic object, the stronger the force exerted on it. A magnetic force can act from a distance and pass through certain materials like paper, water and thin sheets of wood or plastic.

A stronger magnet can attract objects from a greater distance. Its magnetic force can also pass through more layers of paper or wood.

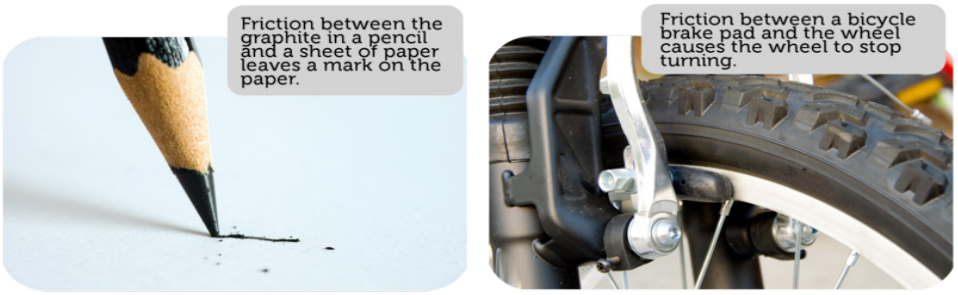
Frictional Force

Friction is produced when two objects rub against each other. The frictional force always acts in the direction opposite to the direction which the object rubs against the surface.

- The amount of friction an object experiences depends on the following factors:
- The heavier the object, the more friction it experiences when it is dragged along the ground.
- The more surface area is in contact, the larger the friction.
- The rougher the surface, the more friction is produced.
- Lubricants like oil can be spread on surfaces to smoothen it and reduce friction.

Frictional force is an example of contact force. It occurs whenever two surfaces in contact move past each other. Friction always opposes motion. Suppose you try to push a bookcase full of books, and it does not move. This is because of the friction between bookcase and floor. This frictional force is just as large as your push but in the opposite direction. If you get someone to help you, and your combine push is greater than the maximum frictional force, then the bookcase will move. Even when you do move an object, friction still opposes the motion. Stop pedaling your bike and the frictional forces soon bring you to a stop. Friction occurs because objects are never completely smooth. The roughness of the two surfaces mean there are many points which catch and stick together.

These photos show two ways that friction is useful:



https://www.ck12.org/book/ck-12-physical-science-for-middle-school/r3/section/12.2/

Spring force

Potential energy is stored in a spring when it is compressed or extended.
When the spring is released, it exerts a force which may be a push or pull as it tries to return to its original length.

- If the spring had been compressed, it would exert a push.
- If it had been extended, it would exert pull.

The strength of the spring force is proportional to the compression or extension of the spring. Similarly, the force required to extend or compress a spring is proportional to the change in its length.

The strength also depends on the material of the spring. Different springs may require different amounts of force to change its length by the same amount.

- A stronger spring requires more force to change its length.

Forces

Effects of forces

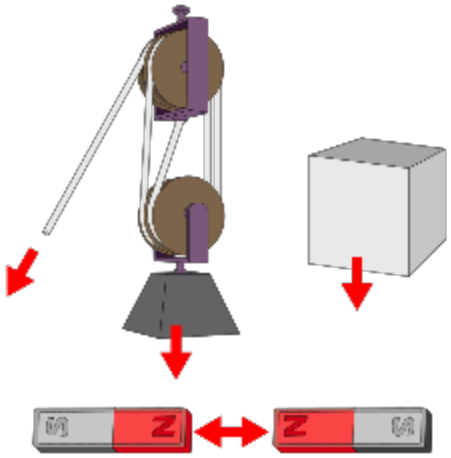
In physics, force is a push or pull on an object . We cannot see forces; however, we can see the effects of a force. A force can cause a stationary object to move. It can also cause a moving object to stop or change direction. Forces can cause a moving object to speed up or slow down.

- The greater the force applied to make an object move, the less time it takes for the object to gain speed.
- Similarly, the greater the force applied to make an object slow down, the less time it takes for the object to slow down.
- A force may change the shape of an object.

How to Measure Force

The unit of measure for force is the newton which is abbreviated as “N”. One newton is the force needed to accelerate one gram of mass by one centimeter per second squared. Other units of force include the dyne and the pound-force.

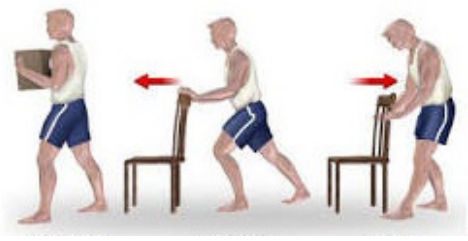
Examples of forces



Forces and Vectors

Force not only has a magnitude (which is what we get in newtons when we use the equation above), but it also has a direction. This makes force a vector. Vectors are shown by an arrow that indicates the direction of the force and a number that indicates the magnitude. See the pictures to the right to see how the arrow is used to show the direction of the force.

A force has both a magnitude (amount) and a direction.



Carrying Pushing Pulling

Unit 3: Matter

Topic: Solutions

Observing solutions

If you stir sugar in a glass of water it disappears. We say it dissolves in the water. The sugar and water have mixed to form a solution. Solutions are very important in your life. The food you eat is digested and dissolved in water. It is then carried around your body in your blood, which is a solution consisting of about 90% water. The wastes produced by your body are also carried away in solution as urine.

A solution is a special mixture that looks and behaves like a single substance. It consists of a liquid and the dissolved substance which is spread evenly through it. Think about what happens when instant coffee dissolves in hot water. The substance that dissolves (the coffee) is called the *solute.* The substance that does the dissolving (the water) is called the *solvent.* So the solute dissolves in the solvent, forming a solution. So the solute dissolves in the solvent, forming a solution.

A substance like sugar or coffee that dissolves in water is said to be soluble. A substance like chalk that will not dissolve in water is insoluble. Some insoluble substances sink in water (settle out), and others float in top. If you shake up an insoluble solid such as chalk dust with water it may seem to dissolve at first, but if you look closely you will see that the mixture is cloudy. The tiny bits of chalk dust are held up by the moving water. Such a mixture is not a solution but a *suspension.* The chalk dust will settle to the bottom of the container if you let it stand for a while. Muddy water is another example of a suspension. The solid that settles to the bottom of a suspension is called *sediment.*

Two liquids can also form a solution. For example, wine is a solution of alcohol (solute) in water (solvent) but not in another. Fuel for two-stroke motor mowers and outboard engines is a solution of oil and petrol.

Properties of solutions

A cup of coffee is like any liquid solution. It comes in many different strength. If you like your coffee stronger, add more coffee powder. If you like it weaker, add less coffee. We use the terms *dilute* and concentrated to help us compare solutions. A dilute solution contains only small amount of solute in a given volume of solvent. A *concentrated* solution contains large amount of solute in the same amount of solvent. You may have used the terms weak cordial or strong coffee – but the correct scientific terms are dilute cordial and concentrated coffee. The color of a solution gives you some idea of its concentration. The darker the color, the higher the concentration. Or, a more dilute solution will be lighter in color. These statements are generalizations.

There is a limit to the amount of solute that will dissolve in a solution. When a solution will dissolve no more solute, it is said to be saturated. Until it reaches this point, it is unsaturated. If you add more solute to an unsaturated solution, it will dissolve. The amount of solute needed to saturate a solution depends on the temperature. For example, at room temperature (around 200C) you can dissolve about 2 kilograms of sugar in a litre of water, but when the water is boiling (1000C) you can dissolve almost 5 kilograms. Most solids are more soluble in warm water

than cold water. We say that their *solubility* increases as the temperature increases. This is another generalization.

Mixture and Substance

Components of mixture

Types of mixtures

Most matter is in the form of mixtures. Mixtures can be classified as heterogenous or homogenous. A heteregenous mixture is unevenly mixed. Often, you can tell that a mixture is heterogenous simply by looking at it. If you can see the different components, the mixture is heterogenous. Vegetable soup is heterogenous mixture. Other examples are fruit salad, soil and concrete.

A homogenous mixture is evenly mixed. To the unaided eye, a homogenous mixture appears to be made up of only one kind of matter.

Air is a homogenous mixture that is made up of mostly nitrogen and oxygen. It also contains small amounts of other gases, including carbon dioxide and water vapour. Sea water is a homogenous mixture of water and salt. Other mixtures contain water and sugar.

Separation of mixtures

Pouring off the liquid like this, while keeping the solid in the container, is called decanting. It is a way of separating the liquid part of a suspension from the solid part. Decanting is not a very good method for complete separation. Some liquid is usually left behind. Also, unless you are very careful, you are likely to pour off some solid with the liquid. A better way of separating suspensions is by *filtering.* Suppose you have a suspension of chalk in water. The chalk can be separated from the suspension using filter paper. The filter paper has microscopic holes in it. The water passes through these holes, but the suspended chalk cannot. This is similar to separating sand and gravel using a sieve. The small sand particles pass through, but the larger gravel particles do not. The solution that passes through the filter paper and collects in the beaker is called the filtrate. The solid material that remains in the filter paper is called residue.

Once a solute has dissolved in a solvent to form a solution, you cannot separate it by filtration. The solution simply passes through the filter paper in the same way that water does. If a solution consists of a solid dissolved in water, you can separate them by heating. The water evaporates and turns into a vapor and seems to disappear into the air – leaving the solid behind. Salt can be obtained from sea water by this method. If you want the liquid you must somehow trap it as it evaporated and condense it back to a liquid. This process is called distillation. Distillation can also be used to separate two or more liquids with different boiling points, for example water and alcohol. This process is used in the making of whisky and brandy, and in the separation of crude oil into petrol, kerosene, diesel fuel and lubricating oil.

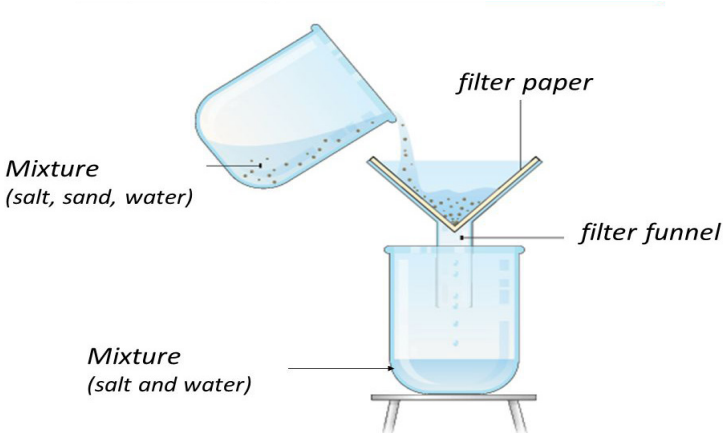


Figure 1: Separating mixtures: Filtrations

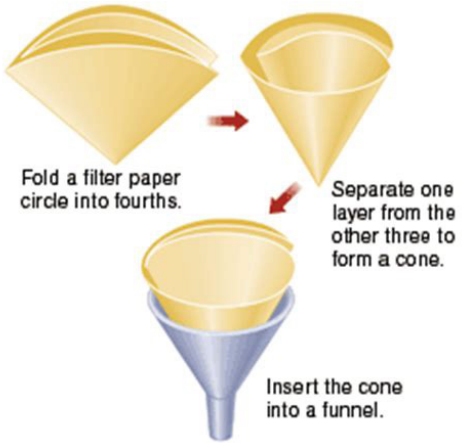


Figure 2: Folding filter paper

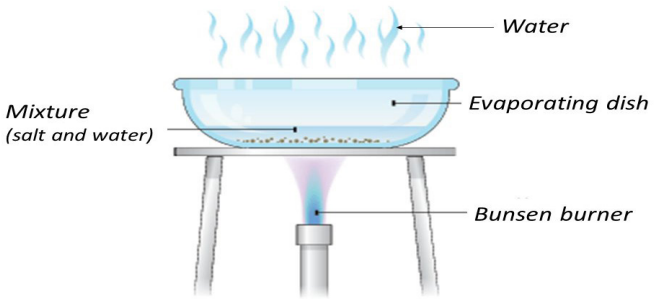


Figure 3: Separating mixtures: Evaporation

Evaporation is a process in which a liquid changes into gaseous form on heating. Allowing the liquid to evaporate, leaving the soluble solid behind.

Strand 3: Earth and Space

Unit 1: Our Earth

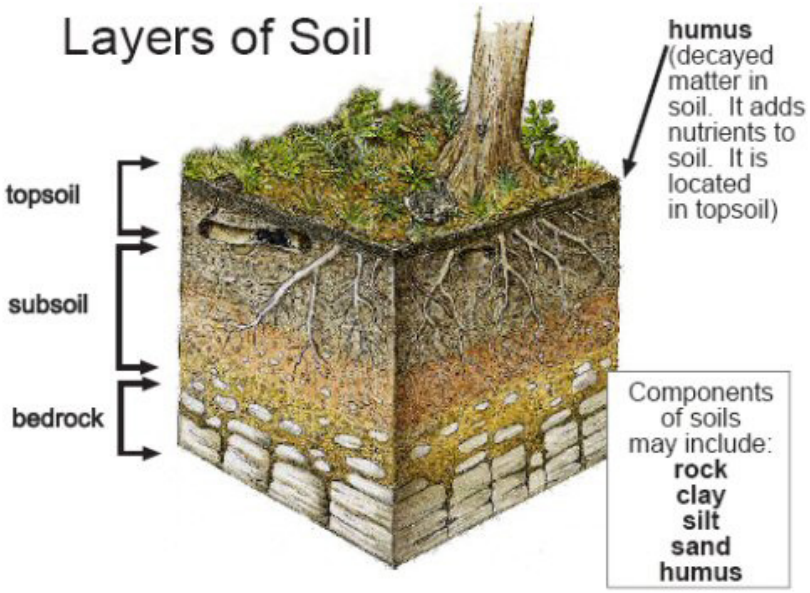
Topic: Formation and change of land

Soil layers

Topsoil: The top layer of soil is called topsoil. Rich top soil contains a lot of humus. The particles, or pieces, that make up top soil are dark and small. Plants grow in top soil.

Subsoil: The bottom layer of soil, called subsoil, contains little humus. The soil particles are larger and lighter in color than in topsoil. Subsoil also contains small pieces of rock.

Bedrock: The solid rock that lies below the lowest layer of soil is bedrock. Some of the materials in the soil above may have come from the bedrock.



Ref: https://www.online-sciences.com/wp-content/uploads/2014/12/Soil-Layers-1.jpg

When wind, moving water, and moving ice slow down or stop, they drop the materials they are carrying. Sand, soil and pieces of rock build up and form layers. In addition to weathered rock, soil also contains humus, air and water. Humus is the decayed remains of plants and animals. The kinds of materials in soils and their amount vary from place to place. Different kinds of soils contain different amounts of weathered rock, minerals, humus, air and water. Some kinds of can hold more water than others. Sandy desert soil can hold only small amount of water. Soils that contain a lot of clay can hold a lot of water.

Sedimentary rocks

Sedimentary rocks are formed by the accumulation of sediments. There are three basic types of sedimentary rocks.

Clastic sedimentary rocks such as breccia, conglomerate, sandstone, siltstone, and shale are formed from mechanical weathering debris.

Chemical sedimentary rocks, such as rock salt, iron ore, chert, flint, some dolomites, and some lime stones, form when dissolved materials precipitate from solution.

Organic sedimentary rocks such as coal, some dolomites, and some lime stones, form from the accumulation of plant or animal debris.

Photos and brief descriptions of some common sedimentary rock types are shown below.

Breccia is a clastic sedimentary rock that is composed of large (over two-millimeter diameter) angular fragments. The spaces between the large fragments can be filled with a matrix of smaller particles or a mineral cement which binds the rock together. The specimen shown above is about two inches (five centimeters) across.

Coal is an organic sedimentary rock that forms mainly from plant debris. The plant debris usually accumulates in a swamp environment. Coal is combustible and is often mined for use as a fuel. The specimen shown above is about two inches (five centimeters) across.

Conglomerate is a clastic sedimentary rock that contains large (greater than two millimeters in diameter) rounded particles. The space between the pebbles is generally filled with smaller particles and/or a chemical cement that binds the rock together. The specimen shown above is about two inches (five centimeters) across.

Iron Ore is a chemical sedimentary rock that forms when iron and oxygen (and sometimes other substances) combine in solution and deposit as a sediment. Hematite (shown above) is the most common sedimentary iron ore mineral. The specimen shown above is about two inches (five centimeters) across.

Limestone is a rock that is composed primarily of calcium carbonate. It can form organically from the accumulation of shell, coral, algal, and fecal debris. It can also form chemically from the precipitation of calcium carbonate from lake or ocean water. Limestone is used in many ways. Some of the most common are: production of cement, crushed stone, and acid neutralization. The specimen shown above is about two inches (five centimeters) across.

Sandstone is a clastic sedimentary rock made up mainly of sand-size (1/16 to 2 millimeter diameter) weathering debris. Environments where large amounts of sand can accumulate include beaches, deserts, flood plains, and deltas. The specimen shown above is about two inches (five centimeters) across.

Shale is a clastic sedimentary rock that is made up of clay-size (less than 1/256 millimeter in diameter) weathering debris. It typically breaks into thin flat pieces. The specimen shown above is about two inches (five centimeters) across.

Siltstone is a clastic sedimentary rock that forms from silt-size (between 1/256 and 1/16 millimeter diameter) weathering debris. Specimens in the photo are about two inches (five centimeters) across.

The change of land

A volcano is an opening in the Earth's crust where hot liquid rock from deep within the Earth, called magma, erupts to the surface. A large volcano eruption can destroy an entire forest.

Earthquakes usually occur on the edges of large sections of the Earth's crust called tectonic plates. These plates slowly move over a long period of time. Sometimes the edges, which are called fault lines, can get stuck, but the plates keep moving. Pressure slowly starts to build up where the edges are stuck and, once the pressure gets strong enough, the plates will suddenly move causing an earthquake.

Movement of tectonic plates has formed large mountain ranges like the Himalayas and the Andes.

Weathering

Weathering is different from erosion. While erosion is the process by which soil and rock particles are worn away and moved elsewhere by wind, water or ice, weathering involves no moving agent of transport. Weathering describes the breaking down or dissolving of rocks and minerals on the surface of the Earth. Water, ice, acids, salts, plants, animals, and changes in temperature are all agents of weathering. Once a rock has been broken down, a process called erosion transports the bits of rock and mineral away. No rock on Earth is hard enough to resist the forces of weathering and erosion.

Weathering and erosion constantly change the rocky landscape of Earth. Weathering wears away exposed surfaces over time. The length of exposure often contributes to how vulnerable a rock is to weathering. Rocks, such as lavas, that are quickly buried beneath other rocks are less vulnerable to weathering and erosion than rocks that are exposed to agents such as wind and water.

Erosion

Erosion is the wearing away of the land by forces such as water, wind, and ice. Erosion has helped to form many interesting features of the Earth's surface including mountain peaks, valleys, and coastlines.

There are many different forces in nature that cause erosion. Depending on the type of force, erosion can happen quickly or take thousands of years. The three main forces that cause erosion are water, wind, and ice.

Erosion by Water

Water is the main cause of erosion on Earth. Although water may not seem powerful at first, it is one of the most powerful forces on the planet. Here are some of the ways that water causes erosion:

- Rainfall - Rainfall can cause erosion both when the rain hits the surface of the Earth, called splash erosion, and when raindrops accumulate and flow like small streams.
- Rivers - Rivers can create a significant amount of erosion over time. They break up particles along the river bottom and carry them downstream. One example of river erosion is the Grand Canyon which was formed by the Colorado River.
- Waves - Ocean waves can cause the coastline to erode. The shear energy and force of the waves causes pieces of rock and coastline to break off changing the coastline over time.
- Floods - Large floods can cause erosion to happen very quickly acting like powerful rivers.

Erosion by Wind

Wind is a major type of erosion, especially in dry areas. Wind can erode by picking up and carrying loose particles and dust away (called deflation). It can also erode when these flying particles strike the land and break off more particles (called abrasion).

Erosion by Glaciers

Glaciers are giant rivers of ice that slowly move carving out valleys and shaping mountains. You can go here to learn more about glaciers.

Other Forces

Living organisms - Small animals, insects, and worms can add to erosion by breaking up the soil so it is easier for the wind and water to carry away.

Gravity - The force of gravity can cause erosion by pulling rocks and other particles down the side of a mountain or cliff. Gravity can cause landslides which can significantly erode an area.

Temperature - Changes in temperature caused by the Sun heating up a rock can cause the rock to expand and crack. This can cause pieces to break off over time and lead to erosion.

How have humans caused erosion?

Human activity has increased the rate of erosion in many areas. This happens through farming, ranching, cutting down forests, and the building of roads and cities. Human activity has caused about one million acres of topsoil to erode each year

Unit 3: Space

Topic: The Moon

Moon in motion

The different ways of the Moon looks throughout the month are called the phases of the Moon. The diagram below shows where the Moon is at each phase. The photos show how each Moon phase looks as seen from Earth.

Moon Phases

The Moon goes through a cycle of phases every month.

You can often see the Moon shining in the night sky. But the moon does not make its own light. The 'moonlight' you see comes from sunlight reflecting, or bouncing, off the Moon's surface. This reflected light makes the side of the Moon that faces the Sun look bright. The side of the Moon that faces away from the Sun is dark. The Moon is a satellite of Earth. A *satellite* is any object that revolves around a planet. As it revolves around Earth, the Moon also rotates on its axis. It takes the Moon 271/3 Earth days to revolve once around Earth. It takes the same amount of time for the Moon to rotate once on its axis. As a result, the same side of the Moon always faces Earth. On some nights, the Moon looks big and round. On other nights, the Moon looks like a thin sliver. The Moon does not really change shape. It is always shaped like a ball.

Why does the Moon appear to change shape? As the Moon revolves around Earth, you see different amounts of the Moon's sunlit side. Sometimes you can see a full moon, which is all of Moon's sunlit side. A *full moon* looks bright and round. Sometimes you cannot see any part of Moon's sunlit side. This is called a *new moon.*

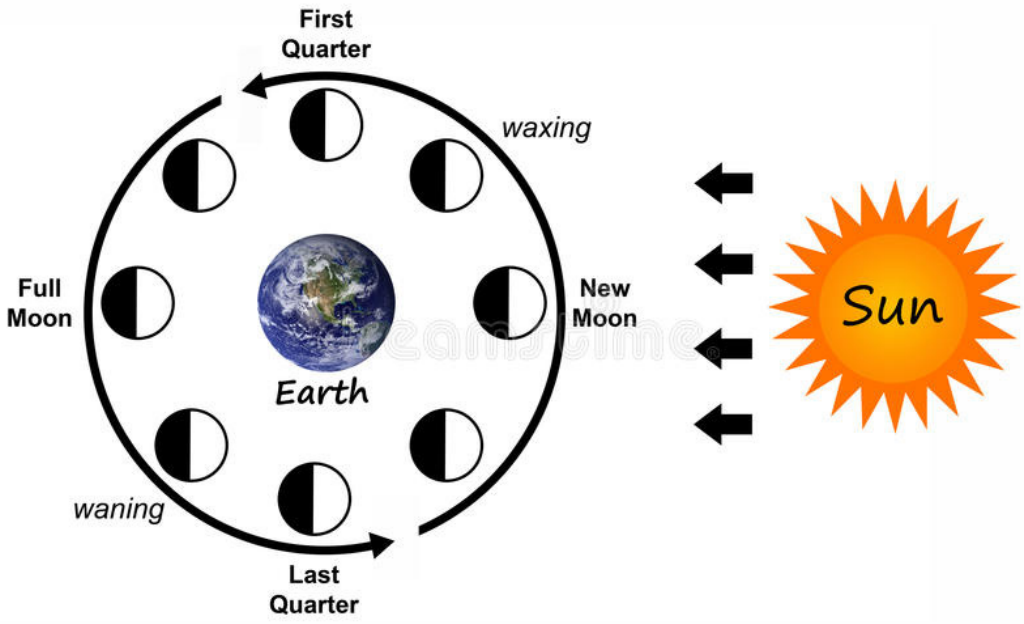


Figure 1: Phases of the moon

Lunar and Solar Eclipse

A solar eclipse occurs when the Moon passes in front of the Sun causing a shadow to fall on certain portions of the Earth. The eclipse is not seen from every place on Earth, but only from the locations where the shadow falls. From these locations it appears as if the Sun has gone dark.

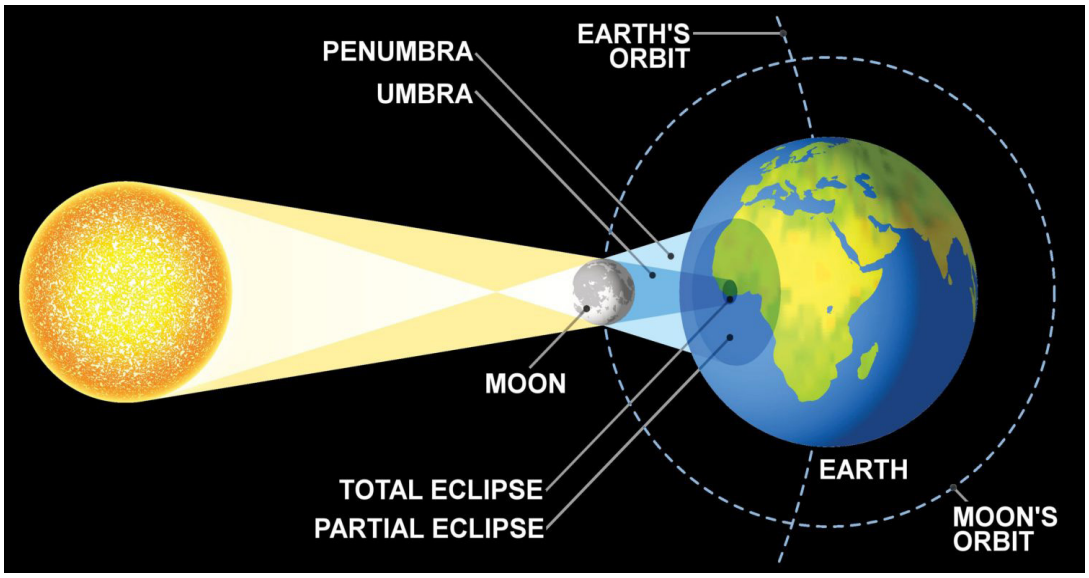


Figure 1: Solar eclipse

A lunar eclipse occurs when the Moon passes through the Earth's shadow. Lunar eclipses can be seen by a much larger area of the Earth than the solar eclipses. They also can be viewed without special equipment to protect the eyes. Lunar eclipses are not totally dark.

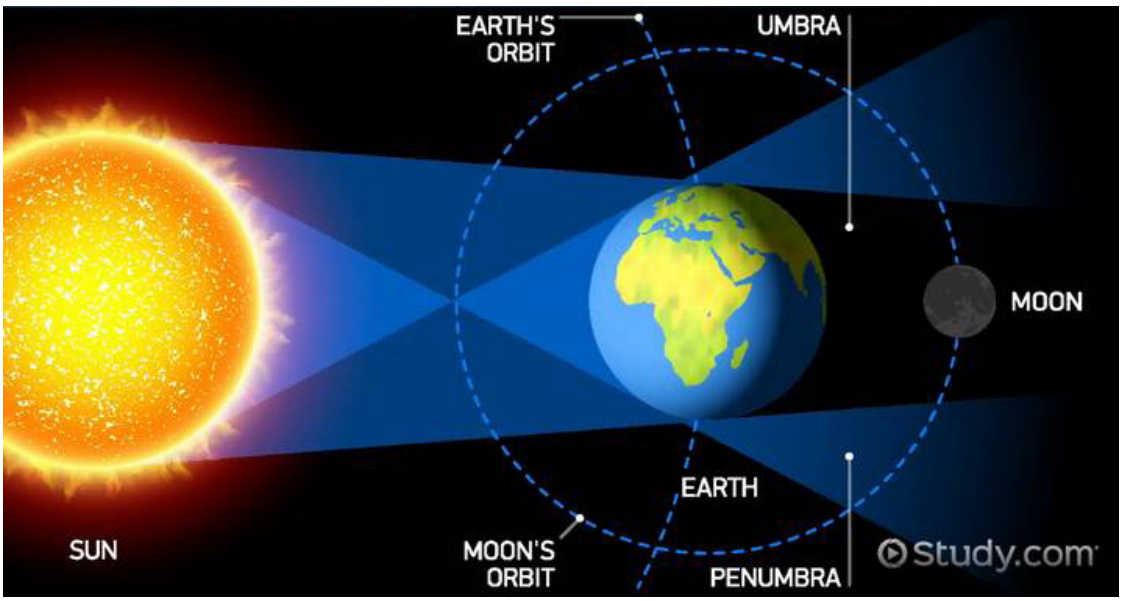


Figure 2: Lunar eclipse

Moon and Tides

The highest tides occur during the full moons and new moons, when the sun and moon are aligned and their gravitational forces pull together on Earth's oceans. The effect is slightly stronger when the moon reaches its perigee, the closest point Earth in its elliptical orbit.

High tides and low tides are caused by the moon. The moon's gravitational pull generates something called tidal force. The tidal force causes Earth-and its water-to bulge out on the side closest to the moon and the side farthest from the moon. These bulges of waters are high tides.

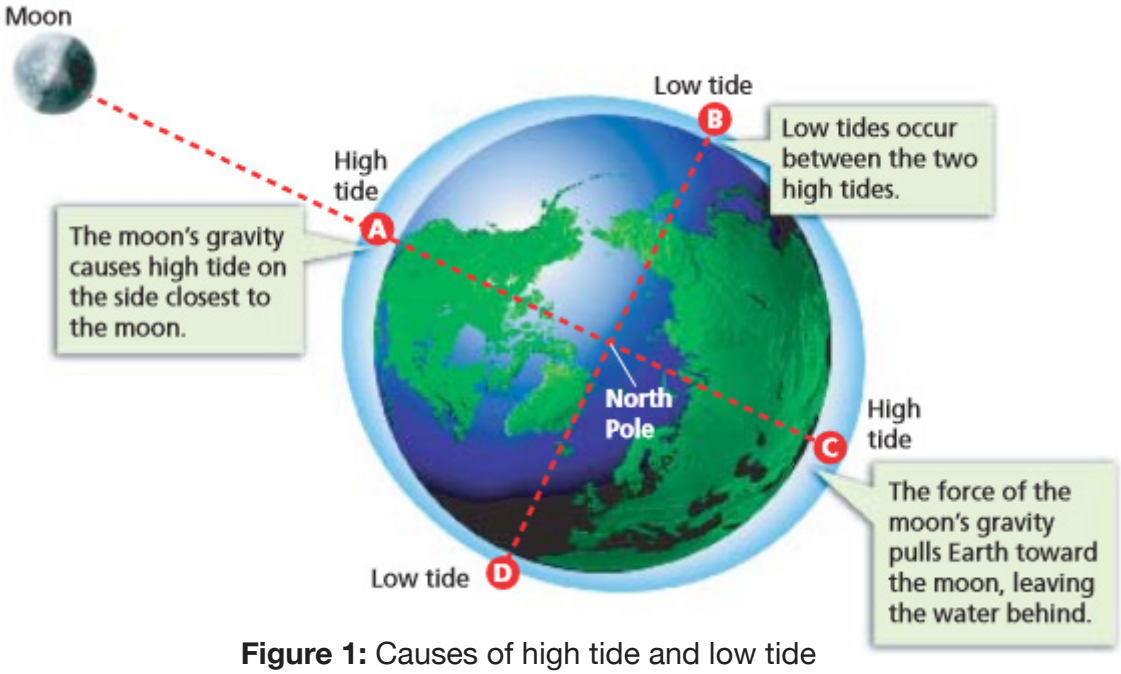


Figure 1: Causes of high tide and low tide

Spring Tides

The sun's gravity also pulls on Earth's waters. The sun, moon, and Earth are nearly in a line during a new moon. The gravity of the sun and the moon pull in the same direction. Their combined forces produce a tide with the greatest difference between consecutive low and high tides, called a spring tide.

At full moon, the moon and the sun are on opposite sides of Earth. Since there are high tides on both sides of Earth, a spring tide is also produced. It doesn't matter in which order the sun is positioned.

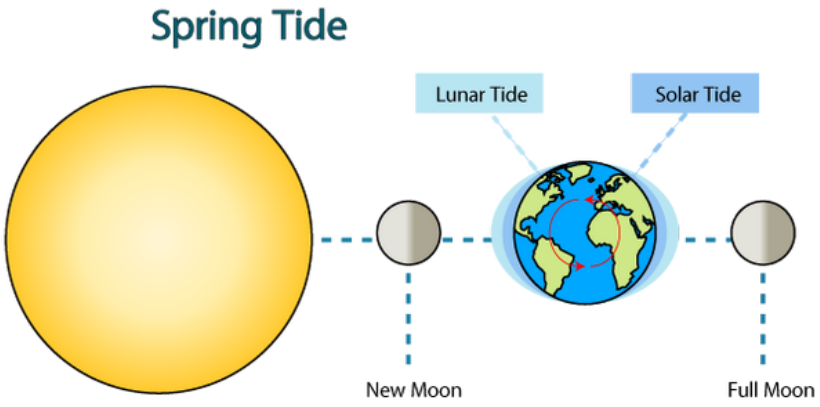


Figure 2: Spring Tide

Neap Tides

During the moon's first-quarter and third-quarter phases, the line between Earth and the sun is at right angles to the line between Earth and the moon. The sun's pull is at right angles to the moon's pull. This arrangement produces a neap tide, a tide with the least difference between consecutive low and high tides. Neap tides occur twice a month.

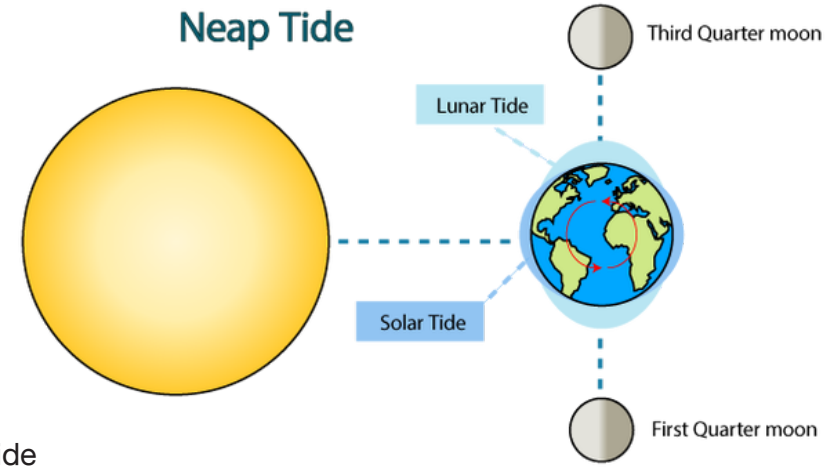


Figure 3: Neap Tide

Unit 3: Space

Topic: Stars

Properties of stars

Stars are large spheres of extremely hot, glowing gases. Stars are clustered in enormous groups called galaxies. Each star goes through changes known as a life cycle.

A star brightness depends on both how far it is from the observer and the actual amount of light it emits. Some stars appear brighter because they are relatively vlose to Earth. Other stars appear brighter because they emit more light.

The brightness of a star is called its magnitude. Magnitude is described in two different ways. Absolute magnitude is the measure of a star's actual brightness, or how much light it gives off. Apparent magnitude is the brightness of a star as it appears to an observer on Earth.

The sun is the closest star to Earth. Other stars are farther away and form patterns in the night sky.

When you look up at stars in the night sky, they look like tiny dots of light. But really, they are not tiny. They only look that way because they are very far away. A star is a ball of hot gases the gives off light and other forms of energy. Stars come in different sizes. The smallest stars are only about 20km (about 12 miles) across. White dwarf stars about the size of Earth. Supergiant stars can be more than 500 million km (about 300 miles) wide. That is more than 1,000 times the distance from Earth to the Moon.

The sun is a star. It is the largest object in the solar system. More than 1 million Earths would fit inside the Sun. Even so, it is just a medium-sized star. The Sun looks much larger than the stars you see at night because it is so much closer to Earth than any other star. Living things on Earth depend on the Sun for the heat and light. Even though the Sun is the closest star to Earth, it is still very far away. The Sun is about 150 million km (about 93 million miles) from Earth.

Motion of stars

You have learned that the Sun seems to move across the sky each day. Each night, the stars also seem to move across the sky. Like the Sun, the stars do not actually move. The stars appear to move because Earth rotates. As Earth rotates on its axis, the part of the sky you see changes. But the shape of each constellation does not change. The stars in each constellation stay in their fixed places in the pattern. They night sky also looks different throughout the year. You can see some constellations on a summer night. You can see other constellations on a winter night. This is because Earth revolves around the Sun. As it does, the part of the sky that is overhead at night changes. So you see different constellations.

The Sun, Moon and stars all appear to rise in the East and set in the West, because the Earth revolves on its axis in the opposite direction from West to East every 24 hours. The movement we therefore observe is not their movement, but our own as we go zipping along on the surface of the Earth towards the East, and these celestial objects pass us overhead.

The North Star (Polaris) in Ursa Minor is useful for illustrating this point, as it is a pivot around which the entire northern sky revolves. If you stand facing North, your right hand-side will point due East, and your left hand-side due West, with the ground beneath you and everything on it is moving from your left to right. Therefore, if you look up at Polaris you will see the stars rotating in the opposite direction from right to left (counter-clockwise) once every 24 hours. In the same way, if you were to face due South the stars would naturally appear to rotate from left to right in a clockwise direction.

In other words, while the Sun, Moon and stars travel from East to West the direction we see them moving depends entirely on which direction we are facing at the time:

Facing North: Stars rotate counter-clockwise (right to left)
Facing South: Stars rotate clockwise (left to right)
Facing East: Stars rise in front, and set behind
Facing West: Stars rise behind, and set in front

Star patterns (Constellation)

Have you ever seen a bear in the sky? How about a lion or a dog? Of course not! But if you look closely, you might see a constellation shaped like one of these animals. A constellation is a group of stars that forms a pattern shaped like an animal, person, or object. There are 88 constellations recognized by scientists. People say that stars "come out" at night. But really, stars are always out. They are always in the sky overhead, even during the day. You just cannot see during the day because the sky is so bright.

The four main stars of the famous Southern Cross constellation are Acrux (Alpha Crucis), bottom; Becrux (Beta Crucis), left; Gacrux (Gamma Crucis), top; and Delta Crucis, right.

Credit: European Southern Observatory

The Southern Constellations is a large group of 32 constellations, many of them named in modern times by European scientists exploring the southern hemisphere for the first time, during the age of exploration that followed the voyages of Columbus in 1492. Although objects of great interest can be found in these skies, they are not visible from North America or Europe, and can only be viewed by traveling south of the equator. The Large Magellanic Cloud can be found in Dorado, while the Small Magellanic Cloud is located in Tucana.

ntlia	Ant	The Pump
Apus	Aps	Bird of Paradise
Ara	Ara	The Altar
Caelum	Cae	The Chisel
Centaurus	Cen	The Centaur
Carina	Car	The Ship's Keel
Chamaeleon	Cha	The Chameleon
Circinus	Cir	The Compass
Columba	Col	The Dove
Crux	Cru	The Cross
Dorado	Dor	The Swordfish
Fornax	For	The Furance
Grus	Gru	The Crane
Horologium	Hor	The Clock
Hydrus	Hyi	The Sea Serpent
Indus	Ind	The Indian
Mensa	Men	The Table
Microscopium	Mic	The Microscope
Musca	Mus	The Fly
Norma	Nor	The Carpenter's Square
Octans	Oct	The Octant
Pavo	Pav	The Peacock
Phoenix	Phe	The Firebird
Pictor	Pic	The Easel
Puppis	Pup	The Ship's Stern
Pyxis	Pyx	The Ship's Compass
Reticulum	Ret	The Net or Reticle

Telescopium	Tel	The Telescope
Triangulum Australe	TrA	The Southern Triangle
Tucana	Tuc	The Toucan
Vela	Vel	The Ship's Sails
Volans	Vol	The Flying Fish

Ref: https://www.space.com/29445-southern-cross-constellation-skywatching.html

Guided Lesson Samples

Guided Lesson Section Descriptions and Icons

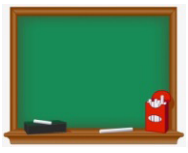
Each section of the guided lesson highlights parts of the lesson, purpose and description to guide the teachers to become well acquainted with the different sections to help them plan and prepare the best science lesson for the students to learn in the classroom and outside of the classroom i.e. field trip, excursions and etc.

Thus, teachers are encouraged to read thoroughly the section descriptions of the guided lesson prior planning and preparing the science lessons.

Sections of guided lesson	Purpose	Description
Lesson title	To show what topic of the lesson that is to be taught.	This is the main topic of the lesson. It also has lesson number tagged beside it.
Strands, Unit, Topic, Sub-topic	To show which strand, unit, topic and sub-topic the lesson title is derived from and linked to in the syllabus.	These are main concepts in the syllabus.
Content standard and Benchmark	To indicate which content standard and benchmark the lesson title is linked to in the syllabus.	These describe students' learning achievements and expectations in the syllabus.
Key question	To promote inquiry learning in science lessons and at the same time guide the teacher and students to achieve what is to be taught and learned in a science lesson.	This is where students are encouraged to give their predictions or make inferences first to the key question prior doing the activity or experiment; then summarize the lesson from their findings which should answer the key question to confirm and conclude with facts.
Lesson objective	To describe what students should learn at the end of the lesson.	This is the aim of lesson which the teacher wants the students to know and be able to do when teaching a particular topic.
Teaching period	To show how many periods and time it will take to teach a lesson.	This is the duration of the lesson that is to be taught.
Preparations	To describe what and how to prepare materials such as teaching and learning aids prior to actual teaching by the teacher.	This is where teachers will identify and describe what teaching and learning materials the he or she will need and how he or she will prepare these materials.
Key words	To help students know scientific words that is important and new when teaching a particular topic in a science lesson.	This includes scientific words that students will learn and know. Furthermore, they should be able to spell, pronounce and know the definitions. Overtime, students will have developed a list of vocabulary of scientific terms.
Knowledge, Skills, Attitudes and Values (KSAV)	To state specific of knowledge, skills, attitudes and values to be learned by the students.	This contains KSAVs which are the main learning content that students will learn in a lesson.

Teachers notes	To inform the teacher with additional information about hints and tips and content background information on the particular topic that is to be taught in a lesson.	This contains information on hints and tips content of the lesson. Furthermore, this section also contains content background information on a particular topic that is to be taught.
Safety	To avoid accidents and injuries that may occur during the experiment or when conducting outdoor activities such as field survey by the students.	This contains safety rules that teachers and students should follow in a lesson. This section will be applicable when experiment and outdoor activities are conducted.
Assessment	To monitor and assess the students to see if they have acquired and understood the learning content (KSAV) in the lesson.	This highlights the assessment tasks that students will do during or after the lesson. The assessments included in this section are types of formative assessment.
Lesson procedure	To outline the teaching and learning activities that the teacher and students will do in a lesson.	Outlines the flow of the lesson that will be taught by the teacher. It also includes the students' activities to show what the students will do in a lesson.
Challenge for students	To challenge students with additional activities based on the topic that have been taught in a lesson.	This contains additional activities that will challenge students to further expand their knowledge and skills on the topic that have been learned in a lesson.

These are the icons that teachers will see in the science guided lesson samples. Below are icons with their uses to help science teachers to understand and follow effortlessly.

Icon	What Is It Used For?
	Teacher's Notes
	Safety
	Assessment
	Lesson Procedure
	Key Question
	Blackboard Plan
	Challenge for the Students

Note: Safety will only be applicable for lessons that require experiment or outdoor activities.

Guided lesson sample 1

Lesson Title: Life cycle of a non-flowering plant - Fern	**Lesson No: 04**
Strand 1: Life	**Unit 1:** Plants
Topic: Reproduction and heredity of plants	**Sub-topic:** Reproduction in non-flowering plants
Content standard:	**6.1.1** Students will be able to investigate the reproductive parts, process of reproduction and heredity in plants.
Benchmark:	**6.1.1.3** Describe and analyze the reproduction process of non-flowering plants using the life cycle of a fern.
Key question:	How do ferns reproduce?
Lesson objective:	**By the end of the lesson the students should be able to;** • describe the stages of reproduction for a non- flowering plant such as a fern.
Teaching period:	40 minutes (1 period)
Preparations:	Sample of a fern plant (picture of a fern), diagram showing the reproductive life cycle of a fern, cut out the different stages of a fern life cycle
Key word(s):	reproduction, fern, non-flowering plant, life cycle

Learning content

Knowledge	Skills	Attitudes
The life cycle of a fern follows the following stages 1. On the fronds (leaves), the Sporangiia (reproductive organs of the fern) produces the spores. 2. The spores are blow by the wind and scatters from the sponrangia 3. The spores grow into structures that produce male and female cells called gametes. 4. Male and female cells join to form zygote a process called fertilization. A new plant begins 5. The zygote then grows into a mature fern.	Making predictions on how ferns reproduce. Infer on the different stages of fern life cycle. Communicating ideas and findings on the reproduction process of a fern using verbal, written and pictorial.	Develop curiosity to know about the life cycle of a fern. Show open-mindedness when learning about the life cycle of a fern. Respect views of others.

The scientific terms used in different stages of reproduction is quite complex. Use simple terms such leaves for fronds, reproductive organs for sporangia, tiny seeds for spores. The terms used depend on the level of understanding by your students.

Describe the main stages of the life cycle of a fern.

Lesson procedure

Time section	Teacher activity	Student activity	Points to notice
Intro **5 mins**	**Access prior knowledge** Question the students to bring about their ideas of prior knowledge and experience on reproduction and life cycle of plants. *"What are the different stages in the life cycle of plants?"* *Introduce the lesson title and the key question.*	**Key Question** How do ferns reproduce? 	Students will use their prior knowledge about life cycle of plants to link to today's lesson.
Body **35 mins**	**Making predictions** Have the students to discuss and list down their answers to the question. Write the students responses on the black board. **Activity:** Show picture of a fern or display a sample of a fern plant. Distribute the different stages of fern life cycle and ask students to organize the pictures in correct sequence of the different stages in a life cycle of a fern. Ask students to present to the class after doing the activity. **Discussion questions on findings** Lead students through the discussion and pose a question based on their findings for the activity. Display the correct reproductive cycle of a fern. **Question:** How does a fern reproduce? Introduce the key words for the lesson: "reproduction, fern, non-flowering"	**Making predictions** Tell the teacher about how ferns reproduce. **Activity:** Observe and study the sample of a fern or picture of a fern. Organize the pictures of the different stages in a life cycle of a fern in sequence and record the suggestions. Present the sequence of the life cycle of a fern to the whole class. **Discussion questions on findings** Students to go through discussions based on the question and give their feedbacks. Observe and study the diagram of a correct reproductive cycle of a fern and compare with the original idea. Give responses based on the correct diagrams shown. **Key words** 1. Reproduction 2. Fern 3. Non-flowering	**Concepts and Misconceptions** **Strategy:** Work in groups Write the key words on the black board.

Conclusion **5 mins**	• In our today's lesson, what did you discover or learn from this lesson? Refer students to their predictions for the key question: How does a fern reproduce? Guide students by having them to summarize what they have learnt about reproductive cycle of a fern.	**Summary:** • The life of a fern is dependent on the wind whereby the spores are blown and scattered resulting in the formation for female and male cells. The cells fertilize to form a zygote which then becomes a mature fern.	The students' conclusion should reflect the key concepts in the lesson.

Black Board Plan Sample

Title: Life cycle of a non-flowering plant - Fern **Key question:** How do ferns reproduce? **Activity:** Organize the pictures in correct sequence of the different stages in a life cycle of a fern.	**Discussion** **Question:** How do ferns reproduce? The life cycle of a fern follows the following stages 1. On the fronds (leaves), the Sporangiia (reproductive organs of the fern) produces the spores. 2. The spores are blow by the wind and scatters from the sponrangia 3. The spores grow into structures that produce male and female cells called gametes. 4. Male and female cells join to form zygote a process called fertilization. A new plant begins 5. The zygote then grows into a mature fern. **Key words** 1. Reproduction 2. Fern 3. Non-flowering	**Summary** • The life of a fern is dependent on the wind whereby the spores are blown and scattered resulting in the formation for female and male cells. The cells fertilize to form a zygote which then becomes a mature fern.

Challenge for students:

Apart from a fern's life cycle, research on a non-flowering plant and describe its life cycle process and make comparisons with the fern life cycle.

Guided lesson sample 2

Lesson Title: Forms of energy	**Lesson No: 11**
Strand 2: Physical Science	**Unit 1:** Energy
Topic: Energy	**Sub-topic:** Forms and uses of energy
Content standard:	**6.2.1** Students will be able to investigate the forms and conversion of energy
Benchmark:	**6.2.1.3** Investigate the different forms of energy and their uses.
Key question:	What are the forms of energy?
Lesson objective:	**By the end of the lesson the students should be able to;** • identity different forms of energy by examples that use energy.
Teaching period:	40 minutes (1 period)
Preparations:	Prepare chart with examples of different forms of energy change.
Key word(s):	energy

Learning content

Knowledge	Skills	Attitudes
• There are different forms of energy: - Light energy - Heat energy - Sound energy - Electrical energy - Chemical energy - Nuclear energy - Gravitational energy - Elastic energy - Mechanical energy	Making predictions on the different forms of energy. Infer on the different forms of energy. Communicating ideas and findings on the different forms of energy using verbal, written and pictoral.	Develop curiosity about the different forms of energy. Show open-mindedness when learning about the different forms of energy. Respect views of others.

There are various forms of energy. Students will be likely to mention chemical energy and nuclear energy therefore you use examples for the students understand. For example;

- a battery has store chemical energy which is used in devices
- bombs and dynamite are nuclear device that have stored energy and through explosions releases nuclear energy.

1. Give an example of a situation where energy can be found.
2. Name the form of energy that is used in that given situation.

Lesson procedure

<table>
<tr><th>Time section</th><th>Teacher activity</th><th>Student activity</th><th>Points to notice</th></tr>
<tr>
<td>Intro
5 mins</td>
<td>Access prior knowledge
Question the students to bring about their ideas of energy.
“What is energy?”
Ask the students about the various forms of energy.

Introduce the lesson title and the key question for the lesson.</td>
<td>Key question
 
What are the different forms of energy?</td>
<td>Students will use their prior knowledge about force to link to today’s lesson.</td>
</tr>
<tr>
<td>Body
35 mins</td>
<td>Making predictions
Have the students to list down answers to the question
You should list 2-3 of the forms of energy.

Activity:
Have the students to fill in the table with examples of situation where energy can be found then identify the form energy it has.

<table><tr><th>Examples of where energy can be found.</th><th>Form of energy</th></tr><tr><td></td><td></td></tr></table>
Ask students to present to the class after doing the activity.</td>
<td>Making predictions
Tell the teacher what forms of energy they know or are there.

List 2-3 of the forms of energy

Activity:
List the example of a situation where energy can be found and identify the form of energy it has.

<table><tr><th>Examples of where energy can be found.</th><th>Form of energy</th></tr><tr><td></td><td></td></tr></table>
Present the sequence of the life cycle of a fern to the whole class.</td>
<td>Concepts and Misconceptions

Energy can changes forms therefore, beware of the student answers as one situation may have two or more forms of energy.</td>
</tr>
</table>

Body **35 mins**	**Discussion questions on findings** Lead students through the discussion and pose a question based on their findings for the activity. **Questions:** 1. Can one form of energy change to another form? 2. Can two or more forms of energy be found in the same situation? Give an example and explain. Introduce the key word for the lesson: 'Energy'	**Discussion questions on findings** Students to go through discussions based on the question and give their feedbacks. **Response:** 1. Yes, one form of energy can change to another form. 2. Yes, two or more forms of energy can be found in the same situation. For example, when you make a fire using the dry woods, the chemical energy is changed to light and heat energy. **Key word** "Energy"	**Strategy:** Work in groups of four (4) Write the key word on the black board.
Conclusion **5 mins**	• In our today's lesson, what did you discover or learn from this lesson? Refer students to their predictions for the key question: How does a fern reproduce? Guide students by having them to summarize what they have learnt about "Forms of Energy".	**Summary:** There are **nine** forms of energy: - Light energy - Heat energy - Sound energy - Electrical energy - Chemical energy - Nuclear energy - Gravitational energy - Elastic energy - Mechanical energy	The students' conclusion should reflect the key concepts in the lesson.

Black Board Plan Sample

Title: Forms of Energy

Key question:
What are the forms of energy?

Activity:

Examples of where energy can be found.	Form of energy
e.g. A burning fire	Heat/Light
e.g. Light from the torch	Light/chemical in the batteries
e.g. FM radio music	Sound/chemical in the batteries

Discussion
Question:
Can one form of energy change to another form?

Example:
A burning candle gives of light energy as wells heat energy

1. Can two or more forms of energy be found in the same situation? Explain

Yes, when you light a candle, the candle produces light and heat energy.

Key word
1. Energy

Summary

There are nine forms of energy
- Light energy
- Heat energy
- Sound energy
- Electrical energy
- Chemical energy
- Nuclear energy
- Gravitational energy
- Elastic energy
- Mechanical energy

Challenge for students:

Identify the forms of energy that are found in the following examples and the types of energy that each comes under.

Examples	Forms of energy	Types of energy
1. Light bulb		
2. An x-ray		
3. A golf club getting ready to hit a ball		

Guided lesson sample 3

Lesson Title: Characteristics of an electromagnet	Lesson No: 15
Strand 2: Physical science	**Unit 1:** Energy
Topic: Electromagnet	**Sub-topic:** Properties of electromagnet
Content standard:	**6.2.2** Students will be able to examine the properties of electromagnet.
Benchmark:	**6.2.2.1** Examine the properties of electromagnet.
Key question:	What are the characteristics of an electromagnet?
Lesson objective:	**By the end of the lesson the students should be able to:** • make an electromagnet and study how it works • identify the characteristics of a magnet.
Teaching period:	40 minutes (1 period)
Preparations:	Copper wire, 3inch nails and bar magnets
Key word(s):	Electromagnet

Learning content

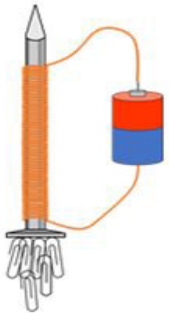
Knowledge	Skills	Attitudes
An electromagnet is made from a wire coiled around a nail and the ends of both wires connected to each end of a dry cell.	Making predictions on whether electromagnet has poles like the permanent magnets. Observing the poles of electromagnets are on the electromagnets. Construct an electromagnet to study its functions. Communicating ideas and findings on the characteristics of electromagnets using verbal, written and pictorial.	Develop a curiosity to find out more about the characteristics of an electromagnet. Show open-mindedness when learning about the characteristics of an electromagnet. Show creativity by suggesting ways to construct an electromagnet. Respect views of others.

Finding the poles of the magnets by students themselves is fun but making sure to find the *like* and *un-like* poles for the bar magnet and electromagnet can be confusing for them. Therefore prior the lesson you must have a mark bar mark magnet indicating the North and the South pole of the magnet. If you cannot find the Poles use a compass and place the one end of the magnet. If the needle of the compass attract then they like poles and when they repel they are unlike poles.

1. Describe the characteristics of an electromagnet.
2. Which poles attract and which poles repel?

Lesson procedure

Time section	Teacher activity	Student activity	Points to notice
Intro **5 mins**	**Access prior knowledge** Question the students to bring about their ideas of prior knowledge and experience of magnet. "What is a magnet?" Introduce the lesson title and key question for the lesson.	**Key question**  What are the characteristics of electromagnet?	Students will use their prior knowledge about magnet to link to today's lesson.
	Making predictions Have the students to list down answers to the question. Write the students responses on the black board. **Activity:** **Conduct investigation to find the results.** 1. Distribute the 3 inch nail, 30cm of copper wire and a dry cell. 2. To make the electromagnet, wind 30 coil of the copper wire around 3inch nail. Coating at the ends of the wire must be removed before connecting it to the dry cell. 3. Connect one end of the wire to the positive ends of the dry cell and let the students try to pick up the clips using the nail. 4. Let them try to lift various things in addition to the clips to know that electromagnet can attract iron. 5. Record your results in groups. Draw the electromagnet in your exercise book and make a list of things it can attract.	**Making predictions** Tell the teacher some of the characteristics of an electromagnet. **Activity:** **Follow the instructions to conduct the investigation.** 1. Use the materials given and conduct the investigation. 2. Wind 30 coil of the copper wire around 3inch nail to make an electromagnet. Remove coatings at both ends before connecting it to the dry cell. 3. Connect one end of the wire to the positive ends of the dry cell and try to pick up the clips using the nail. 4. Lift various things in addition to the clips to know that electromagnet can attract iron. 5. Record the results in groups. Draw the electromagnet in your exercise book and make a list of things it can attract.	**Concepts and Misconceptions** Electromagnets attract things that are made of iron. Electromagnets have two poles; North Pole and South Pole.

Body **35 mins**	**Discussion questions on findings** Lead students through the discussion and pose a question based on their findings for the activity. **Question:** Do electromagnets have poles? Introduce the key word for the lesson 'Electromagnet'	**Discussion questions on findings** Students to go through discussions based on the question and give their feedbacks. Yes, the electromagnets have poles. The north pole and the south pole **Key word** 'Electromagnet'	**Strategy:** Work in groups of four (4) Diagram of the electromagnet and how it works.  Write the key word on the black board.
Conclusion **5 mins**	• In our today's lesson, what did you discover or learn from this lesson? Refer students to their predictions for the key question: "What are the characteristics of electromagnet?" Guide students by having them to summarize what they have learnt about electromagnets.	**Summary:** • Electromagnets attract things that are made of iron. • Electromagnets have two poles; North Pole and South Pole.	The students' conclusion should reflect the key concepts in the lesson.

Black Board Plan Sample

Title: Characteristics of an electromagnet **Key question:** What are the characteristics of an electromagnet? **Activity:** What does electromagnets do? e.g. 1. Electromagnets attract things that are iron. 2. Repels a bar magnet 3. Attracts a bar magnet	**Discussion** **Question:** Do electromagnets have poles? **Response:** Yes, electromagnets have two poles: North Pole and South Pole. **Key word** 1. Electromagnet	**Summary** • Electromagnet acts like a magnet. • It attracts things that are iron. • It has two poles – North pole and South pole.

Challenge for students:

How does an electromagnet work?

Guided lesson sample 4

Lesson Title: Structure of the lungs	Lesson No: 28
Strand 1: Life	**Unit 3:** Human Body
Topic: Respiratory and Circulatory System	**Sub-topic:** Breathing
Content standard:	**6.1.3** Students will be able to Investigate the structure and functions of the respiratory and circulatory system of the human body
Benchmark:	**6.1.3.1** Describe the structure and function of the lung.
Key question:	What happens in the body when breathing in and out?
Lesson objective:	**By the end of the lesson the students should be able to:** • describe the structure of the lungs.
Teaching period:	40 minutes (1 period)
Preparations:	A chart with the diagram of the respiratory system
Key word(s):	trachea, bronchi, lungs, oxygen, carbon dioxide

Learning content

Knowledge	Skills	Attitudes
We take in and let out air from our lungs Air enters the body through the nose and mouth As air enters the nose, it goes through the windpipe to the air tubes into the lungs.	Making predictions on what happens in the body when breathing in and out. Inferring on the movement of air as it enters the nose. Communicating ideas and findings on the movement of air in and out of the body using verbal, written and pictorial.	Develop a curiosity to find out more about the structure of lungs. Show open-mindedness when learning about the structure of the lungs. Respect views of others.

It is very important for students to describe the movement of the air using the words: nose, mouth, windpipe, air tubes, and lungs.

Describe the movement of air in the respiratory system.

Lesson procedure

Time section	Teacher activity	Student activity	Points to notice
Intro **5 mins**	**Access prior knowledge** Question student's prior knowledge on breathing. What is breathing? Introduce the lesson title and the key question for the lesson.	**Key question**  What happens in your body when you breathe in and out?	Students will use their prior knowledge about the mechanism of breathing to link to today's lesson.
Body **35 mins**	**Making predictions** Allow students to discuss in groups and give answers to the key question. **Activity:** Answer the following questions. 1. How does air enter the body? 2. What is the name given to the air tubes that branch off the windpipe and carry air directly to the lungs?	**Making predictions** Share the group's assumptions on what happens in the body when breathing in and out with the teacher. **Activity:** Answer the following questions. 1. Air enters the body through the nose and the mouth. 2. The air tubes that branch off the windpipe and carry air directly to the lungs are the bronchi.	**Concepts and Misconceptions** **Strategy:** Work in groups

Body **30 mins**	**Discussion questions on findings** Lead students through the discussion and pose a question based on their findings for the activity. **Question:** Why is the lung important? Introduce the key words for the lesson: "windpipe, bronchi, lungs, oxygen and carbon dioxide"	**Discussion questions on findings** Students to go through discussions based on the question and give their feedbacks. **Response:** Lungs form the most important part of the human respiratory system. They are located on the two sides of the heart. They are responsible for transporting oxygen into blood and releasing carbon dioxide from blood. **Key words** 1. trachea 2. bronchi 3. lungs 4. oxygen 5. carbon dioxide	For the discussion question, the students will recall what they have learnt in the mechanism of breathing to describe the movement of air during breathing. Write the key words on the black board.
Conclusion **5 mins**	• In our today's lesson, what did you discover or learn from this lesson? Refer students to their predictions for the key question: What happens in your body when you breathe in and out? Guide students by having them to summarize what they have learnt about the "respiratory system".	Summary: • During breathing, air enters the mouth and nose and travels down the trachea (windpipe). • The windpipe filters the air that we breathe and branches into the bronchi. • The bronchi are two air tubes that branch off the trachea and carry air directly into the lungs. • Lungs form the most important part of the human respiratory system. • They are responsible for transporting oxygen into blood and releasing carbon dioxide from blood.	The students' conclusion should reflect the key concepts in the lesson.

Black Board Plan Sample

Title: Structure of the lungs: Movement of Air **Key question:** What happens in the body when breathing in and out? **Activity:** Answer the following questions. 1. How does air enter the body? 2. What is the name given to the air tubes that branch off the windpipe and carry air directly to the lungs?	**Discussion** **Question:** Why is the lung important? Lungs form the most important part of the human respiratory system. They are located on the two sides of the heart. They are responsible for transporting oxygen into blood and releasing carbon dioxide from blood. **Key words** 1. trachea 2. bronchi 3. lungs 4. oxygen 5. carbon dioxide	**Summary** • During breathing, air enters the mouth and nose and travels down the trachea (windpipe). • The windpipe filters the air that we breathe and branches into the bronchi. • The bronchi are two air tubes that branch off the trachea and carry air directly into the lungs. • Lungs form the most important part of the human respiratory system. • They are responsible for transporting oxygen into blood and releasing carbon dioxide from blood.

Challenge for students:

Compare the respiration process in humans and plants and describe the difference.

Guided lesson sample 5

Lesson Title: Structure and function of the heart	**Lesson No: 32**
Strand 1: Life	**Unit 3:** Human Body
Topic: Respiratory and Circulatory System	**Sub-topic:** Circulation
Content standard:	**6.1.3** Investigate the structure and functions of the respiratory and circulatory system of the human body
Benchmark:	**6.1.3.4** Examine the structure and function of heart and blood vessels.
Key question:	How can you describe the heart?
Lesson objective:	**By the end of the lesson the students should be able to;** • describe the structure of the heart.
Teaching period:	40 minutes (1 period)
Preparations:	Chart with diagram of the structure of the heart and flash cards with the key words.
Key word(s):	oxygenated blood, deoxygenated blood, atrium, ventricle

Learning content

Knowledge	Skills	Attitudes
• The human heart is a muscular pump about the size of a clenched fist. • The heart is divided into two parts – right atrium and left atrium. • The heart has four chambers-two atria and two ventricles. • The heart is divided into two parts – right atrium and left atrium. • The heart has four chambers-two atria and two ventricles.	• Make predictions on the structure of the heart. • Infer on the structure and function of the heart • Comparing the heart to a pump. • Reason out why the right ventricle has a thin wall compared to the left ventricle. • Communicate ideas and findings on the structure of the heart using verbal, written and pictorial.	• Appreciate the importance of knowing how the heart works. • Develop a curiosity to find out more about the function of heart. • Show open-mindedness when learning about the structure of the lungs. • Respect views of others.

It is very important for students to know the importance of the heart and that the heart has two parts which are the right and left side and four chambers and they are the right atrium, right ventricle, left atrium and left ventricle.

Why is the oxygenated blood darker in colour compared to deoxygenated blood?

Lesson procedure

Time section	Teacher activity	Student activity	Points to notice
Intro **5 mins**	Access prior knowledge Ask students questions to elicit their ideas about the lesson title. Ask students to point to where their heart is located in the body. Now ask students why the heart is important. Introduce the lesson title and the key question for the lesson.	**Key question**  How can you describe the heart?	Students will use their prior knowledge about the heart to link to today's lesson.
Body **35 mins**	**Making predictions** Allow time for students to discuss in groups and give answers to the key question. **Activity:** Answer the following questions on the board. **Q1**. How many parts does a heart have? **Q2**. Name these parts. **Q3**. How many chambers (rooms) does a heart have? **Q4**. What are the names of the four chambers of the heart?	**Making predictions** Discuss in groups and share their ideas with the teacher. **Activity:** Refer to chart showing the structure of the heart to answer the given questions. **A1**. The heart has two parts. **A2**. The heart has a right side and a left side. **A3**. The heart has four chambers. **A4**. The four chambers (rooms) of the heart are the right atrium and right ventricle and the left atrium and the left ventricle.	**Concepts and Misconceptions** **Strategy:** Groupings

Body **35 mins**	**Discussion questions on findings** Lead students through the discussion and pose a question based on their findings for the activity. **Question:** How is the right side of the heart different from the left side of the heart? *Introduce the key words for the lesson;* "oxygenated blood, deoxygenated blood, atrium, ventricle	**Discussion questions on findings** Students to go through discussions based on the question and give their feedbacks. **Response:** The right and left sides of the heart have separate functions. The right side of the heart collects oxygen-poor blood from the body and pumps it to the lungs where it picks up oxygen and releases carbon dioxide. The left side of the heart then collects oxygen-rich blood from the lungs and pumps it to the body so that the cells throughout the body have the oxygen they need to function properly. **Key words** 1. Oxygenated blood, 2. deoxygenated blood 3. atrium 4. ventricle	Recall their previous knowledge of the heart to describe its function. Place the flash cards with the key words on the blackboard.
Conclusion **5 mins**	• In our today's lesson, what did you discover or learn from this lesson? Refer students to their predictions for the key question: *What is the difference between the right side of the heart and the left side of the heart?* Guide students by having them to summarize what they have learnt about the structure and function of the heart.	Summary: • The heart is a muscular pump about the size of a clenched fist. • The human heart is a four-chambered organ with a dividing wall that separates it into a right heart for pumping blood from the returning veins into the lungs and a left heart for pumping blood from the lungs to the body.	The students' conclusion should reflect the key concepts in the lesson.

Black Board Plan

Title: Structure and function of the heart **Key question:** What is the function of the heart? **Activity:** Answer the following questions on the board. **Q1.** How many parts does a heart have? **Q2.** Name these parts. **Q3.** How many chambers (rooms) does a heart have? **Q4**. What are the names of the four chambers of the heart?	**Discussion** **Q:** How is the right side of the heart different from the left side of the heart? The right and left sides of the heart have separate functions. The right side of the heart collects oxygen-poor blood from the body and pumps it to the lungs where it picks up oxygen and releases carbon dioxide. The left side of the heart then collects oxygen-rich blood from the lungs and pumps it to the body so that the cells throughout the body have the oxygen they need to function properly. Key words 1. Oxygenated blood, 2. deoxygenated blood 3. atrium 4. ventricle	**Summary** • The heart is a muscular pump about the size of a clenched fist. • The human heart is a four-chambered organ with a dividing wall that separates it into a right heart for pumping blood from the returning veins into the lungs and a left heart for pumping blood from the lungs to the body.

Challenge for students:

1. Explain relationship between the human circulatory and respiratory system.
2. How are they related in terms of the functions?

Guided lesson sample 6

Lesson Title: Finding gravity around us	**Lesson No: 50**
Strand 2: Physical Science	**Unit 2:** Force and Motion
Topic: Earth's Gravity	**Sub-topic:** Gravity
Content standard:	**6.2.4** Students will be able to examine the effects of Earth's gravity on weights of objects
Benchmark:	**6.2.4.5** Identify and examine examples of gravity in daily life.
Key question:	What would happen to the objects of the Earth if there is no gravity?
Lesson objective:	**By the end of the lesson the students should be able to;** • identify the importance of Earth's gravity acting on objects. • identify examples of the presence of gravity in daily life.
Teaching period:	40 minutes (1 period)
Preparations:	Picture of astronaut in a space shuttle floating
Key word(s):	Gravity

Learning content

Knowledge	Skills	Attitudes
• Gravity is a non-contact force that pulls all matter (anything you can physically touch) toward each other. • Without gravity objects on the earth will be floating off in the atmosphere. • Rain falling from sky, things falling down when thrown up, rivers flowing downward, climbing a mountain slope than going down, are examples of presence of gravity.	• Make predictions to what would happen if there was no gravity. • Inferring on what would happen to the objects if there was no gravity. • Communicating ideas and findings on gravity using verbal, written and pictorial.	• Appreciate the importance of gravity on Earth. • Develop a curiosity to find out more about gravity. • Show open-mindedness when learning about gravity. • Respect views of others.

Gravity is the mutual attraction of two bodies in the universe. Since gravity refers to an invisible force pulling matter, there are many examples of gravity. Every single thing has gravity, including people.

List five examples of gravity in daily life.

Lesson procedure

Time section	Teacher activity	Student activity	Points to notice
Intro **5 mins**	**Access prior knowledge** Ask students questions to elicit their ideas about the lesson title. What is something new that you have learnt from the previous lesson on "Gravity"? (gravity is non-contact force, gravity acts from a distance) Introduce the lesson title and the key question for the lesson.	**Key question**  What would happen to the objects of the Earth if there was no gravity?	Students will use their understanding from the previous lesson *"Gravity"*
Body **35 mins**	**Making predictions** If there was no gravity and you threw a ball upward, what will happen to the ball? Allow students to discuss in groups and give answers to the key question. **Activity:** Give some examples of the presence of gravity in different situations on the Earth. For example; 1. A bird flying in the air 2. Rain falling from the sky 3. Ripe fruits falling to the ground 4. Leaves falling to the ground 5. Rivers flowing downward 6. It keeps a book on a desk Discussion questions on findings Lead the students through the discussion about their findings. "Why is gravity important?" Introduce the key word for the lesson. "Gravity"	**Making predictions** *Allow students to discuss in groups and provide ideas to the teacher.* **Activity:** Give examples of the presence of gravity in different situations on the Earth. For example; 1. A bird flying in the air 2. Rain falling from the sky 3. Ripe fruits falling to the ground 4. Leaves falling to the ground 5. Rivers flowing downward 6. It keeps a book on a desk **Discussion questions on findings** Engage in discussion Gravity is important because it keeps us on the ground, it helps river to flow downward, and it helps trees by standing upright because of the roots being pulled down deep into the soil. **Key word** 1. Gravity	**Concepts and Misconceptions** *Students will have misconception that the ball will fall to the ground because of its mass* **Strategy:** Work in groups Show picture of an astronaut floating in the space shuttle to explain the importance of gravity. Write the key word on the black board.

Conclusion **5 mins**	In our today's lesson, what did you discover or learn from this lesson? Refer students to their predictions for the key question: *What would happen to the objects of the Earth if there was no gravity?* Guide students by having them to summarize what they have learnt about gravity.	**Summary:** • Earth's Gravity plays an important role by attracting objects to the centre of the earth. • Examples of gravity attracting things to the centre of earth includes, fruit falling from the tree, rain falling, rivers flowing downward, moon orbiting the Earth.	The students' conclusion should reflect the key concepts in the lesson.

Black Board Plan

Title: Finding gravity around us **Key question:** What would happen to the objects of the Earth if the is no gravity? **Activity:** Give some examples of the presence of gravity in different situations on the Earth. For example: 1. A bird flying in the air 2. Rain falling from the sky 3. Ripe fruits falling to the ground 4. Leaves falling to the ground 5. Rivers flowing downward 6. It keeps a book on a desk	**Discussion** **Question:** Why is gravity important? **Response:** Gravity is important because it keeps us on the ground, it helps river to flow downward, and it helps trees by standing upright because of the roots being pulled down deep into the soil. **Key word** 1. Gravity	**Summary** • Earth's Gravity plays an important role by attracting objects to the centre of the earth. • Examples of gravity attracting things to the centre of earth includes, fruit falling from the tree, rain falling, rivers flowing downward, moon orbiting the Earth.

Challenge for students:

Why is gravity important in space?

Guided lesson sample 7

Lesson Title: Food chain in different environment 2: Ocean	Lesson No: 54
Strand 1: Life	**Unit 4:** Interaction and relationship in the environment
Topic: Paths of energy in food chain and food web	**Sub-topic:** Food Chain
Content standard:	**6.1.4** Students will be able to examine the paths of energy and the relationship of organisms in the food chain and food web
Benchmark:	**6.1.4.1** Use basic research skills to investigate food chains in different environments such as land and ocean, and draw appropriate conclusions.
Key question:	How can you describe the food chain found in the ocean environment?
Lesson objective:	**By the end of the lesson the students should be able to;** • describe a simple food chain from the ocean environment.
Teaching period:	40 minutes (1 period)
Preparations:	Prepare chart with pictures of different animals found in the ocean including algae, plankton, seaweed.
Key word(s):	marine, plankton, algae

Learning content

Knowledge	Skills	Attitudes
The marine environment supplies many kinds of habitats that support marine life. The ocean is full of living creatures. The tiniest ocean creatures are plankton and the biggest ocean animal is the blue whale. It is the biggest animal on Earth.	Making predictions on the food chain found in the ocean environment. Infer on the different food chains found in the ocean environment. Comparing ocean and land environments. Communicate ideas and findings on food chain in the ocean environment using verbal, written and pictorial.	Be responsible by caring for the ocean/marine environment. Develop a curiosity to know more about different food chains in the marine environment. Show open-mindedness when learning about the marine environment. Respect views of others.

It is very important for students to know that the marine environment supplies many kinds of habitats that support marine life.

1. Construct a simple food chain of the ocean environment.
2. How is food chain in the land environment different from the ocean environment?

Lesson procedure

Time section	Teacher activity	Student activity	Points to notice
Intro **5 mins**	**Access prior knowledge** Ask students questions to elicit their ideas about the lesson title. What is the difference between a marine/ocean environment and a land environment? Introduce the lesson title and the key question for the lesson.	**Key question**  How can you describe the food chain found in the ocean environment?	Students will use their prior knowledge about the food chain to link to today's lesson.
Body **35 mins**	**Making predictions** Allow time for students to discuss in groups and give their predictions. **Activity:** Show the chart of different ocean animals (including planktons, seaweeds) and ask the following questions: 1. Name the producers in the ocean environment. 2. Name the consumers in the ocean environment. 3. Construct a simple food chain of the ocean environment using the animals in the chart provided.	**Making predictions** Discuss in groups and share predictions with the teacher. **Activity:** Discuss in groups and name producers and consumers in the ocean environment. 1. The algae, seaweed and plankton are producers in the ocean environment. 2. Fish, shark, whale are consumers in the ocean environment. 3. Food chain in the ocean environment. Plankton → Prawn → Fish → Shark	**Concepts and Misconceptions** **Strategy:** Work in groups

Body **35 mins**	**Discussion questions on findings** Lead students through the discussion and pose a question based on their findings for the activity. **Question:** How is the food chain in the ocean environment different from the land environment? Introduce the key words for the lesson; "marine, planton, and algae"	**Discussion questions on findings** Students to go through discussions based on the question and give their feedbacks. The food chain in ocean environment is different from the land environment because of the following factos; - types of plants found in the ocean and on land are different. - Types of animals found in the ocean and on land are different. - The type of environment the plants and animals of ocean and land are different. **Key words** 1. marine 2. plankton 3. algae	In the ocean you have a plant like organism, an alga that floats around in the waves. A small prawn swims up to the alga and starts to eat it. A hungry fish eats the prawn and as it tries to swim away it is eaten by a deadly shark. Write key words on the black board.
Conclusion **5 mins**	• In our today's lesson, what did you discover or learn from this lesson? Refer students to their hypothesis for the key question: How are marine/ocean organisms adapted to the ocean environment? Guide students by having them to summarize what they have learnt about food chain in the ocean environment.	**Summary:** • The ocean environment has producers and consumers. • The producers in the ocean are algae, seaweeds and plankton. • The consumers in the ocean are fish, shark and whale. • The food chain in the ocean and land environment is different because of the types of plants, animals that live in it.	The students' conclusion should reflect the key concepts in the lesson.

Black Board Plan

Title: The food chain in different environment 2: Ocean **Key question:** How can you describe the food chain found in the ocean environment? **Activity:** 1. Name the producers in the ocean environment. 2. Name the consumers in the ocean environment. 3. Construct a simple food chain of the ocean environment using the animals in the chart provided. Plankton → Prawn → Fish → Shark	**Discussion** **Question:** How is the food chain in the ocean environment different from the land environment? **Response:** The food chain in ocean environment is different from the land environment because of the following factos; - types of plants found in the ocean and on land are different. - Types of animals found in the ocean and on land are different. - The type of environment the plants and animals of ocean and land are different. **Key words** 1. ocean 2. plankton 3. algae	**Summary** • The ocean environment has producers and consumers. • The producers in the ocean are algae, seaweeds and plankton. • The consumers in the ocean are fish, shark and whale. • The food chain in the ocean and land environment is different because of the types of plants, animals that live in it.

Challenge for students:

Construct another food chain in the ocean environment and describe how each organisms feed on each other to get energy.

Guided lesson sample 8

Lesson Title: Types of sedimentary rocks	Lesson No: 65
Strand 3: Earth and Space	**Unit 1:** Our Earth
Topic: Formation and change of land	**Sub-topic:** Sedimentary rocks
Content standard:	**6.3.1** Students will be able to investigate the formation of soil layers, sedimentary rocks and the causes of land change
Benchmark:	**6.3.1.2** Classify and profile the types of sedimentary rocks according to their physical characteristics.
Key question:	What are different types of sedimentary rocks?
Lesson objective:	**By the end of the lesson the students should be able to:** Identity different types of sedimentary rocks.
Teaching period:	40 minutes (1 period)
Preparations:	Chart with pictures of the different types of sedimentary rocks with their descriptions.
Key word(s):	clastic sedimentary rock, chemical sedimentary rock, organic sedimentary rock.

Learning content

Knowledge	Skills	Attitudes
Sedimentary rocks are formed by the accumulation of sediments. There are three basic types of sedimentary rocks. 1. Clastic sedimentary rocks such as breccia, conglomerate, sandstone, siltstone, and shale are formed from mechanical weathering debris. 2. Chemical sedimentary rocks, such as rock salt, iron ore, chert, flint, some dolomites, and some limestones, form when dissolved materials precipitate from solution. 3. Organic sedimentary rocks such as coal, some dolomites, and some limestones, form from the accumulation of plant or animal debris.	Making predictions on the different types of sedimentary rocks. Infer on the different types of sedimentary rocks. Compare and classify rocks into three types of sedimentary rocks. Communicate ideas and findings on the three types of sedimentary rocks using verbal, written and pictorial.	Develop curiosity to learn more about the examples of the different types of sedimentary rocks. Show open-mindedness when learning about the different types of sedimentary rocks. Respect views of others.

For this lesson, provide a chart with pictures and descriptions of common rocks that students are familiar with in their daily life; for example, sandstone, siltstone, and shale rocks. This will help to the students when identify rocks using the characteristics. It would be helpful to provide samples of sandsotone, siltstone, and shale rocks.

1. Identify and list examples of clastic, chemical and organic sedimentary rocks.
2. Describe sandstone, shale and siltstone based on their physical appearances.

Lesson procedure

<table>
<tr><th>Time section</th><th>Teacher activity</th><th>Student activity</th><th>Points to notice</th></tr>
<tr><td>Intro
5 mins</td><td>Access prior knowledge
Question the students to bring about their ideas of sedimentary rocks.
“What is a sedimentary rock?”
.
Introduce the lesson title and the key question for the lesson.</td><td>Key question
 
What are the different types of sedimentary rocks?</td><td>Students will use their prior knowledge about sedimentary rock to link to today’s lesson.</td></tr>
<tr><td>Body
35 mins</td><td>Making predictions
Have the students to discuss and give their answers based on the key question.

Activity:
1. Study the chart with the three types of sedimentary rocks with the examples and descriptions.

2. Identify examples of the three types of rocks and list them in the table below.

<table><tr><th colspan="3">Sedimentary rocks</th></tr><tr><th>Clastic</th><th>Chemical</th><th>Organic</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><tr><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td></tr></table></td><td>Making predictions
Discuss and list their answers based on the key question and tell the teacher.

Activity:
Observe the chart of the three types of sedimentary rocks with the examples and descriptions.

Identify examples of the three types of sedimentary rocks and list them in the table below.

<table><tr><th colspan="3">Sedimentary rocks</th></tr><tr><th>Clastic</th><th>Chemical</th><th>Organic</th></tr><tr><td>breccia</td><td>rock salt</td><td>Some dolomites</td></tr><tr><td>con-glomer-ate</td><td>iron ore</td><td>Some lime stones</td></tr><tr><td>sand-stone</td><td>chert</td><td></td></tr><tr><td>siltstone</td><td>flint</td><td></td></tr><tr><td>shale</td><td>some dolomites</td><td></td></tr><tr><td></td><td>some lime stones</td><td></td></tr></table></td><td>Concepts and Misconceptions
If students mention sandstones or siltstone, that is okay but they are not the types of sedimentary rocks, they are examples of clastic sedimentary and organic sedimentary rock.</td></tr>
</table>

Body **35 mins**	**Discussion questions on findings** Lead students through the discussion and pose a question based on their findings for the activity. **Question:** Describe sandstone, shale and siltstone based on their physical appearances (size of the sand, clay and silt)  **sandstone**  **shale**  **siltstone** Introduce the key words for the lesson "Clastic sedimentary rock, chemical sedimentary rock and Organic sedimentary rock"	**Discussion questions on findings** Students to go through discussions based on the question and give their feedbacks. **Question:** 1. Describe sandstone, shale and siltstone based on their physical appearances (size of the sand, clay and silt) • *Sandstone* is a clastic sedimentary rock made up mainly of sand-size (1/16 to 2 millimeter diameter) weathering debris. • *Shale* is a clastic sedimentary rock that is made up of clay-size (less than 1/256 millimeter in diameter) weathering debris. It typically breaks into thin flat pieces. • *Siltstone* is a clastic sedimentary rock that forms from silt-size (between 1/256 and 1/16 millimeter diameter) weathering debris. **Key words** 1. Clastic sedimentary rock 2. Chemical sedimentary rock 3. Organic sedimentary rock	**Strategy:** Work in groups of four (4) Write the key words on the blackboard

Conclusion **5 mins**	• In our today's lesson, what did you discover or learn from this lesson? Refer students to their predictions for the key question: What are the different types of sedimentary rocks? Guide students by having them to summarize what they have learnt about the three types of sedimentary rocks.	**Summary:** • Sedimentary rocks are formed by the accumulation of sediments. • There are three basic types of sedimentary rocks. 1. Clastic sedimentary rock 2. Chemical sedimentary rock 3. Organic sedimentary rock	The students' conclusion should reflect the key concepts in the lesson.

Black Board Plan

Title: Types of sedimentary rocks

Key question:
What are the different types of sedimentary rocks?

Activity:

1. Study the chart with the three types of sedimentary rocks with the examples and descriptions.
2. Identify examples of the three types of rocks and list them in the table below.

Sedimentary rocks		
Clastic	**Chemical**	**Organic**
breccia	rock salt	Some dolomites
conglomerate	iron ore	Some lime stones
sandstone	chert	
siltstone	flint	
shale	some dolomites	
	some lime stones	

Discussion

Question:
Describe siltstone, sandstone and shale based on their physical appearances (size of sand, clay and silt)

- **Sandstone** is a clastic sedimentary rock made up mainly of sand-size (1/16 to 2 millimeter diameter) weathering debris.
- **Shale** is a clastic sedimentary rock that is made up of clay-size (less than 1/256 millimeter in diameter) weathering debris. It typically breaks into thin flat pieces.
- **Siltstone** is a clastic sedimentary rock that forms from silt-size (between 1/256 and 1/16 millimeter diameter) weathering debris.

Key words

1. Clastic sedimentary rock
2. Chemical sedimentary rock
3. Organic sedimentary rock

Summary

- Sedimentary rocks are formed by the accumulation of sediments.
- There are three basic types of sedimentary rocks.
  1. Clastic sedimentary rock
  2. Chemical sedimentary rock
  3. Organic sedimentary rock

Challenge for students:

1. How are clastic sedimentary rocks formed?
2. How are chemical sedimentary rocks formed?
3. How are organic sedimentary rocks formed?

Guided lesson sample 9

Lesson Title: Comparing weight of water and water solution	Lesson No: 77
Strand 2: Physical Science	**Unit 3:** Matter
Topic: Mixtures and Solutions	**Sub-topic:** Observing Mixtures
Content standard:	**6.2.5** Students will be able to Investigate the properties of mixtures and solutions.
Benchmark:	**6.2.5.3** Explain that the weight of water and the solute remains unchanged when the solute is dissolved in water.
Key question:	Does the weight of water change after the solution has been mixed?
Lesson objective:	**By the end of the lesson the students should be able to;** • measure the weight of solutes and solvents using a scale. • understand that mass of solutes and solvents remain the same even after the solution is formed.
Teaching period:	40 minutes (1 period)
Preparations:	Scale, graduated cylinder, sugar, salt, coffee and water.
Key word(s):	solute, solvent, solution

Learning content

Knowledge	Skills	Attitudes
• The mass of the solute and solvent combined is the same as the mass of the product (solution).	Making predictions on the mass of the product (solution). Measure the mass of the solute and solvent before and after mixing the solution. Infer on the mass of solute and solvent before and after mixing the solution. Communicating ideas and findings on the weight of solutions using verbal, written and pictorial.	Develop curiosity when finding the mass before and after mixing the solution. Show open-mindedness when learning about mass of solutions. Show objectivity by seeking data to validate observations. Respect views of others

When a soluble solute is dissolved in water, the crystals do not cease to exist. They are only broken down into particles so small that they are not visible to the naked eye. For example, if 10g of salt dissolved in 200g of water. Then the resulting mixture has a mass equal to 200g+10g which is equal to 210g (200g+10g=210g). This reasoning can be extended to all dissolutions. There is always conservation of mass when a solid is dissolved in a liquid. The total mass of the solute and solvent is equal to the mass of solution obtained.

1. Be careful when pouring solute into the solvent.
2. Make sure the table bench/desk is clear before conducting the experiment.

Take the measurement of solute and solvent correctly as instructed in the environment.

Lesson procedure

<table>
<tr><th>Time section</th><th>Teacher activity</th><th>Student activity</th><th>Points to notice</th></tr>
<tr><td>Intro
5 mins</td><td>Access prior knowledge
Ask students questions to elicit their ideas about the lesson title. What are the common types of solution that we have looked at in the last lesson on types of Solutions?

Introduce the lesson title and the key question.</td><td>Key question
 
Does the mass change after the solution has been mixed?</td><td>Students will use their prior knowledge about solutions to link to today's lesson.</td></tr>
<tr><td>Body
35 mins</td><td>Making predictions
What will happen to the mass of sugar and water if it is mixed together?

Allow students to give answers to the key question.

Activity:
Complete the table by measuring their masses

<table><tr><th>Mass of Solute</th><th>Mass of Solvent</th><th>Mass of Solution</th></tr><tr><td>Sugar =</td><td>Water =</td><td></td></tr><tr><td>Salt =</td><td>Water =</td><td></td></tr><tr><td>Coffee=</td><td>Water =</td><td></td></tr></table>
Remind students to take the mass of the graduated cylinder and other apparatus before adding the solute and solvent.</td><td>Making predictions
Allow students to discuss in groups
Provide answers to the key question with justifications.
For example:
- The mass of the sugar and water will not change
- The mass of the sugar and water will change.

Activity:
1. Copy the table into the exercise book.
2. Using the scale, measure the mass and record it in the table. Ensure to measure the apparatus first before adding the solute and solvent.</td><td>Concepts and Misconceptions
The students will think that the sugar will disappear and the mass will change.

Strategy:
Work in groups</td></tr>
</table>

Body **35 mins**	**Discussion questions on findings** Lead students through the discussion and pose a question based on their findings for the activity. **Question:** 1. What was the mass of solute and solvent before mixing the solution? 2. What was the mass of solution (solute and solvent mixed) after mixing? 3. Why is there no loss or gain in the mass of the solution? Introduce the key words for the lesson; "solute, solvent, solution"	**Discussion questions on findings** Students to go through discussions based on the question and give their feedbacks. **Response:** 1. The mass of the solute and solvent before mixing is 30g. 2. The mass of the solution after mixing the solute and solvent is 30g. 3. There is no loss or gain because the total mass of the solute and solvent is equal to the mass of the solution. **Key words** 1. Solute 2. Solvent 3. Solution	Write the key words on the blackboard.
Conclusion **5 mins**	• In our today's lesson, what did you discover or learn from this lesson? Refer students to their predictions for the key question: Does the mass change after the solution has been mixed? Guide students by having them to summarize what they have learnt about weight of solutions.	**Summary:** • The total mass of the solute and solvent is equivalent to the mass of the solution	The students' conclusion should reflect the key concepts in the lesson.

Black Board Plan

Title: Comparing weight of water and water solutions

Key question:
Does the mass change after the solution has been mixed?

Activity:
Complete the table by measuring their masses.

Mass of Solute	Mass of Solvent	Mass of Solution
Sugar =	Water =	
Salt =	Water =	
Coffee=	Water =	

Discussion Questions:

1. What was the mass of solute and solvent before mixing the solution?
2. What was the mass of solution (solute and solvent mixed) after mixing?
3. Why is there no loss or gain in the mass of the solution?

Key words

1. Solute
2. Solvent
3. Solution

Summary
The total mass if the solute and solvent is equivalent to the mass of the solution.

Challenge for students:

Conduct further investigation and answer the following questions:

1. What would happen if you continue to add more solute (salt, sugar or coffee) to the solvent (water)?
2. What would happen to the mass of solution? Give your reason.

Guided lesson sample 10

Lesson Title: Causes of Moon phases	**Lesson No: 88**
Strand 3: Earth and Space	**Unit 3:** Space
Topic: The Moon	**Sub-topic:** Moon Phases
Content standard:	**6.3.2** Students will be able to explain the motion of the moon and the different moon phases
Benchmark:	**6.3.2.2** Examine the causes of the different types of Moon Phases.
Key question:	Why is the moon continuously changing its shape?
Lesson objective:	**By the end of the lesson the students should be able to;** • understand the relationship between the Moon phases and the position of the Sun, Earth and Moon. • know that the moon does not actually produce light, it reflects it from the Sun.
Teaching period:	40 minutes (1 period)
Preparations:	A chart with the diagrams of the different types of Moon phases with shapes drawn and their names.
Key word(s):	new moon, waxing, waning, crescent, gibbous, full moon

Learning content

Knowledge	Skills	Attitudes
The Sun always lights one half of the Moon. The moon does not produce light, it reflects light. As the Moon orbits the Earth, different amounts of the lighted half are visible from the Earth. The shapes created by the changing amounts of visible lighted areas are called the Moon phases. The cycle of the phases of the moon takes about a month.	Making predictions on why the moon is continuously changing its shape. Demonstrate the phases of the moon using given materials. Infer and relate the phases of the moon with the position of the Earth and Sun. Draw the different phases of the moon. Communicate ideas and findings on the moon phases using verbal, written and pictorial.	Develop curiosity to find out more about the causes of different phases of the moon. Show open-mindedness when learning about different types of moon phases. Show creativity by suggesting ways to demonstrate the moon phases. Respect views of others.

For this lesson, the teacher should have the chart with diagrams of the different types of moon phases prepared prior the actual lesson. For further deliberation, refer to the teacher's content background notes.

1. Draw the different types of Moon phases.
2. Demonstrate the causes of different moon phases by following the steps given

Lesson procedure

Time section	Teacher activity	Student activity	Points to notice
Intro **5 mins**	**Access prior knowledge** Question the students to bring about their ideas of prior knowledge and experience on the moon phases. *How long does it take for the moon to orbit the Earth?*	**Key question**  Why is the moon continuously changing its shape?	Students will use their prior knowledge about "Movement of the Moon around the Earth" to link to today's lesson.
Body **35 mins**	**Making predictions** Allow students to discuss and provide feedbacks to the key question. **Activity:** Demonstration of Phases of the Moon 1. The glowing lamp represents the sun (should be stationary), the foam ball represents the moon, and you represent the Earth. 2. Place the glowing lamp (the height should be just above your head) in front and hold the foam ball a meter away from the lamp. 3. The new moon starts when the ball is aligned straight with the lamp. 4. Gradually orbit the lamp at an angle towards the left and observe the tiny light forming from the side. 5. Repeat steps 4 and record your results until you come back to where you started	**Making predictions** Give their feedbacks based on the key question. **Activity:** 1. Have one student to be the Sun, one to be the Earth holding the moon. 2. Sun student to hold the glowing lamp (the height should be just above your head). Moon student to hold the foam ball a meter away from the lamp. 3. Align the moon and sun so you could not see the lamp. This is new moon. 4. Gradually orbit the moon an angle towards the left and observe the tiny light forming from the side. Record your result. 5. Repeat steps 4 until you come back to where you started. 6. Present your findings to the class.	**Concepts and Misconceptions**

Body **35 mins**	**Discussion questions on findings** Lead students through the discussion and pose a question based on their findings for the activity. **Question:** *If the moon does not give off its own light, why is it so bright in the night sky? (The Moon reflects light from the sun. it is represented by the foam ball (moon) reflecting light from the lamp (sun).* *Introduce the key words for the lesson: "*new moon, waxing, waning, crescent and gibbous*"*	**Discussion questions on findings** Students to go through discussions based on the question and give their feedbacks. *(The Moon reflects light from the sun. it is represented by the foam ball (moon) reflecting light from the lamp (sun).* **Key words** 1. new moon, 2. waxing 3. waning 4. crescent 5. gibbous 6. full moon	**Strategy:** Work in groups Write the key words on the blackboard.
Conclusion **5 mins**	• In our today's lesson, what did you discover or learn from this lesson? Refer students to their predictions for the key question: Why is the moon continuously changing its shape? Guide students by having them to summarize what they have learnt about reproductive causes of the Moon Phases.	**Summary:** • The light from the sun lights only one half of the moon • The shape of the moon changes relative to the position of the sun and the Earth. • The new moon cannot be seen from the Earth because the lighted part is facing the sun. • It takes about 29 days from a complete cycle of the phases of the moon-from one new moon to the next.	The students' conclusion should reflect the key concepts in the lesson.

Black Board Plan

Title: Causes of the Moon Phases **Key question:** Why is the moon continuously changing its shape? **Activity:** 1. Have one student to be the Sun, one to be the Earth holding the moon. 2. Sun student to hold the glowing lamp (the height should be just above your head). Moon student to hold the foam ball a meter away from the lamp. 3. Align the moon and sun so you could not see the lamp. This is new moon. 4. Gradually orbit the moon an angle towards the left and observe the tiny light forming from the side. Record your result. 5. Repeat steps 4 until you come back to where you started. 6. Present your findings to the class.	**Discussion** **Question** If the moon does not give off its own light, why is it so bright in the night sky? **Response** The Moon reflects light from the Sun. It is represented by the foam ball (moon) reflecting light from the lamp (Sun). **Key words** 1. new moon, 2. waxing moon 3. waning moon 4. crescent moon 5. gibbous moon	**Summary** • The light from the sun lights only one half of the moon • The shape of the moon changes relative to the position of the sun and the Earth. • The new moon cannot be seen from the Earth because the lighted part is facing the sun. • It takes about 29 days from a complete cycle of the phases of the moon-from one new moon to the next fern.

Challenge for students:

How does the position of the Sun, Earth and the Moon affect each other?

Knowledge, Skills and Attitudes (KSA) for teachers to write lessons

Strand 1: Life	Unit 1: Plants	Topic: Reproduction and heredity of plants
Content standard: 6.1.1 Students will be able to investigate the reproductive parts, process of reproduction and heredity in plants.		

Lesson Title: Reproductive parts of a flower **Lesson No. 01**

Benchmark: 6.1.1.1 Identify the reproductive parts of a flower and examine their functions.

Key question: What are the main reproductive parts of a flower?

Lesson objective: By the end of the lesson, the students should be able to;

- describe the main reproductive parts of a flower with their functions.

Knowledge	Skills	Attitudes
The main parts of a flower include: Petals, pistil which consists of stigma, style and ovary. The flower contains the reproductive parts of a plant. **Petals:** forms corolla (inner part of petal) **Sepal:** forms carlyx (outer part of sepals) **Stamen:** male organ, anther produces pollen **Pistil:** contain female organ found at the centre of the flower	Make predictions on the different parts of a flower. Infer on the different parts of a flower. Communicate ideas and findings on different parts of a flower using verbal, written and pictorial.	Appreciate the biological creation of flowering plants.

Lesson Title: Pollination process in a flower **Lesson No. 02**

Benchmark: 6.1.1.2 Describe and analyse the sexual reproduction process of flowering plants such as pollination, fertilization and seed dispersals.

Key question: What is pollination?

Lesson objective: By the end of the lesson, the students should be able to;

- explain pollination process and its function in plant reproduction system.

Knowledge	Skills	Attitudes
Pollination is a process whereby pollens produced by anther from stamen is transferred to the female stigma to produce reproduce a new seed then offspring (plant). Types of pollination include; Self-pollination: male and female cells contained in the same part of a plant e.g. bean. Wind pollination: transferred by wind Water pollination: transferred by water Animal pollination: transferred by animal to allow pollination to take place.	Make predictions on the pollination process in flowering plants. Infer on the different types of pollination in flowering plants. Communicate ideas and findings on the pollination process using verbal, written and pictorial.	Value the biological creation of flowering plants. Develop curiosity in how the nature forms and reproduces its offspring.

Lesson Title: Fertilization in a flower **Lesson No. 03**

Benchmark: 6.1.1.2 Describe and analyse the sexual reproduction process of flowering plants such as pollination, fertilization and seed dispersals.

Key question: How does fertilization take place in a flower?

Lesson objective: By the end of the lesson, the students should be able to;

- explain the process of fertilization in a flowering plant.

Knowledge	Skills	Attitudes
Fertilization is a process in a flowering plant whereby the male cell produced in the stamen of a flower meets and unites with the egg or cell from female part to produce a new product or seed.	Make predictions on the fertilization process in flowering plants. Infer on the fertilization process in flowering plan. Communicate ideas and findings on the fertilization process in flowering plants using the verbal, written and pictorial.	Develop curiosity in how the nature forms and reproduces its offspring.

Lesson Title: Hereditary Characteristics in Plants **Lesson No. 05**

Benchmark: 6.1.1.4 Identify and evaluate the hereditary characteristics of plants

Key question: What are some parts of a plant that are inherited?

Lesson objective: By the end of the lesson, the students should be able to;

- discuss some inherited characteristic of plants.

Knowledge	Skills	Attitudes
All living things have characteristics and traits that are inherited and variable. Living things have genetic patterns and instructions that specify its traits or characters. These are passed from generation to generation through genes found in the chromosomes. For plants, some of the characteristics that are fully inherited include the colour of the flower, shape of leaves, shape of seeds, colour of seeds or fruit. On the other hand, changes of the characteristics can occur due to climate or environment change.	Make predictions on parts of a plant that are inherited. Infer on the inherited characteristics of plants. Communicate ideas and findings on inherited characteristics of plants using the verbal, written and pictorial.	Develop curiosity in how the nature forms and reproduces its offspring.

Topic review on Reproduction and heredity of plants **Lesson 6**

Strand 2: Physical Science	Unit 1: Energy	Topic: Energy
Content standard: 6.2.1. Students will be able to investigate the forms and conversion of energy.		

Lesson Title: Sources of Energy 1: From the Sun **Lesson No. 07**

Benchmark: 6.2.1.1. Recognize that the Sun is the primary source of heat and light energy.

Key question: Is Sun a source of energy?

Lesson objective: By the end of the lesson, the students should be able to;

- describe that the Sun is a source of energy.

Knowledge	Skills	Attitudes
Sun is the source of energy. Sun gives of light and heat energy.	Make predictions on Sun as primary source of heat and light energy. Infer that the sun is a source of energy. Investigate by experimenting with a hand lens to start a fire. Communicate ideas and findings on inherited characteristics of plants using the verbal, written and pictorial.	Develop an interest about the energy that comes from the sun.

Lesson Title: Sources of Energy 2: From moving water **Lesson No. 08**

Benchmark: 6.2.1.2. Examine the different sources of energy.

Key question: Does moving water have energy?

Lesson objective: By the end of the lesson, the students should be able to;

- explain moving water has energy by making a simple water wheel turn and pull up a weight.

Knowledge	Skills	Attitudes
Energy from moving water makes things work. Moving water has energy turns the waterwheel and pull up an object	Make predictions on whether moving water has energy. Infer that moving water has energy. Construct a simple water wheel to demonstrate that water has energy. Communicate ideas and findings on how moving water has energy using verbal, written and models.	Be interested that moving water has energy to make things work.

Lesson Title: Sources of Energy 3: From moving air **Lesson No. 09**

Benchmark: 6.2.1.2. Examine the different sources of energy.

Key question: Does moving air have energy?

Lesson objective: By the end of the lesson, the students should be able to;

- explain that moving air has energy by making a pin-fold propeller.

Knowledge	Skills	Attitudes
Moving air has energy to make the pin-wheel to spin at will.	Make predictions on whether moving air has energy. Infer that moving air has energy. Construct a simple water wheel to demonstrate that water has energy. Communicate ideas and findings on how moving air has energy using verbal, written and models.	Develop a curiosity about air has having energy.

Lesson Title: Sources of Energy 4: From fuel **Lesson No. 10**

Benchmark: 6.2.1.2. Examine the different sources of energy.

Key question: Does fuel have energy?

Lesson objective: By the end of the lesson, the students should be able to;

- explain that fuels have energy that machines makes machines work.

Knowledge	Skills	Attitudes
Fuels such as petrol, diesel and others burn and produces heat to make machines work.	Make predictions on whether fuel has energy. Infer that fuels such as petrol and diesel produce heat energy to make machines work. Construct a simple water wheel to demonstrate that water has energy. Communicate ideas and findings on how fuel has energy using verbal and written.	Develop a curiosity about water having energy.

Lesson Title: Changes in energy form **Lesson No. 12**

Benchmark: 6.2.1.4. Discuss how energy changes from one form to another.

Key question: How does energy change from one form to another?

Lesson objective: By the end of the lesson, the students should be able to;

- explain that energy is not lost but changes from one form to another.

Knowledge	Skills	Attitudes
Energy can be transformed or converted from one form into another. Sometimes more than one form of energy is produced when an energy change occurs.	Make predictions on how energy changes from one form to another. Infer that energy can change from one form to another. Investigate how energy conversion by setting up a simple electric circuit. Communicate ideas and findings on how energy changes from one form to another using verbal and written.	Appreciate energy conversion which is making our life easier today.

Lesson Title: Uses of Energy in Daily Life **Lesson No. 13**

Benchmark: 6.2.1.3. Investigate the different forms of energy and their uses.

Key question: What are the uses of energy?

Lesson objective: By the end of the lesson, the students should be able to;

- identify some uses of energy in daily life.

Knowledge	Skills	Attitudes
Energy is used in homes, schools, factories and everywhere. Plants use energy from the sun plants to make their food.	Make predictions on the different uses of energy in daily life. Infer that energy can change from one form to another. Compare the different uses of energy in daily life. Communicate ideas and findings on how energy changes from one form to another using verbal, written and pictorial.	Appreciate the different uses of energy in daily life.

Topic review on energy **Lesson 14**

Strand 2: Physical Science	Unit 1: Energy	Topic: Electromagnet
Content standard: 6.2.2. Students will be able to examine the properties of electromagnet.		

Lesson Title: How do we strengthen electromagnet? 1 **Lesson No. 16**

Benchmark: 6.2.2.3. Investigate the conditions that strengthen the magnetism of an electromagnet.

Key question: How do we strengthen an electromagnet?

Lesson objective: By the end of the lesson, the students should be able to;

- identify conditions that should strengthen an electromagnet by increasing the number of loops of wire around the nail.

Knowledge	Skills	Attitudes
The strength of an electromagnet can be increased by increasing the number of loops of wire around the iron (nail).	Make predictions on how to strengthen an electromagnet. Infer about ways to strengthen an electromagnet. Investigate how to strengthen an electromagnet using copper wire, nail and a dry cell. Communicate ideas and findings on strengthening an electromagnet using verbal and written.	Show curiosity about how to strengthen an electromagnet.

Lesson Title: How do we strengthen electromagnet? (2) **Lesson No. 17**

Benchmark: 6.2.2.3. Investigate the conditions that strengthen the magnetism of an electromagnet.

Key question: How do we strengthen an electromagnet?

Lesson objective: By the end of the lesson, the students should be able to;

- identify conditions that should strengthen an electromagnet by increasing the number of dry cells to increase the current flowing through the coil of wire.

Knowledge	Skills	Attitudes
The strength of an electromagnet can be increased by increasing the number of dry cells to increase the current flowing through the coil of wire.	Make predictions on how to strengthen an electromagnet. Infer about ways to strengthen an electromagnet. Investigate how to strengthen an electromagnet copper Communicate ideas and findings on strengthening an electromagnet using verbal and written.	Show curiosity about how an electromagnet can be strengthened.

Lesson Title: Uses of electromagnet in daily life **Lesson No. 18**

Benchmark: 6.2.2.4. Appraise the uses of electromagnets in daily life.

Key question: What are some uses of electromagnets?

Lesson objective: By the end of the lesson, the students should be able to;

- identify uses of electromagnets in different applications.

Knowledge	Skills	Attitudes
Electromagnets are also used extensively when it comes to musical equipment. These include loudspeakers, earphones, electric bells, and magnetic recording and data storage equipment – such as tape recorders. The multimedia and entertainment industry relies on electromagnets to create devices and components, such as VCRs, and hard disks. Electrical actuators, which are motors responsible for converting electrical energy into mechanical torque, also rely on electromagnets. Electromagnetic induction is also the means through which power transformers function, which are responsible for increasing or decreasing the voltages of alternating current along power lines. Induction heating, which is used for cooking, manufacturing, and medical treatment, also relied on electromagnets, which convert electrical current into heat energy. Electromagnets are also used for industrial applications, such as magnetic lifters that use magnetic attraction to lift heavy objects or magnetic separators that are responsible for sorting ferromagnetic metals from scrap metal.	Making predictions on the different uses of electromagnets in today's world. Infer about the different uses of electromagnets. Comparing uses of electromagnets in different applications. Communicate ideas and findings on the different uses of electromagnets using verbal, written and pictorials.	Having open-mind to know more about the different uses of electromagnets. Show curiosity about the uses of electromagnets in different applications.

Topic review on electromagnet **Lesson 19**

Unit review on energy **Lesson 20**

Strand 1: Life	Unit 2: Plants	Topic: Pathway of Water In Plants
Content standard: 6.1.2 Students will be able to investigate the pathways of water in plants		

Lesson Title: Paths of water transport system in plants **Lesson No.21**

Benchmarks: 6.1.2.1 Identify the paths of the transport system in plants and describe their functions.

Key question: What are the paths of the water transport system in plants?

Lesson objective: By the end of the lesson, the students should be able to;

- identify the paths of the water transport system in plants.

Knowledge	Skills	Attitudes
There are two transport systems in plants. Xylem transports water and minerals from roots to other parts of the plant. Phloem transports sugar (sucrose) and amino acids in leaves to other parts of plants. These are called phloem vessels.	Make predictions on the paths of water transport system in plants. Infer on the paths of water transport system in plants. Communicate ideas and findings on how energy changes from one form to another using verbal, written and pictorial.	Accept and appreciate plants in our surrounding.

Lesson Title: Where does water in plants pass through? Roots **Lesson No. 22**

Benchmark: 6.1.2.2 Discuss the transportation of water to all parts of the plant through the roots, stem, and leaves.

Key question: How does a plant gets water through the roots?

Lesson objective: By the end of the lesson, the students should be able to;

- explain how water is absorbed into a plant through the roots.

Knowledge	Skills	Attitudes
Plants absorb nutrients and water through their roots from the ground, travels through the stem to other parts of the plant.	Make predictions on how water is absorbed into a plant through the roots. Infer on how water is absorbed into a plant through the roots. Communicate ideas and findings on how water is absorbed into a plant through the roots using verbal, written and pictorial.	Develop curiosity about how plants absorb water through the roots.

Lesson Title: Where does water in plants pass through? Stem **Lesson No. 23**

Benchmark: 6.1.2.2 Discuss the transportation of water to all parts of the plant through the roots, stem, and leaves.

Key question: How does a plant gets water through the stem?

Lesson objective: By the end of the lesson, the students should be able to;

- explain how water is absorbed into a plant through the stem.

Knowledge	Skills	Attitudes
Plants absorb nutrients and water through their roots from the ground, travels through the stem to other parts of the plant. Xylem is a plant tissue that transports water and minerals up from the roots to the leaves. The phloem transports sugar molecules, amino acids, and hormones both up and down through the plant. Sap is the mix of water and minerals that move through the xylem as well. The Carbohydrates travel through the phloem. Plants use xylem and phloem as “modes of transport” to allow plants to function and keep all cells of the plant hydrated and nourished.	Make predictions on how water is absorbed into a plant through the stem. Infer on how water is absorbed into a plant through the stem. Communicate ideas and findings on how water is absorbed into a plant through the stem using verbal, written and pictorial.	Develop curiosity about how plants absorb water through the stem.

Lesson Title: Where does water in plants pass through? Leaves **Lesson No. 24**

Benchmark: 6.1.2.2 Discuss the transportation of water to all parts of the plant through the roots, stem, and leaves.

Key question: How does a plant gets water through the leaves?

Lesson objective: By the end of the lesson, the students should be able to;

- explain how water is absorbed into a plant through the leaves.

Knowledge	Skills	Attitudes
The leaves contain veins, through which nutrients and hormones travel to reach the cells throughout the leaf. Some leaves from certain trees have their Veins easy to see while some leaves in some plants are difficult to see the veins contained in the leaves. Water and nutrients also travel to the plant through transportation process. When transportation occurs, evaporation happens through the leaves. The water is pulled upwards when it moves from the plant to the air. About 99% of the water that goes to the roots is transpires by the leaves.	Make predictions on how water is absorbed into a plant through the leaves. Infer on how water is absorbed into a plant through the leaves. Communicate ideas and findings on how water is absorbed into a plant through the leaves using verbal, written and pictorial.	Develop curiosity about how plants absorb water through the leaves.

Lesson Title: Transpiration process in plants **Lesson No. 25**

Benchmark: 6.1.2.3. Investigate the process of transpiration in plants.

Key question: What will happen if we cover and tie a plant inside a plastic bag?

Lesson objective: By the end of the lesson, the students should be able to;

- conduct an experiment to investigate the process of transpiration in plants.

Knowledge	Skills	Attitudes
Transpiration is the process by which water evaporates from the plant's leaves. Tiny droplets of water will appear inside the bag. These tiny droplets are due to transpiration from leaves. Plants have small pores, or holes, on their leaves. Take a look at the bottom of a leaf under a microscope, and you will be able to see these holes, which are known as stomata. This is where plants can lose water through transpiration.	Making predictions on what will happen if the plant is covered and tied with a plastic bag. Infer on the process of transpiration in plants using the results from the experiment. Investigate the process of respiration by conducting experiment. Communicate ideas and findings on transpiration process in plants using verbal, written and pictorial.	Develop a curiosity to know more about the transpiration process in plants. Show open-mindedness when learning about the transpiration process in plants. Respect views of others.
Topic review on pathway of water in plants		**Lesson 26**
Unit review on plants		**Lesson 27**

Strand 1: Life	Unit 3: Human Body	Topic: Respiratory System
Content standard: 6.1.3. Students will able to investigate the structure and functions of the respiratory and circulatory system of the human body		

Lesson Title: Organs of the human respiratory system. **Lesson No.29**

Benchmarks: 6.1.3.2 Identify the organs of the human respiratory system and state their functions.

Key question: What are the organs of the human respiratory system?

Lesson objective: By the end of the lesson, the students should be able to;

- identify the organs of the human respiratory system.

Knowledge	Skills	Attitudes
Organs of the human respiratory system. Nose and Nasal cavity main external opening for the respiratory system. Nose, Mouth, Pharynx, Larynx, Trachea, Bronchi, Lungs, Muscles. **Functions of respiratory system** Inhalation and exhalation pulmonary ventilation. External respiration exchanges gases between the lungs and the blood stream. Internal respiration exchanges gases between the blood stream and body tissues.	Make predictions on the different organs of the respiratory system. Infer on different organs of the respiratory system. Communicate ideas and findings on different organs of the human respiratory system using verbal, written and pictorial.	Appreciate organs in the respiratory system in our body.

Lesson Title: Mechanism of breathing (function of a lung) **Lesson No. 30**

Benchmark: 6.1.3.3. Investigate the movement of air in and out of the human body through the respiratory system.

Key question: What happens to our body when we breathe in and out?

Lesson objective: By the end of the lesson, the students should be able to;

- describe what happens in their body during breathing in and out.

Knowledge	Skills	Attitudes
Breathing is the only process that delivers oxygen to where it is needed in the body and removes carbon dioxide. We breathe in air in order to take in oxygen into our bloodstream and get rid of carbon dioxide. The lungs make up one of the largest organs of the body, and they work with the respiratory system to allow us to breathe. The process of taking air into the lungs is called inhalation and the process of breathing it out is called exhalation.	Making predictions on the what happens to the body when we breathe in and out. Make observation on the movement of the chest during breathing in and out. Infer on why the lungs work with the respiratory system. Communicate ideas and findings on how water is absorbed into a plant through the leaves using verbal, written and pictorial.	Value the lung as a very important organ in the respiratory system.
Topic review on breathing		**Lesson 31**

Strand 1: Life	Unit 3: Human Body	Topic: Circulatory System
Content standard: 6.1.3 Students will be able to investigate the structure and the functions of the respiratory and circulatory systems of the human body.		

Lesson Title: The Heart: Measuring pulse at rest and after work **Lesson No. 33**

Benchmark: 6.1.3.4. Examine the structure and function of the heart and blood vessels.
Key question: How do we measure the pulse at rest and after work?

Lesson objective: By the end of the lesson, the students should be able to;

- measure a person's pulse at rest and after work.

Knowledge	Skills	Attitudes
A healthy person's heart runs at about 72 beats per minute when they are resting. The heart rate goes up during working to supply more blood to hard working muscles. The pulse can be checked in many places and the easiest is on the wrist and neck.	Make predictions on the how to measure the pulse at rest and after work. Infer on why the heart beat increases during work or activity. Measure the pulse by counting the number of beats in 15 seconds and multiplying this number by 4 to calculate the beats in a minute. Communicate ideas and findings on how to measure pulse at rest and after work using verbal and written.	Appreciate the importance of heart as being vital for survival.

Lesson Title: The Heart: Movement of the blood **Lesson No. 34**

Benchmark: 6.1.3.4. Examine the structure and function of the heart and blood vessels.

Key question: What helps the blood to flow from the heart to the rest of the body?

Lesson objective: By the end of the lesson, the students should be able to;

- describe the flow of the blood from the heart to the rest of the body.

Knowledge	Skills	Attitudes
There are three types of blood vessels in the body, each with a different job to do. Arteries are the vessels that carry blood away from the heart. The arteries branch into smaller and smaller vessels until they reach a network of fine narrow vessels called capillaries. It is in the capillaries that the exchange of substances takes place. Substances such as oxygen and dissolved food needed by the cells move across the walls of the capillaries and into the cells. Veins are the larger vessels in which the joined from the capillaries. The function of the veins is to carry the blood from the capillaries back to the heart.	Make predictions on what helps the blood to flow from the heart to the rest of the body. Infer on the flow of the blood from the heart to the rest of the body. Communicate ideas and findings on the movement of blood using verbal, written and pictorial.	Appreciate the three blood vessels that carry the blood to the heart and away from the heart.

Lesson Title: Organs of the human circulatory system **Lesson No.35**

Benchmark: 6.1.3.5 Identify the organs of the human circulatory system and state their functions.

Key question: What are the organs of the human circulatory system?

Lesson objective: By the end of the lesson, the students should be able to;

- identify the organs of the human circulatory system.

Knowledge	Skills	Attitudes
The organs of the human circulatory system are heart, blood vessels, lymph nodes, lymph. **Functions circulatory system** Circulates blood to all parts of the body. Transport water oxygen and nutrients to cells. Transports waste including carbon dioxide away from cells Helps maintain correct body temperature. Helps fight disease through white blood cells and antibiotics in the blood.	Make predictions on the different organs of the circulatory system. Make observation on the movement of the chest during breathing in and out. Infer on why the lungs work with the respiratory system. Communicate ideas and findings on the different organs of the circulatory system using verbal, written and pictorial.	Appreciate circulatory organs in our body system.

Lesson Title: Heart and Lung **Lesson No. 36**

Benchmark: 6.1.3.6. Explain the relationship between the heart and the lung.

Key question: What is the relationship between the heart and the lungs?

Lesson objective: By the end of the lesson, the students should be able to;

- describe the relationship between the heart and lungs.

Knowledge	Skills	Attitudes
The heart has four chambers. The right atrium receives blood coming from the body and the left atrium collects blood coming from the lungs. The ventricles are underneath the atria (plural for atrium) and are the chambers that pump blood out of the heart. The right ventricle has a thin wall because it only needs to pump the blood around the lungs at low pressure. The left ventricle has a much thicker wall because it generates the high pressure needed to push blood to the head and body. The right side of the heart collects oxygen-poor blood from the body and pumps it to the lungs. The left side of the heart collects oxygen-rich blood from the lungs and pumps it to the body.	Make predictions on the relationship between the heart and the lung. Infer about the relationship between the heart and the lungs. Communicate ideas and findings on the relationship between the heart and the lung using verbal, written and pictorial.	Appreciate the fact that the heart and lungs work together for a person's survival.

Topic review on circulation	**Lesson 37**
Unit review on human body	**Lesson 38**

Strand 2: Physical Science	Unit 2: Force And Motion	Topic: Earth's Gravity
Content standard: 6.2.3 Students will be able to investigate the types of forces and their effects.		

Lesson Title: Different types of Forces **Lesson No. 39**

Benchmark: 6.2.3.1 Investigate the different types of force and their effects.

Key question: What are the different forces that we have and how can we classify all these forces?

Lesson objective: By the end of the lesson, the students should be able to;

- identify different types of forces.

Knowledge	Skills	Attitudes
Forces are categorized into two main groups- Contact and Non-contact Forces Contact forces are those forces which represent the result of physical contact between two objects, where one of the objects exerts force on the other. Some types of contact forces are; Applied Force, normal force, frictional force, tension force, air resistance force and spring force Non-contact forces are forces which do not involve physical contact between the two objects but act through the space between the two forces. Examples of non-contact or action at a distance forces are; Gravitational force and electromagnetic force.	Make predictions on the different types of forces. Classify different types of forces into contact and non-contact forces. Communicate ideas and findings on the different types of forces using verbal, written and pictorial.	Appreciate the uses and effects of forces. Value the importance of force in our daily lives.

Lesson Title: Frictional force **Lesson No. 40**

Benchmark: 6.2.3.1. Investigate the different types of forces and their effects.

Key question: What is a frictional force?

Lesson objective: By the end of the lesson, the students should be able to;

- describe the frictional force.

Knowledge	Skills	Attitudes
When two surfaces that contacts and slide against each other. These *forces* are mainly affected by the surface texture and amount of *force* impelling them together. The angle and position of the object affect the amount of *frictional* force.	Make predictions on the different types of forces. Infer on the frictional force and its effects. Demonstrate how frictional force occurs. Communicate ideas and findings on the different types of forces using verbal, written and pictorial	Accept and appreciate frictional force used in everyday life.

Lesson Title: Gravitational force **Lesson No. 41**

Benchmark: 6.2.3.1 Investigate the different types of force and their effects.

Key question: What is gravitational force?

Lesson objective: By the end of the lesson, the students should be able to;

- describe the gravitational force.

Knowledge	Skills	Attitudes
Gravitational force is a *force* that attracts any objects with mass. You, right now, are pulling on every other object in the entire universe! This is called Newton's Universal Law of *Gravitation*.	Make predictions on the different gravitational force. Infer on gravitational forces and its effects using concrete objects. Communicate ideas and findings on gravitational forces using verbal, written and pictorial.	Accept and appreciate the effects of gravitational forces daily.

Lesson Title: Elastic force **Lesson No. 42**

Benchmark: 6.2.3.1 Investigate the different types of force and their effects.

Key question: What is elastic force?

Lesson objective: By the end of the lesson, the students should be able to;

- describe the elastic force.

Knowledge	Skills	Attitudes
Elastic force *Elasticity* is the ability of a material to return to its original shape after being stretched or compressed. When an elastic material is stretched or compressed, it exerts elastic force.	Make predictions on elastic force. Infer on elastic forces using concrete objects. Communicate ideas and findings on elastic forces using verbal, written and pictorial.	Accept and appreciate elastic forces daily.

Lesson Title: Uses and Effects of Forces in Daily Life **Lesson No. 43**

Benchmark: 6.2.3.3 Evaluate the effects of forces.

Key question: What can force do when acting objects?

Lesson Objective: By the end of the lesson, the students should be able to;

- demonstrate the effects of force on objects in daily life.

Knowledge	Skills	Attitudes
A force acting on an object may cause the object to: - change shape - to start or to stop moving, - to accelerate or decelerate When two objects interact with each other they exert a force on each other, the forces are equal in size but opposite in direction.	Make predictions on elastic force. Infer and make hypothesis on the effects of force on objects. Demonstrate the effects of forces using concrete materials and objects. Communicate ideas and findings on elastic forces using verbal, written and pictorial.	Develop curiosity on the effects of forces.

Lesson Title: Describing force **Lesson No. 44**

Benchmark: 6.2.3.4. Categorize force by its magnitude and direction.

Key question: How can you describe force by its magnitude and direction?

Lesson Objective: By the end of the lesson, the students should be able to;

- describe force by its magnitude and direction.

Knowledge	Skills	Attitudes
Force-has magnitude and direction Magnitude-size or extent of force. Direction-to move force in a certain way.	Make predictions about describing force by its magnitude and direction. Infer and make hypothesis on describing force by its magnitude and direction. Investigate the force by its magnitude and direction. Communicate ideas and findings on elastic forces using verbal, written and pictorial.	Accept and appreciate force, magnitude and direction.
Topic review on force		**Lesson 45**

Strand 2: Physical Science	Unit 2: Force and Motion	Topic: Earth's Gravity
Content standard: 6.2.4 Students will be able to examine the effects of Earth's gravity on weights of objects		

Lesson Title: Earth's gravity **Lesson No. 46**

Benchmark: 6.2.4.1. Investigate the effects of Earth's gravity on weights and objects.

Key question: How does the gravity affect the weights of objects on Earth?

Lesson objective: By the end of the lesson, the students should be able to;

- describe the effects of gravity on weights of objects.

Knowledge	Skills	Attitudes
Gravity affects weight because gravity creates weight. Objects have mass, which is defined as how much matter an object contains. Weight is defined as the pull of gravity on mass. Weight is a measure of how much gravity pulls on a mass or object	Making predictions on how gravity affects weights of objects on Earth. Infer on how gravity affect the weight of objects on Earth. Communicate ideas and findings on effect of gravity on objects using verbal and written.	Appreciate the effects of gravity on the weights of objects.

Lesson Title: Measuring weight **Lesson No. 47**

Benchmark: 6.2.4.2 Use a spring balance to measure weights of objects.

Key question: What is the instrument and unit used to measure weight?

Lesson objective: By the end of the lesson, the students should be able to;

- measure weights of different objects using a spring balance.

Knowledge	Skills	Attitudes
A spring balance is an equipment that can be used to measure weights of objects. The International Standard unit to measure weight is Newton (N).	Make predictions on the type of instrument and unit used to weights of objects. Use a spring balance to measure weight of objects. Correctly handle the spring balance. Communicate ideas and findings on elastic forces using verbal, written and pictorial.	Appreciate the importance of spring balance.

Lesson Title: Characteristics of weight **Lesson No. 48**

Benchmark: 6.2.4.4 Explain the characteristics of weight.

Key question: What are some characteristics of weight?

Lesson objectives: By the end of the lesson, the students should be able to;

- identify characteristics of weight.

Knowledge	Skills	Attitudes
Weight is the force of gravity acting on an object due to its mass. The weight of an object is the force of gravity on the object and may be defined as the mass times the acceleration of gravity, w = mg. Since the weight is a force, its SI unit is the newton. Weight changes from place to place, but mass does not change.	Making predictions on the characteristics of weight. Infer about characteristics of weight. Communicate ideas and findings on the characteristics of weight using verbal and written.	Be open-minded to new knowledge about characteristics of weight. Respect opinions of class mates.

Lesson Title: Characteristics of mass **Lesson No.49**

Benchmarks: 6.2.4.4 Explain the characteristics of weight and mass.

Key question: What are the characteristics of mass?

Lesson objective: By the end of the lesson, the students should be able to;

- identify the characteristics of mass.

Knowledge	Skills	Attitudes
Mass is a measure of the amount of matter in an object. Mass is usually measured in grams (g) or kilograms (kg). Mass measures the quantity of matter regardless of both its location in the universe and the gravitational force applied to it. An object's mass is constant in all circumstances; contrast this with its weight, a force that depends on gravity.	Making predictions on the characteristics of mass. Infer on the characteristics of mass. Communicate ideas and findings on the characteristics of mass using verbal and written.	Accept and appreciate characteristics of mass.
Topic review on earth' s gravity		**Lesson 51**
Unit review on force and motion		**Lesson 52**

Strand 1: Life	Unit 4: Interaction and Relationship in the Environment	Topic: Paths of Energy in Food Chain and Food Web
Content standard: 6.1.4 The students will be able to examine the paths of energy and the relationship of organisms in the food chain and food web.		

Lesson Title: Food Chains in Different Environments 1: Land **Lesson No. 53**

Benchmark: 6.1.4.1 Use basic research skills to investigate the food chains in different environments such as land and ocean, and draw appropriate conclusions.

Key question: How can you describe the food chain in the land environment?

Lesson objective: By the end of the lesson, the students should be able to;

- describe a simple food chain for different land environments.

Knowledge	Skills	Attitudes
There are many different places on Earth where organisms can live. Every living species has its own favourite habitat, which it shares with other living creatures. **For Example** In a tree habitat, bugs feed on the leaves of the tree. Small birds build their nests on the branches and feed on the small bugs. And a snake who lives in a hole on the branch of the tree feeds on the small birds as they sleep in the night.	Make predictions on food chains in different land environments. Infer about food chains in different land environments. Construct simple food chain in different land environment. Communicate ideas and findings on food chains of different land environments using verbal, written and pictorial.	Value the fact that animals, plants and all living things are adapted to their way of life in their natural surroundings and take care not to destroy natural surroundings unnecessarily.

Lesson Title: Roles of organisms in a food chain **Lesson No. 55**

Benchmark: 6.1.4.2. Investigate the relationship between the organisms in the food chain such as prey and predator.

Key question: What the roles of prey and predator in a food chain?

Lesson objective: By the end of the lesson, the students should be able to;

- describe the roles of prey and predator in a food chain.

Knowledge	Skills	Attitudes
A predator is an animal that hunts and eats other animals, and the prey is the animal that gets eaten by the predator. In the food chain for example: the frog is a predator and the grasshopper is its prey. The hawk is a predator and the frog is its prey.	Make predictions on the roles of prey and predator in a food chain. Infer about the roles prey and predator in a food chain. Communicate ideas and findings on roles of organisms in a food chain using verbal, written and pictorial.	Value the roles that all living organisms play in the environment.

Lesson Title: Food web in different environment 3: Land **Lesson No. 56**

Benchmark: 6.1.4.3. Analyse food webs in different environments such as land and ocean.

Key question: How can you describe the food webs found in different natural environment on land?

Lesson objective: By the end of the lesson, the students should be able to;

- draw food webs to illustrate the feeding connection among species of different natural environment on land.

Knowledge	Skills	Attitudes
The food web is a illustration of various methods of feeding that links the ecosystem. The food web also defines the energy flow through species of a community as a result of their feeding relationships. All the food chains are interconnected and overlapping within an ecosystem and they make up a food web. There are different food webs in the natural environment on land, such as; • grass land food web, • rainforest food web and, • desert food web.	Make predictions on how to describe food webs of different natural environment on land. Infer on the food webs of different natural environment on land. Draw food webs to illustrate the feeding connection among species of different natural environment on land. Communicate ideas and findings on food webs of different natural environment of land using verbal, written and pictorial.	Develop curiosity to learn more about the food webs of different natural environment on land.

Lesson Title: Food web in different environment 4: Ocean **Lesson No. 57**

Benchmark: 6.1.4.3. Analyse food webs in different environments such as land and ocean.

Key question: How can you describe the food webs found in ocean environment?

Lesson objective: By the end of the lesson, the students should be able to;

- draw food webs to illustrate the feeding connection among species of ocean environment.

Knowledge	Skills	Attitudes
A food web diagram illustrates 'what eats what' in a particular habitat. Pictures represent the organisms that make up the food web, and their feeding relationships are typically shown with arrows. The arrows represent the transfer of energy and always point from the organism being eaten to the one that is doing the eating. Marine food webs include all animals living in the sea, from phytoplankton, bacteria and small shrimp-like animals in the water, to animals living on the sea bed like sponges and corals, to fish, squid, whales, seals and seabirds.	Make predictions on how food webs in the ocean environment can be described. Infer on the food webs in the ocean environment. Draw food webs to illustrate the feeding connection among species of ocean environment. Communicate ideas and findings on food webs in the ocean environment using verbal, written and pictorial.	Develop curiosity to learn more about the food webs of ocean environment.

Lesson Title: Roles of organisms in food web **Lesson No. 58**

Benchmark: 6.1.4.4. Examine the relationship between the organisms in the food web such as producers and consumers.

Key question: What are the roles of producers and consumers in a food web?

Lesson objective: By the end of the lesson, the students should be able to;

- describe the roles of producers and consumers in a food web.

Knowledge	Skills	Attitudes
Food Web Basics: Producers are plants and other organisms that carry out photosynthesis, using the sun as food energy. Consumers include plant-eating herbivores, meat-eating carnivores, and organisms that eat both, called omnivores.	Make predictions on the roles of producers and consumers in a food chain. Infer about the roles of producers and consumers in a food chain. Communicate ideas and findings on roles of producers and consumers in a food chain using verbal, written and pictorial.	Show curiosity to learn more about producers and consumers in the food web.

Lesson title: Population Size in Food Chain **Lesson No. 59**

Benchmark: 6.1.4.5 Assess the impact of population change in food chain or food web.
Key question: What are some factors that affect the population size in a food chain?

Lesson objective: By the end of the lesson, the students should be able to;

- identify factors that affect the population size in a food web.

Knowledge	Skills	Attitudes
A population is a group of animals of the same species living in an area. Food chains and food webs describe feeding relationships. The population of species in a food chain is shown using a pyramid of numbers. Organisms in an ecosystem affect each other's population. There are six factors that can affect the population size: 1. food available 2. number coming in 3. number dying 4. number moving elsewhere 5. competition 6. number born If the birth rate increases the population size will increase. If the death rate increases due to an increase in predators the population size will decrease. If competition increases the population will decrease. Competition occurs when another species that eats the same food (or occupies the same space) comes into an area. The other two factors are less common. They arise if animals move from one area to another, usually in migration.	Making predictions on factors that can affect the population size in a food chain. Infer about factors that affect population size in a food chain. Analysing effects of the factors that affect the population size. Communicate ideas and findings on factors affecting population size using verbal, written and pictorial.	Show caring attitude towards the environment. Show concern towards factors that can affect the population size in food chain.

Lesson title: Causes and effects of changes in population **Lesson No. 60**

Benchmark: 6.1.4.5 Assess the impact of population change in food chain or food web.

Key question: What happens when there is a change in the population of the same kind of organisms in a feeding level?

Lesson objective: By the end of the lesson, the students should be able to;

- identify the effects of population change of the same kind of organisms in a feeding level.

Knowledge	Skills	Attitudes
Organisms in an environment are divided into trophic levels or groups based on how they get their energy. Within each feeding level, there are different populations or a group of organisms of the same species or kind living in the same place at the same time. Although the population of the different kinds of organisms in each feeding level may seem separate, everything in an organism's environment is interlinked in a food web. When all the populations are in balance, then an organism environment is also balanced. However, altering just one population can have damaging effects on the rest of the environment and disrupt balance.	Make predictions on what happens to the feeding when there is a change in population of the same kind of organisms a feeding level is affected. Infer and make hypothesis about the effects of population change of the same kind of organisms in a feeding level. Analyse the effect of altering just one population can have on the rest of the environment and disrupt the balance. Communicate ideas and findings on the effects of population change of the same organisms using verbal, written and pictorial.	Value the importance of food chains and food webs in the environment and take care of the environment.

Lesson Title: Functions of Decomposers in a food chain and food web **Lesson No. 61**

Benchmark: 6.1.4.6. Probe the roles of decomposers and the recycle of energy in a food chain.

Key question: What happens to plants and animals when they die and decay?

Lesson objective: By the end of the lesson, the students should be able to;

- describe the roles of decomposers in a food web.

Knowledge	Skills	Attitudes
Decomposers are organisms that help in the decomposition of dead or dying organism. They break down dead plants and animals. They also break down animal wastes. Fungi, such as mushrooms and moulds, and bacteria are decomposers. They turn dead material and waste into nutrients that go back into the soil. Plants take up the nutrients with their roots. They use the nutrients to make more food.	Make predictions on what happens to plants and animals when they die and decay. Infer about the roles of decomposers in the environment. Compare roles decomposers such as fungi and bacteria. Communicate ideas and findings on the roles of decomposers using verbal, written and pictorial.	Value the importance of having decomposers in the environment as their role is important for the cycle of life. Show curiosity to study more about decomposers.

Topic review on paths of energy in food chain and food web **Lesson 62**

Unit review on interaction and relationship in the environment **Lesson 63**

STRAND 3: Earth and Space	UNIT 1: Our Earth	TOPIC: Formation and change of land
CONTENT STANDARD: 6.3.1. Students will be able to investigate the formation of soil layers, sedimentary rocks and the causes of land change.		

Lesson Title: Formation of soil layers **Lesson No. 64**

Benchmark: 6.3.1.1. Examine the formation of soil layers.

Key question: How is soil layers formed?

Lesson objective: By the end of the lesson, the students should be able to;

- describe the formation of soil layers.

Knowledge	Skills	Attitudes
Soil is made up of distinct horizontal layers; these layers are called horizons. • **Topsoil:** The top layer of soil is called topsoil. • **Subsoil:** The bottom layer of soil, called subsoil, contains little humus. • **Bedrock:** The solid rock that lies below the lowest layer of soil is bedrock.	Make predictions on how soil layers are formed. Observing the different layers of soil layers. Infer about the formation of soil layers. Communicate ideas and findings on the formation of soil layers using verbal, written and pictorial.	Show curiosity to learn about the formation of soil layers.

Lesson Title: Formation of rocks: Sedimentary Rocks **Lesson No. 66**

Benchmark: 6.3.1.3. Investigate the formation of sedimentary rocks.

Key question: How are Sedimentary rocks formed?

Lesson objective: By the end of the lesson, the students should be able to;

- describe the how sedimentary rocks are formed.

Knowledge	Skills	Attitudes
Sedimentary – sedimentary rock forms from layers of sediment that are deposited, usually on the bottom of rivers, lakes, and oceans. The layers become pressed together, and they hardened to form rock. You can often see layers of different colors in sedimentary rocks.	Making predictions on how sedimentary rocks are formed. Infer about the formation of sedimentary rocks. Communicate ideas and findings on the formation of sedimentary rocks using verbal, written and pictorial.	Show curiosity on how sedimentary rocks are formed.

Lesson Title: Erosion **Lesson No. 67**

Benchmark: 6.3.1.4. Analyse the natural causes of land change such as soil erosion, weathering, volcanoes, and earth quakes.

Key question: How does erosion change the land?

Lesson objective: By the end of the lesson, the students should be able to;

- describe how erosion can change the land.

Knowledge	Skills	Attitudes
Earth surface features are worn down by destructive forces such as erosion. The carrying away of sediments by moving water, wind, or moving ice is called erosion.	Making predictions on how erosion can change the land based on prior knowledge. Infer on how erosion can change the land. Conduct experiment to show how erosion can cause the land to change. Communicate ideas and findings on the effect of erosion on land using verbal, written and pictorial.	Show curiosity on how erosion can change the land.

Lesson Title: Weathering **Lesson No. 68**

Benchmark: 6.3.1.4. Analyse the natural causes of land change such as soil erosion, weathering, volcanoes, and earth quakes.

Key question: How does weathering change the land?

Lesson objective: By the end of the lesson, the students should be able to;

- describe how weathering can change the land.

Knowledge	Skills	Attitudes
Weathering is the process that breaks down rock into smaller pieces called sediments. There are two types of weathering; mechanical and chemical. Mechanical weathering is the breaking of large rocks into smaller pieces called sediments. Water is the main factor that causes chemical weathering.	Making predictions on how weathering can change the land based on prior knowledge. Infer on how weathering can cause the land to change. Communicate ideas and findings on the effects of weathering on land using verbal, written and pictorial.	Show curiosity on how weathering can change the land.

Lesson Title: Volcanoes and Earthquakes **Lesson No. 69**

Benchmark: 6.3.1.4. Analyse the natural causes of land change such as soil erosion, weathering, volcanoes, and earth quakes.

Key question: How does volcanoes and earthquake change the land?

Lesson objective: By the end of the lesson, the students should be able to;

- describe how volcanoes and earthquakes can change the land.

Knowledge	Skills	Attitudes
A volcano is an opening in the Earth's crust where hot liquid rock from deep within the Earth, called magma, erupts to the surface. A large volcano eruption can destroy an entire forest. Movement of tectonic plates can form large mountain ranges.	Make predictions on how volcanoes and earthquakes can change the land. Infer about how volcanoes and earthquakes can cause the land to change. Communicate ideas and findings on the effects of earthquakes and volcanoes on land using verbal, written and pictorial.	Develop curiosity on how volcano and earthquake can cause land to change.

Lesson Title: Natural disasters **Lesson No. 70**

Benchmark: 6.3.1.4. Analyse the natural causes of land change such as soil erosion, weathering, volcanoes, and earth quakes.

Key question: How do natural disasters change the land?

Lesson objective: By the end of the lesson, the students should be able to;

- explain how natural disasters change the land.

Knowledge	Skills	Attitudes
Natural disasters such as flash flooding, tsunami and landslides can cause drastic environmental changes to the land and if severe enough, even mass extinctions of species of animals.	Make predictions on how natural disasters can change the land. Infer about how volcanoes and earthquakes can cause the land to change. Communicate ideas and findings on the effect natural disasters using verbal, written and pictorial.	Develop curiosity on how natural disasters can cause change to the land.
Topic review on the change of land		**Lesson 71**
Unit review on our earth		**Lesson 72**

Strand 2: Physical Science	Unit 3: Matter	Topic: Mixtures And Solutions
Content standard: 6.2.5 Students will be able to investigate the properties of mixtures and solutions.		

Lesson Title: What are solutions? **Lesson No. 73**

Benchmark: 6.2.5.1 Describe what solutions are.

Key question: What are solutions?

Lesson objective: By the end of the lesson, the students should be able;

- describe what solutions are.

Knowledge	Skills	Attitudes
Solutions can be : solid - liquid (Sugar and water) gas - liquid (Carbon dioxide in Soda gas - gas (Air) liquid- liquid (Gasoline) Liquid –Solid (Dental Filing Solid-solid (Metal alloys)	Making predictions on what solutions are. Infer on what solutions are. Communicate ideas and findings on solutions using verbal, written and pictorial.	Appreciate the use of mixtures and solutions in our daily living. Value the importance of having mixtures and solutions in our daily lives.

Lesson Title: Solubility 1: Volume of water **Lesson No. 74**

Benchmark: 6.2.5.2 Explain the conditions that affect the solubility of substances such as temperature, amount of water, and amount of solute.

Key question: How much can salt be dissolved in water?

Lesson objective: By the end of the lesson, the students should be able to;

- know that solutions have limited amounts to dissolve solids.

Knowledge	Skills	Attitudes
There is a limit to the amount of solid that can be dissolved in a volume of water. When the limit is reached the solid is no longer dissolves and the remains are visible.	Making hypothesis on how much salt can be dissolved in water. Observe and record the maximum amount of a solute to be dissolved in a given volume of water. Infer on how much salt can be dissolved in water. Evaluate the changes that occur when the limit is reached. Communicate ideas and findings on amount of salt that can be dissolved in a volume of water using verbal, written and pictorial.	Show curiosity to evaluate the changes that may occur when the limit of dissolving a substance is reached. Respect views of others.

Lesson Title: Solubility 2: Temperature of water **Lesson No. 75**

Benchmark: 6.2.5.2 Explain the conditions that affect the solubility of substances such as temperature, amount of water, and amount of solute.

Key question: How does temperature affect the rate of dissolving a substance?

Lesson objective: By the end of the lesson, the students should be able to;

- know that temperature plays an important role in the dissolution of substances.

Knowledge	Skills	Attitudes
Solute (solids) dissolve in solvents (liquids) in solutions in different amounts of given times, which is called rate of dissolving. The rate of dissolving can be affected by temperature. Temperature not only affects how quickly we can dissolve a solute but also how much solute can be dissolved.	Making hypothesis on how temperature affects the rate of dissolving a solute. Infer on the effect of heat on the rate of dissolution of a substance. Analyse the effect of heat on the rate of dissolution of a substance. Conduct experiment to find out if the temperature can affect the rate of dissolving a solute. Communicate ideas and findings on rate of dissolving affected by temperature using verbal, written and graphs.	Appreciate the fact that when heat is added to a solvent, it dissolves more solid materials.

Lesson Title: Solubility 3: Particle size **Lesson No. 76**

Benchmark: 6.2.5.2 Explain the conditions that affect the solubility of substances such as temperature, amount of water, and amount of solute.

Key question: How does particle size affects the rate of dissolving a substance?

Lesson objective: By the end of the lesson, the students should be able to;

- know that particle size affects the dissolution of substances.

Knowledge	Skills	Attitudes
Solute (solids) dissolve in solvents (liquids) in solutions in different amounts of given times, which is called rate of dissolving. The rate of dissolving can be affected by the particle size. When considering surface area, smaller salt crystals will dissolve faster than larger salt crystals.	Making hypothesis on how particle size affects the rate of dissolving a substance. Infer on the effect of particle size on the rate of dissolution of a substance. Conduct experiment to find out if the smaller salt crystal will dissolve faster or the large salt crystals. Communicate ideas and findings on rate of dissolving affected by particle size of salt using verbal, written and pictorial.	Show curiosity to learn more about how particle size can affect the dissolution of substances.

TOPIC REVIEW ON PROPERTICES OF SOLUTIONS **LESSON 78**

Note: ***This review lesson is to revise some of lessons that have been covered under this topic before term 3 ends. The rest of the lessons under this topic will be covered in the beginning of term 4.***

Lesson Title: Saturated solutions **Lesson No.79**

Benchmark: 6.2.5.4 Determine that there is a limit to the amount of solute that can be dissolved in a solvent to form a saturated and unsaturated solution.

Key question: How are saturated solutions formed?

Lesson objective: By the end of the lesson, the students should be able to;

- make saturated solutions using common substances.

Knowledge	Skills	Attitudes
Saturated solution is a solution with solute that dissolves until it is unable to dissolve anymore, leaving the undissolved substances at the bottom. A saturated solution contains the maximum amount of dissolved solute. - Changes with the temperature - Units: (g)solute/100g water - Additional solute will not dissolve	Making hypothesis on how saturated solutions are formed. Infer on how to form saturated solutions. Investigate the saturated solution by doing experiment using the salt (solute) and water (solvent). Communicate ideas and findings on forming a saturated solution using verbal, written and pictorial.	Accept and appreciate that saturated solutions occur in our daily lives.

Lesson Title: Unsaturated solutions **Lesson No.80**

Benchmarks: 6.2.5.4 Determine that there is a limit to the amount of solute that can be dissolved in a solvent to form a saturated and unsaturated solution.

Key question: How are unsaturated solutions formed?

Lesson objective: By the end of the lesson, the students should be able to;

- make unsaturated solutions using the common substances.

Knowledge	Skills	Attitudes
Unsaturated solution is a solution (with less solute than the saturated solution) that completely dissolves, leaving no more substances. A solution that contains less than the maximum amount of solute is unsaturated.	Making hypothesis on how unsaturated solutions are formed. Infer on how to form unsaturated solutions. Investigate the unsaturated solution by doing experiment using the salt (solute) and water (solvent). Communicate ideas and findings on forming a saturated solution using verbal, written and pictorial.	Accept and appreciate that unsaturated solutions occur in our daily lives.

Lesson Title: Components of different types of mixtures **Lesson No. 81**

Benchmark: 6.2.5.5 Examine the components of different types of mixtures.

Key question: What are the components of different types of mixtures?

Lesson objectives: By the end of the lesson, the students should be able to;

- classify mixtures into heterogeneous and homogeneous mixtures.
- identify characteristics of heterogeneous and homogeneous mixtures.

Knowledge	Skills	Attitudes
Components of different types of mixtures: solid and solid, solid and liquid, liquid and gas, gas and gas Mixtures can be heterogeneous or homogeneous. A mixture is said to be heterogeneous if at least two of its parts are visible to the naked eye even after shaking. (sand and water) A mixture is said to be homogeneous if everything is evenly spread out and thoroughly and are not visible to the naked eye. (sugar and water)	Making predictions on the component of different types of mixtures. Use known substances to make heterogeneous or homogeneous mixtures. Classify mixtures into heterogeneous and homogeneous mixtures. Communicate ideas and findings on the components of different types of mixtures using verbal, written and pictorial.	Appreciate the use of mixtures and solutions in our daily living. Value the importance of having mixtures and solutions in our daily lives.

Lesson Title: Solutions and Suspensions **Lesson No.82**

Benchmarks: 6.2.5.6 Compare and contrast the difference between solutions and suspensions.

Key question: What is the difference between solutions and suspensions?

Lesson objective: By the end of the lesson, the students should be able to;

- identify the difference between solutions and suspensions.

Knowledge	Skills	Attitudes
Solution: - homogenous - when left to stand, solute does not separate from solvent. - When filtered, no residue is left on the filter paper. **Suspension:** - Heterogeneous - When left to stand, the insoluble particles are left as residue on the filter paper.	Making prediction on the difference between soltutions and suspensions. Infer on the difference between solutions and suspensions. Compare the difference between solutions and suspensions. Communicated ideas and findings on the difference between solutions and suspensions using verbal and written.	Accept and appreciate that solutions and suspensions use daily.

Lesson Title: Separation of water solution 1: Filtering **Lesson No. 83**

Benchmark: 6.2.5.7 Apply different methods of separating mixtures such as filtering and evaporating.

Key question: How can you separate sand from the mixture?

Lesson objective: By the end of the lesson, the students should be able to;

- separate mixtures using the filtration process.

Knowledge	Skills	Attitudes
Mixtures can be separated based on the properties of the components such as particle size. Filtration is a method of separating an insoluble solid from a liquid. Liquid particles are small enough to pass through the filter. Solid particles are too large to pass through the filter and stay behind as a residue.	Making hypothesis on how to separate sand from the mixture. Use the filtering technique to separate soil from soil mixture. Infer about separating mixtures using filtering process. Communicate ideas and findings on separating mixtures by filtering process using verbal, written and pictorial.	Appreciate the use of filtering process in daily life.

Lesson Title: Separation water solution 2: Evaporation **Lesson No. 84**

Benchmark: 6.2.5.7 Apply different methods of separating mixtures such as filtering and evaporating.

Key question: How can you separate salt from the salt solution?

Lesson objective: By the end of the lesson, the students should be able to;

- separate solutions using the evaporation process.

Knowledge	Skills	Attitudes
Evaporation is a process in which liquid changes into gases form on heating. This allows the liquid to evaporate, leaving the soluble solid behind. **For example:** Heating salt water. The water evaporates and the salt crystals are left behind.	Making hypothesis on how to separate salt from salt solution. Use evaporation technique to separate salt from salt solution. Infer on how to separate salt from salt solution. Communicate ideas and findings on separating salt solutions by evaporation process using verbal, written and pictorial.	Value the use of evaporation process in daily life.
Topic review on mixtures and solutions		**Lesson 85**
Unit review on matter		**Lesson 86**

Strand 3: Earth and Space	Unit 3: Space	Topic: Moon 1
CONTENT STANDARD: 6.3.2. Students will be able to explain the motion of the moon and the different moon phases.		

Lesson Title: Movement of the Moon around the Earth **Lesson No.87**

Benchmark: 6.3.2.1. Explain that moon orbits around the Earth.

Key question: Does the Earth move around the moon or the moon moves around the Earth?

Lesson objective: By the end of the lesson, the students should be able to;

- identify and model the movement of the moon around the Earth.

Knowledge	Skills	Attitudes
The moon orbits the Earth about 12.8 degrees a day. The moon rotates on its own axis as it orbits the Earth. The Moon takes 27 days to complete one revolution around the Earth. Only one side of the moon always faces the Earth even though the Moon rotates. The sun lights different parts of the moon at different times.	Model the moon rotating and revolving the Earth. Differentiate between rotation and revolving. Calculate/estimate the number of days it takes to complete one revolution around the Earth.	Appreciate the importance of the moon revolving and rotating around the earth. Value and respect their classmates view point.

Lesson Title: Lunar and Solar eclipse **Lesson No.89**

Benchmark: 6.3.2.3. Discuss the positional relationship between Moon, Earth, and the Sun.

Key question: What causes lunar eclipse and solar eclipse to occur?

Lesson objective: By the end of the lesson, the students should be able to;

- demonstrate the causes lunar eclipse and solar eclipse using the models of the Earth, Moon and the Sun.

Knowledge	Skills	Attitudes
A solar eclipse occurs when the Moon passes in front of the Sun causing a shadow to fall on certain portions of the Earth. The eclipse is not seen from every place on Earth, but only from the locations where the shadow falls. From these locations it appears as if the Sun has gone dark. A lunar eclipse occurs when the Moon passes through the Earth's shadow. Lunar eclipses can be seen by a much larger area of the Earth than the solar eclipses. They also can be viewed without special equipment to protect the eyes. Lunar eclipses are not totally dark.	Make predictions on what causes solar eclipse and lunar eclipse to occur. Infer on the causes of solar eclipse and lunar eclipse. Compare the difference between solar eclipse and lunar eclipse. Use models of the Earth, Moon and the Sun to demonstrate the solar eclipse and lunar eclipse. Communicate ideas and findings on the causes of solar eclipse and lunar eclipse using verbal, written and pictorial.	Develop curiosity to know more about lunar eclipse and solar eclipse. Show open-mindedness when learning about lunar eclipse and solar eclipse. Show creativity by suggesting ways to demonstrate lunar and solar eclipse. Respect views of others.

Lesson Title: Moon and Tides **Lesson No.90**

Benchmark: 6.3.2.4. Investigate the effects of the positional relationship between the Moon and the Earth.

Key question: How does high and low tides occur?

Lesson objective: By the end of the lesson, the students should be able to;

- describe the causes of tides in relation to positional relationship between the Sun, Moon and the Earth.

Knowledge	Skills	Attitudes
The highest tides occur during the full moons and new moons, when the sun and moon are aligned and their gravitational forces pull together on Earth's oceans. The effect is slightly stronger when the moon reaches its perigee, the closest point Earth in its elliptical orbit. The sun's gravity also pulls on Earth's waters. The sun, moon, and Earth are nearly in a line during a new moon. The gravity of the sun and the moon pull in the same direction. Their combined forces produce a tide with the greatest difference between consecutive low and high tides, called a spring tide. During the moon's first-quarter and third-quarter phases, the line between Earth and the sun is at right angles to the line between Earth and the moon. The sun's pull is at right angles to the moon's pull. This arrangement produces a neap tide, a tide with the least difference between consecutive low and high tides. Neap tides occur twice a month.	Make predictions on how high tides and low tides occur. Infer on the causes on high tides and low tides in relation to the positional relationship between the Sun, Moon and the Earth. Compare and contrast spring tides and neap tides. Communicate ideas and findings on the causes of tides in relation to positional relationship between the Sun, Moon and the Earth using verbal, written and pictorial.	Develop curiosity to know more about spring tide and neap tides. Show open-mindedness when learning about causes of tides in relation to the positional relationship between the Sun, Moon and the Earth. Respect views of others.

Topic review on the Moon Lesson 91

Lesson Title: What are stars? **Lesson No. 92**

Benchmark: 6.3.3.1. Describe the properties of stars.

Key question: What are stars made of?

Lesson objective: By the end of the lesson, students should be able to;

- describe what stars are made of.

Knowledge	Skills	Attitudes
A star is a hot ball of gases. The Sun is the closest star to Earth. Stars give off light, heat and other forms of energy. Stars appear to be in different colors of blue, white, yellow, orange and red. This depends on how hot they are.	Make predictions on what are stars are made of. Infer on stars by colour through experience. Communicate ideas and findings on stars using verbal, written and pictorial.	Develop curiosity to know more about the stars in the universe. Show open-mindedness when learning about the stars. Respect views of others.

Lesson Title: Observing stars: Movement of stars **Lesson No. 93**

Benchmark: 6.3.3.2. Investigate the movement of stars in relation to the Earth's rotation.

Key question: How do stars appear to move in the night sky?

Lesson objective: By the end of the lesson, students should be able to;

- describe the movement of stars in relation to the Earth's rotation.

Knowledge	Skills	Attitudes
At night, the stars also seem to move across the sky. Like the Sun, the stars do not actually move. The stars appear to move because Earth rotates. As Earth rotates on its axis, the part of the sky you see changes. But the shape of each constellation does not change. The stars in each constellation stay in their fixed places in the pattern. They night sky also looks different throughout the year.	Make predictions on how stars appear to move in the night sky. Infer about the movement of stars in relation to the Earth's rotation. Compare the movement of the stars and the Sun. Communicate ideas and findings on the movement of stars using verbal, written and pictorial.	Develop curiosity to know more about the movement of stars in the night sky. Show open-mindedness when learning about the movement of stars. Respect views of others.

Lesson Title: Constellation in PNG **Lesson No. 94**

Benchmark: 6.3.3.3. Examine the different types of constellation seen in the night sky of Papua New Guinea.

Key question: What are some groups of stars can you see in the night?

Lesson objective: By the end of the lesson, the students will be able to;

- identify groups of stars in the night sky that form a patterns known as a constellation.

Knowledge	Skills	Attitudes
Constellations are groups of stars that can be seen from earth. The Southern Cross is a famous constellation in the southern hemisphere can also be seen in PNG night sky. The largest constellation is Hydra (Sea Serpent), which contains at least 68 stars.	Making predictions on groups of stars that can be seen in the night. Observing patterns of the constellations. Infer on the groups of stars that can be seen at night. Draw the patterns of a constellation. Communicate ideas and findings on the constellations seen at night using verbal, written and pictorial.	Develop a curiosity to know more about the constellations and also why PNG flag have stars on it. Show open-mindedness when learning about the stars. Respect views of others.

Lesson Title: Traditional knowledge of the night sky **Lesson No. 95**

Benchmark: 6.3.3.4. Investigate the use of traditional knowledge of the night sky.

Key question: How did our people in the past use the night sky?

Lesson objective: By the end of the lesson, the students should be able to;

- describe the how people in the past use the night sky.

Knowledge	Skills	Attitudes
Many people in Papua New Guinea use the sky or night sky as a clock, calendar and compass. People use movement of the heavenly bodies for navigation, farming and hunting.	Make predictions on how people in the past use the night sky. Infer on the uses of the night sky by people in the past. Communicate ideas and findings on the uses of the night sky by people in the past using verbal, written and pictorial.	Develop a curiosity to know more about the uses of night sky by the people in the past. Show open-mindedness when learning about the traditional knowledge of the night sky. Respect views of others.
Topic review on the stars		**Lesson 96**
Unit review on the earth and space		**Lesson 97**

Assessment, Recording and Reporting

Assessment and reporting is an integral part of the delivery of any curriculum used in the schools. In Standard Based Curriculum (SBC) assessment encourages the use of benchmarks and commended types of assessment that promote standards for a range of purposes.

Standards Based Assessment

What does standards based assessment looks like?

- It is based on the academic achievement of the student;
- Establishes clear guidelines for proficiency (rubrics)
- Compares each student's performance to preset standards, not to the performance of other students.

Assessment

Assessment is the process of identifying, gathering and interpreting information about students' learning. It is purposely done to provide information on student's achievement and progress. It directs teachers in ongoing teaching and learning.

Effective and meaningful assessment must be maintained at all times. The content standards stated in the expected curriculum for this grade are prescribed by units and sets the basis for planning and conducting on-going assessment.

Ongoing classroom assessment is done to:

- support student learning
- monitor student learning
- diagnose student learning needs
- evaluate teaching program and
- inform student reporting process

Teachers are encouraged to use two or more types of assessment when assessing students learning. SBC specifically promotes three types of assessment. These are assessment;

- *for* learning
- *as* learning and
- *of* learning

Types of Assessment Strategies and Methods

Teachers are encouraged to use two or more types of assessment when assessing students learning. SBC specifically promotes three types of assessment. These are assessment;

- *for* learning
- *as* learning and
- *of* learning

Assessment *for* Learning

Assessment for learning is assessment which takes place during the course of teaching. It is an on-going assessment and asks the question 'where are you in the learning of this unit?'. It is used mainly to inform teachers on how much and how well teaching and learning program has been delivered and received. It is also known as formative assessment.

This assessment type helps teachers to identify students' strength and weakness areas in the content learned. For example: In a week's teaching of the unit,' Animals' the assessment task on how different animals reproduce their young revealed that most students lack knowledge of how reptiles and birds reproduce their young. This evidence will assist teachers to plan effective remedial and re-teaching lessons to improve weakness area/s identified in students immediately.

Assessment *as* and *in* Learning

Assessment as learning means that children are involved in assessing their own work and the work of other children in the class. For example, If a teachers learning objective is to use adjectives to make a sentences more interesting a child will read out a sentence and the other will assess it. They might have to say which words are adjectives and whether they think they make the sentence interesting

Assessment *of* learning

Summative assessment is assessment that takes place at the end of a unit of study, a term, year or a program. It is used to provide information on student achievements and effectiveness of the content engaged in. This type of assessment asks the question; 'What did you learn?' For example: The class teacher may want to evaluate his or her teaching in term 1 on animal reproduction, so asks the students,' what did you learn about animal reproduction in term1? The teacher can then use the students' responses to plan for revisit and revision on particular content areas in preparation for the new content to be learned.

Teachers need to apply processes for assessment. Recording and reporting enables them to determine which content standards and benchmarks students have achieved and to report these achievements to parents in ways that make sense to them. The students' knowledge and skills are continually developing in a healthy classroom environment. It is important for teachers to be aware of and record, what the students know and what they can do. When teachers have this information, programming can be made purposeful. It can be directed at the learning weakness and matches the student's needs.

Assessment Strategies

Assessment strategies are used to conduct or deliver the assessment tasks planned for the students. There are many options available for teachers to choose from. The few listed below are recommended for all the teachers to use to assess students. These include:

- Observations
- Portfolios
- Tests and
- Self and peer assessment

1. Observation

To observe is to look and listen carefully to a student or students to make an assessment of and about what they know, understand and can do. The teachers while listening and looking can ask questions and look at or observe how the student/s can work as a group or an individual to complete a task. The teacher should do this to gather information about students:

- Ability to work alone or in a group
- Understanding of the content of the learning task
- Way of thinking how
- Leadership behavior and
- Interaction with each other

This strategy is very suitable for peer assessing. Students can be tasked to observe a friend and later report what they saw.

2. Portfolios - Studying Work Samples

The teacher thinks about and examines work samples from students. Work samples can be written tasks on paper, small chalkboards or slates, worksheets, drawing or models. Studying work samples helps the teachers to assess;

- the students level of knowledge and understanding of the learning taking place
- students thinking skills and their ability to present their own ideas and be creative
- how much time and effort the students used to do the assigned tasks the skills the students used to produce the work and if the work meets the result of the content standard.

3. Test

Test is an assessment strategy used to assess student performances of their learning formatively or summative. Class teachers prepare these tests with careful considerations of;

- the knowledge and skills to assess the students on
- the language level to be used
- the construction of questions – clear and precise
- the content of the intended part of the curriculum content
- how much each question is worth and
- how to award marks the questions.

4. Self and Peer Assessment

In peer assessment organized structure is partner work. Each student performs a skill and the other acts as the observer. They change places when they complete their task. The observer records the partner's performance on an agreed checklist or recording journal. The recoding of each other's performance is recorded and reported against an agreed set of criteria.

Assessment Tasks

It is important to plan assessment for the whole year using the content overview and the yearly or term plans. Assessment tasks form the basis of the assessment processes, of assessing each learner in relation to the content standards.

Assessment tasks are learning activities created from the benchmarks. These are written and specifically designed and planned before administering. This particular activity has key knowledge, skills, attitudes and values that must be achieved at the end of performing the assessable tasks.

Assessment Plan

To plan assessment tasks, teachers must decide which type of assessment methods will be used to demonstrate the achievement of the content standard. Content standards are the starting points in the process of identifying and planning assessment tasks.

Learning activities and assessment tasks must be planned before delivery. In the process of writing and planning an assessment task, the following are some points that you may consider;

- choose assessment methods suitable for the assessment task
- develop assessment criteria by breaking down the knowledge, skills, attitudes and values that the students will need to demonstrate to complete the activity successfully
- consulting Bloom's Taxonomy as per the students cognitive levels

Teachers are the best assessors of the students and must ensure that all assessment tasks are;

- clearly stated in language students can interpret
- link to the content standards
- balanced, comprehensive, reliable and fair
- engages the learner.

Best practice in Assessment

- clear understanding that the purpose of assessment is for students to develop and improve in their learning and for teachers to plan and teach effectively
- the use of diagnostic tools to determine what the students already know, understand and can do
- ongoing assessment through a variety of differentiated tasks and strategies, both formal and informal, so that sufficient evidence is gathered to make sound judgments about individual students' learning
- students being actively involved in, and having some control over, their learning
- learning goals that are explicit in that students know what they are learning, why the learning is important, what products are expected, and how they will be assessed
- assessment tasks that are differentiated through offering quality choices of ways for students to demonstrate knowledge, understanding and skills
- assessment tasks and strategies that are fair and enable all students to demonstrate their learning achievements
- the giving of specific and timely feedback, for example, through conversations between students and the teacher, written feedback, peer assessment and self-assessment
- students' work being discussed and moderated through shared concepts and language
- assessment tasks that are integrated/embedded in instruction so that they are a planned and essential part of teaching and learning
- authentic assessment tasks that align with the ways such knowledge and skills

Assessment Tasks Overview

It is important to plan assessment for the whole year using the content overview and the yearly or term plans for the school year. Assessment tasks form the basis of the assessment process, of assessing the achievements of each individual learner in relation to the content standards.

The assessment tasks are written from the listed benchmarks stated for each content standard. This particular activity must have key knowledge skills attitudes and values that must be assessed. Teachers are the best assessors of the students and must ensure the all assessment tasks are:

- clearly stated in language students can interpret
- link to the benchmarks and content standards
- balanced, comprehensive, reliable and fair and
- engages the learner.

According to the suggested Grade 6 content overview and yearly plan, a suggested yearly assessment plan for assessment tasks has been planned and placed according to the number of teaching weeks in the school year. You are given the flexibility to formulate your own assessment tasks if you are not comfortable with the suggested specific assessment tasks.

Yearly plan of suggested assessment tasks for Grade 6

Strand	Unit	Topic	Content Standard	Benchmark	Assessment Task
Strand 1: **Life**	**Unit 1:** Plants	Reproduction and Hereditary in plants	**6.1.1**	**6.1.1.1.** Describe the processes in sexual reproduction of flowering plants such as pollination, fertilization and seed dispersals.	Explain the difference between pollination and fertilization process of reproduction in flowering plants.
				6.1.1.2. Describe the reproduction process of non-flowering plants using the life cycle of a fern.	Draw a life cycle of fern and label the different stages with short description.
				6.1.1.3. Identify the hereditary characteristics in plants.	Identify the similarities and differences in plants according to their heredity characteristics.

Strand 2: **Physical Science**	**Unit 1:** Energy	Energy forms	**6.2.1**	**6.2.1.2.** Examine the different sources of energy	List the different sources of energy and explain why they are called
				6.2.1.4 Discuss how energy changes from one form to another.	Construct a simple electric circuit and explain the transfer of energy.
		Electromagnet	**6.2.2**	**6.2.2.2.** Determine that the polarity of the electromagnet changes when direction of the electric current changes.	Construct a simple electromagnet and explain how the electromagnet's strength changes when direction of the electric current changes.
				6.2.2.3. Investigate conditions that strengthen the magnetism of an electromagnet.	Construct a simple electromagnet and explain how the electromagnet's strength changes depending on the number of wire coils.
Strand 1: **Life**	**Unit 1:** Plants	Pathway of water in plants	**6.1.2**	**6.1.2.1.** Identify the parts of the transport system in plants and describe their functions.	Draw the parts of the transport system and state their functions.
				6.1.2.2. Discuss the transportation of water to all parts of the plant through the roots, stem and leaves.	Draw a plant and indicate the flow of how water and food is transported to all parts the plants using arrows with short descriptions.
				6.1.2.3. Investigate the process of transpiration in plants.	Examine the process of transpiration of a plant and write a scientific report explaining how transpiration occurs in plants.
	Unit 3: Human Body	Respiratory and Circulatory System	**6.1.3**	**6.1.3.2.** Identify the organs of the human respiratory system and examine their functions.	Explain the functions of the organs of the respiratory system in the human body.
				6.1.3.4. Examine the structure and function of the heart and blood vessels.	Outline the structure of the heart and the circulation of the blood.
Strand 2: **Physical Science**	**Unit 2:** Force and Motion	Earth's gravity and Force	**6.2.3**	**6.2.3.1** Investigate the different types of forces.	Demonstrate how frictional force can reduce speed.
				6.2.3.2 Distinguish types of forces as contact and non-contact forces.	Describe the difference between contact and non-contact forces.

Strand 1: **Life**	**Unit 4:** Interaction and relationship in the environment	Paths of energy in food chain and food web	**6.1.4**	**6.1.4.2** Investigate the relationship between the organisms in the food chain such as prey and predator.	Illustrate a simple food chain and explain the relationship of organisms in the food chain.
				6.1.4.4 Examine the relationship between the organisms in the food web such as producer and consumers.	Illustrate a simple food web and explain the relationship of organisms in the food web.
Strand 3: **Earth and Space**	**Unit 1:** Our Earth	Formation and change of land	**6.3.1**	**6.3.1.1** Examine the formation of soil layers.	Outline the process involved in the formation of soil layers.
				6.3.1.3 Investigate the formation of sedimentary rocks.	Outline the process involved in sedimentary rock formation using a flow chart.
				6.3.1.4 Analyze the natural causes of land changes such as soil erosion, weathering, volcanoes, and earthquakes.	Explain land changes caused by natural changes such as erosion, weathering, earthquake and volcano.
Strand 2: **Physical Science**	**Unit 3:** Matter	Mixture and Solutions	**6.2.5**	**6.2.5.1** Explain the conditions that affect the solubility of substances such as temperature, amount of water and amount of solute.	Experiment the three conditions; temperature, amount of water and amount of solute that affect the solubility of substances and write a report on the findings.
				6.2.5.4 Determine that there is a limit to the amount of solute that can be dissolved in a solvent to form a saturated and an unsaturated solution.	Conduct experiment on saturated solutions and unsaturated solutions and write a report on the findings based on the amount of solute that form the two solutions.
				6.2.5.7 Apply different methods of separating mixtures such as filtering and evaporating.	Separate mixture of salt and water by using filtering method to separate the mixture. Describe what happens during filtering based on the observations.

Strand 3: **Earth and Space**	**Unit 3:** Space	The Moon 1	**6.3.2**	**6.3.2.2** Examine the causes of the different types of Moon Phases.	Model the different moon phases and demonstrate how different phases of the moon are created using the projector or torch.
				6.3.2.3 Discuss the positional relationship between Moon, Earth and the Sun.	Demonstrate the positional relationship between Moon, Earth and the Sun using the models of the Moon, Earth and the Sun.
		Stars	**6.3.3**	**6.3.3.3** Examine the different types of constellation in the night sky of Papua New Guinea.	Observe and record the movement of stars for a period of 28 days and outline the pattern discovered from the observation.

Sample Assessment Plan

There are different ways to plan assessment tasks and teachers have used them in classrooms .These sample assessment tasks are given as examples for teachers to use and plan their own to suit the context and the learning needs of the grade six students in the classroom. The sample plans here are very explicit and directs the teacher to the content of learning given in the syllabus.

Teachers will need to;

- identify valid and reliable assessment tasks from the learning activities
- develop specific assessment criteria that describe exactly what a student must do to be successful in the assessment task
- make sure the students are aware of and understand the assessment criteria and
- give students feedback on their performances in each assessment task against the criteria.

Assessment Task Samples

Sample Assessment Task 1

Strand: Physical Science **Unit:** Energy **Topic:** Energy Forms

Lesson Title: Changes in energy form **Lesson No. 12**

Content Standards: 6.2.1. Students will be able to investigate the forms and conversion of energy.

Benchmark: 6.2.1.4. Discuss how energy changes from one form to another.

Assessment Type	Assessment Task	Assessment Criteria	Assessment Method	Recording & Reporting Method
Assignment	Set up a complete circuit and explain how energy is transferred from the dry cell to the light bulb.	Students will make a poster and present. The students will be assessed using the following criteria: • Constructing a simple circuit • Infer the transfer of energy • Attitude	Observation, checklist and rubrics	Students portfolio

Sample Assessment Rubrics

Proficiency or achievement levels of the benchmark
Sample scale for the assessment criteria used in Sample Assessment – Task 1

Proficiency levels					
Performance Criteria (quality)	**Level of Mastery (Scale)**				**Rating (score)**
	1. Limited Proficiency	**2. Some proficiency**	**3. Proficiency**	**4. Higher Proficiency**	**30 marks**
Constructing a simple circuit	Could not be able to construct a simple circuit 0-6	Can construct a simple circuit with assistance from the teacher 7-9	Construct a simple circuit without teacher's supervision 10-12	Construct a simple circuit using all the components 13-15	
Infer the transfer of energy	Could not be able to explain the conversion of energy 0-6	Can explain conversion of energy with assistance from the teacher 7-9	Explain clearly the conversion of energy in a complete simple circuit. 10-12	Explain distinctively how energy converts from the dry cell to the bulb. 13-15	
Other details	**0-2**	**3-5**	**6-8**	**9-10**	**10 marks**
Attitude	Often is publically critical of work and openly displays a negative attitude	Occasionally has a negative attitude about the assigned task	Usually has a positive attitude about the assigned task	Always has a positive attitude about the assigned task	
Total Score:					**40 marks**
Teacher's comment:					

Recording and Reporting Method

Sample recording strategy for the assessment task identified from the sample assessment task 1

Name	CRITERIA			TOTAL MARKS	PERCENTAGES
	Constructing a simple circuit	Infer transfer of energy	Attitude		
	15	**15**	**10**	**40**	**100%**
Joshua	10	8	5	23	57.5%
Gelma	12	10	5	27	67.5%
Peter	9	6	2	17	42.5%
Jennifer	15	10	7	32	80%
Emily	5	10	5	20	50%
Fredrick	8	12	9	29	72.5%

Sample Assessment Task 2

Strand: Physical Science **Unit:** Matter **Topic:** Mixtures and Solutions

Lesson Title: Comparing weight of water and water solutions **Lesson No. 77**

Content Standard: 6.2.5. Students will be able to investigate the properties of mixtures and solutions.

Benchmark: 6.2.5.3. Explain that the weight of water and the solute remains unchanged when the solute is dissolved in water.

Assessment Type	Assessment Task	Assessment Criteria	Assessment Method	Recording & Reporting Method
Practical Test	Find the mass of solute and water after the solute is dissolved.	Students will make a poster and present. The students will be assessed using the following criteria: Following the steps of the experiment (step by step) Using and reading the scale to take measurements Summarize the findings	Observation, checklist and rubrics	Students portfolio

Sample Assessment Rubrics

Proficiency or achievement levels of the benchmark.
Sample scale for the assessment criteria used in Sample Assessment – Task 2

Proficiency Levels					
Performance Criteria (quality)	**Level of Mastery (Scale)**				**Rating (score)**
	1. Limited Proficiency	**2. Some proficiency**	**3. Proficiency**	**4. Higher Proficiency**	**30 marks**
Following the steps of the experiment (step by step)	Could not be able to follow steps when conducting the experiment 0-2	Can follow the steps but with the assistance from the teacher 3-5	Follow steps without teacher's supervision 6-8	Following instructions step by step with confidence 9-10	
Using and reading the scale to take measurements	Could not be able to use and read the scale to take measurement	Can use the scale and reading the scale to take measurement but with the assistance from the teacher	Can use the scale and reading the scale to take measurements confidently without teacher's supervision	Can use the scale confidently and reading the scale to take measurement precisely	
Summarize the findings	Could summarize the findings	Can summarize the findings but with the assistance with from the teacher	Can summarize the findings with confidence and explain the procedure of the experiment and the results	Summarize the findings by explaining step by step how the experiment was conducted, the materials used, results (findings) and tell whether result has answered the question or not.	
Other details	**1-2**	**3-4**	**5-7**	**8-10**	**10 marks**
Attitude	Often is publically critical of work and openly displays a negative attitude	Occasionally has a negative attitude about the experiment	Usually has a positive attitude about the experiment	Always has a positive attitude about the experiment	
Total Score:					
Teacher's comments:					

Sample recording and Reporting Method

Sample recording strategy for the assessment task identified from the sample assessment task 2

Name	CRITERIA				TOTAL MARKS	PERCENTAGES
	Following the steps of the experiment (step by step)	Using and reading the scale to take measurements	Summarize the findings	Attitude		
	10	10	10	10	40	100%
Joshua	8	8	7	5	28	70%
Gelma	10	10	8	7	32	80%
Peter	6	6	8	4	24	60%
Jennifer	7	10	5	7	29	73%
Emily	9	5	4	5	23	56%
Fredrick	5	9	7	9	30	30%

Recording and Reporting

The recording and reporting of student achievements in the classroom is very important, as teachers use a range of tasks to ensure that commended standard statements are equally assessed and reported. This helps the teachers to reflect the effectiveness of their teachings.

Teachers should keep almost accurate records of how well the students have achieved the knowledge, skills, attitudes and values in the content standards or specifically in the benchmarks in grade six.

Strategies for recording
Teachers can record the evidence of students' demonstration of achieving the content standards, using assessment instruments that are manageable. The types of strategies teachers may want to use in recording student achievements must be easily interpreted to the expected audience. Here are some recording methods;

- Checklist
- Student portfolio
- Work sample

Students are given constructive feedback by the teacher on what they can do well and what they need to do to improve. Likewise, teachers are focused on the content they are assessing and are able to apply fair and consistent assessments.

Reporting
Reporting is important in assessment and must be done effectively. Teachers should report what students have done well and how they can improve further. Formal reporting through written reports and interviews are done to inform parents and guardians of the students' learning progress and other related areas such as behaviours. Teachers must ensure that the student has demonstrated and achieved the content standards independently on a number of occasions. These can be done formally or informally.

The achievements are reported to the respective stakeholders in relation to;

- Weaknesses
- Strengths
- Parent and guardian support and
- Evaluation of content learning.

Samples of recording and reporting templates

Keeping informed records of student performances on formal recording tools is very important both for the student, guardians, parents and teachers of the next grade level. Some recording tools are shown below as samples for teachers to use apart from those currently used in the classroom.

Sample Anecdotal Notes – Class Grid

- Record the dates of assessment tasks
- Write comments on the performance observed as per the criteria given.
- One box is for a student.
- This same grid can be used for a term depending on the type and number of assessment tasks prepared.

Individual sample recording strategy for all the assessment tasks in a term

Individual termly assessment record

Name: Joshua **Grade: 6** **Term: 1**

Assessment type	Total Score	Date	Student Score	%	Proficiency Level	Benchmark/CS	Evaluation/ Remarks
Assignment 1	20		10	50%	Satisfactory achievement	6.1.1.1. 6.1.1.2.	Needs improvement
Project	30		25	83.3%	High Achievement	6.1.1.3. 6.1.1.4.	Exceeds expectations
Assignment 2	20		15	75%	High Achievement	6.2.1.3 6.2.2.3	Meets expectations
Test	30		20	66.6%	Satisfactory achievement	6.1.1. 6.2.1. 6.2.2.	Meets expectations

Key

Proficiency Level	Low Achievement (LA)	Satisfactory Achievement (SA)	High Achievement (HA)	Very High Achievement (VHA)
% scale score range	<50%	50-69%	70-89%	90-100%
Criteria/Evaluation	Does not meet the benchmark(s)	Meets expectations of the benchmark(s)	Meets expectations of the benchmark(s)	Exceeds expectations of the benchmark(s)

Class Sample recording strategy for all the assessment tasks in a term

Termly Assessment Record – Class Overview							
Grade: 6			**Term: 1**		**Year: 2019**		
Name	**Assessment type**				**Total Score**	**%**	**Evaluation/ Remarks**
	Assignment 1	**Project**	**Assignment 2**	**Test**			
	20	**30**	**20**	**30**	**100**	**100%**	
	6.1.1.1. 6.1.1.2.	**6.1.1.3. 6.1.1.4.**	**6.2.1.3 6.2.2.3**	**6.1.1. 6.2.1. 6.2.2.**			
Joshua	10	25	15	20	70	70%	Meets expectations
Gelma	15	30	10	20	75	75%	Exceeds expectations
Peter	17	10	10	15	52	52%	Needs improvement
Jennifer	13	20	15	23	71	71%	Meets expectations
Emily	18	25	12	20	75	75%	Exceeds expectations
Fredrick	9	26	10	27	72	72%	Meets expectations

Resources

Teaching Science lessons require resources to help the students understand and meaningfully learn the main concepts and also practice the skills to explore and follow processes and instructions.

There are resources that teachers themselves can access in the surrounding environment and provide for the students and for themselves. Here are some suggested resources that students and teachers can access to plan and prepare science lessons.

Science Resource Books
Grade 6 Science TV Resource Books
Fundamental Science for Melanesia, Book 1
Fundamental Science for Melanesia, Book 2
Outcomes Edition for Papua New Guinea, Science Grade 6 Teacher Resource Book
Science Teacher's Manual - Grade 6
National Science Textbook - Grade 6

Glossary

These are the words that are used in the teaching and learning of content for Grade 6 science.

Words	Definitions
blood vessel	a tube through which the blood circulates in the body.
circulatory system	the system that carries oxygen and nutrients to all cells in the body and takes waste away from the cells; it consists of the heart, blood vessels and blood.
constellation	a group of stars that forms an unchanging pattern in the sky.
consumer	an organism that eats other organisms.
crescent moon	thin curved shape of the moon when only one part of its face is lit up, as seen from earth.
decomposers	organisms (such as some bacteria and fungi) that break down the bodies of dead organisms to simpler substances.
electromagnet	a temporary magnet made from a coil of wire wound round a piece of iron; the electromagnet works when electricity flows through the wire.
energy	the ability to make things happen or cause changes; light and sound are the two of the many forms of energy.
evaporate	to change state from liquid to gas; evaporation can be used to separate a solute from solvent.
fern	a type of plant that has a stem and reproduces by spores.
fertilization	the joining of male and female sex cells. e.g. sperm and egg
filtrate	the liquid obtained from filtration (from which the solid has been removed)
filtration	the process of separating suspended solid matter from a liquid, by causing the latter to pass through the pores of some substance, called a filter. the liquid which has passed through the filter is called the filtrate.
food chain	a diagram that shows a chain of organisms in which each organism is eaten by the next in the chain.
food web	a number of food chains together showing what all organisms in particular area eat.
force	any push or pull, measured in newtons (n); it may act by contact or at a distance.
friction	a force that exists when two things rub against each other; it slows down or prevents movement
full moon	the shape of the moon when its face is seen fully from earth.
gibbous moon	shape of the moon when about two-thirds of its face is lit up, as seen from earth.
gravity	the force of attraction between any two objects; e.g. between a person and the earth.
heredity	is the passing of traits from parents to offspring.
mass	the amount of matter in an object; it is measured in kilograms.
mixture	a combination of two or more pure substances in which each pure substance retains its individual chemical properties
new moon	the phase of the moon when its face is almost invisible from earth.
organisms	an animal or a plant; any living thing
phases of the moon	the different shapes of the sunlit face of the moon as seen from earth.

pollination	the movement of pollen from an anther to a stigma of a flower.
population	a group of animals of the same kind.
predator	an animal that catches and eats animal
prey	an animal that is eaten by a predator.
producer	an organism that makes its own food using the energy of sunlight.
saturated	describes a solution that contains the maximum amount of solute that will dissolve at that temperature.
solutions	a homogeneous mixture of two or more substances. a solution may exist in any phase. a solution consists of a solute and a solvent. ... for example, in a saline solution, salt is the solute dissolved in water as the solvent.
suspension	a mixture in which tiny bits of solid (or liquid) are evenly spread through a liquid (or gas), but are not dissolved; if allowed to stand, the suspended matter slowly settles out.
transpiration	the process through which water evaporates from a plant's leaves.
weathering	the breakdown of rocks by weather; in physical weathering the rocks are simply broken down into smaller pieces, while in a chemical weathering the minerals in the rocks are changed by chemical reactions.
weight	the force that is exerted on an object by gravity; it is measured in newtons.
xylem	the tubes or vessels that carry water from roots to the leaves.

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Appendices

The appendices section contains template of lesson plan, student worksheet, sample timetable and other useful information for teachers to choose from and use in the teaching, learning and assessing of students in the classroom.

Appendix 1: Science lesson template

Lesson Title:	Lesson No:
Strand:	Unit:
Topic:	Sub-topic:
Content standard:	
Benchmark:	
Key question:	
Lesson objective:	By the end of the lesson the students should be able to; •
Teaching period:	40 minutes (1 period)
Preparations:	
Key word(s):	

Knowledge	Skills	Attitudes

Lesson procedure

Time section	Teacher activity	Student activity	Points to notice
Intro **5 mins**	**Access prior knowledge** Question the students to bring about their ideas of prior knowledge and experience on the topic.	**Key question** 	Students will use their prior knowledge about ..... to link to today's lesson.
Body **35 mins**	**Making predictions** **Activity:** **Discussion questions on findings** Introduce the key words for the lesson.	**Making predictions** **Activity:** **Discussion questions on findings** **Key words**	**Concepts and Misconceptions** **Strategy:** Write the key words on the blackboard.
Conclusion **5 mins**	In our today's lesson, what did you discover or learn from this lesson?	**Summary:** • _____ _____ • _____ _____ • _____ _____	The students' conclusion should reflect the key concepts in the lesson.

Black Board Plan

Title: Key question: Activity:	Discussion Key word(s) 1. _____ 2. _____ 3. _____	Summary • _____ • _____ • _____

Challenge for students:

Appendix 2: Student worksheet template

Student Work Sheet

Lesson title: **Lesson No.**

Key question:

.....
.....
.....

Today's Objective (What am I going to learn today?)

.....
.....
.....
.....

Key word(s):

Summary: (What I have learned today)

Challenge:

Appendix 3: Sample timetable

This suggested timetable is flexible and teachers must teach according to the subjects scheduled per week and the number of lessons identified accordingly. You may make adjustments when equipment and materials are unavailable or swap theory and practical lessons where necessary.

<table>
<tr><th>Time</th><th>Monday</th><th>Tuesday</th><th>Wednesday</th><th>Thursday</th><th>Friday</th></tr>
<tr><td>8:00 – 8:15</td><td>Assembly</td><td>Assembly</td><td>Assembly</td><td>Assembly</td><td>Assembly</td></tr>
<tr><td>8:15 -8:40</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>9:20 – 10:00</td><td>English</td><td>Assembly</td><td>Assembly</td><td>Assembly</td><td>Assembly</td></tr>
<tr><td>10:00 – 10:30</td><td colspan="5">RECESS BREAK</td></tr>
<tr><td>10:30 – 11:10</td><td>Mathematics</td><td>Mathematics</td><td>Mathematics</td><td>Mathematics</td><td>Mathematics</td></tr>
<tr><td>11:10 – 11:50</td><td></td><td></td><td rowspan="2">Christian Religious Education</td><td></td><td>Science</td></tr>
<tr><td>11:50 – 12:30</td><td colspan="2">Science</td><td>Science</td><td>Arts</td></tr>
<tr><td>12:30 1:00</td><td colspan="5">LUNCH BREAK</td></tr>
<tr><td>1:00 – 1:40</td><td>Health /Physical Education</td><td>Health/ Physical Education</td><td>Health /Physical Education</td><td>Health /Physical Education</td><td>Social Science</td></tr>
<tr><td>1:40 – 2:20</td><td>Social Science</td><td>Social Science</td><td>Social Science</td><td rowspan="2">Making a Living</td><td rowspan="2"></td></tr>
<tr><td>2:20 – 3:00</td><td>Mathematics</td><td>Making a Living</td><td>Making a Living</td></tr>
<tr><td>3:00 – 4:06</td><td colspan="5">Teachers Planning and Preparation</td></tr>
</table>

Suggested Sample time break up - Analyses

Revised SBC (2018)	Total min/ week	%	(40/60) Slots/ week
English	280	16.9	7x40
Maths	240	14.5	6x40
Science	200	12.1	5x40
Social Science	160	9.7	4x40
Arts	140	8.5	2x40 and 1x60
PE/Health	180	8.5	3x40 and 1x60
Making a Living	160	9.7	2x40 and 1x80
Citizenship & Christian Values Education	120	6	3x40
Assembly	75	4.5	5x15
Access (Movement)	35		
Sports	60	3.6	1x60
Total time allocation	**1650**	**100**	**36 lesson/week - 36x35=1260 annually**

Appendix 4: Bloom's taxanomy (promoting thinking)

These action verbs will help you as the teacher to enhance students in their learning and as well promoting their thinking skills from low level to higher order level using the Blooms Taxanomy.

Definitions	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Bloom's definitions	Exhibit memory of previously learned material by recalling facts, terms, basic concepts and answers.	Demonstrate understanding of facts and ideas by organizing, comparing and translating, interpreting, giving descriptions, and stating main ideas.	Solve problems to new situations by applying acquired knowledge, facts, techniques and rules in a different way	Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations.	Present and defend opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria.	Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions.
Verbs	Choose Define Find How Label List Match Name Omit Recall Relate Select Show Spell Tell What When Where Which Who Why	Classify Compare Contrast Demonstrate Explain Extend Illustrate Infer Interpret Outline Relate Rephrase Show Summarize Translate	Apply Build Choose Construct Develop Experiment with Identify Interview Make use of Model Organize Plan Select Solve Utilize	Analyze Assume Categorize Classify Compare Conclusion Contrast Discover Dissect Distinguish Divide Examine Function Inference Inspect List Motive Relationships Simplify Survey Take part in Test for Theme	Agree Appraise Assess Award Choose Compare Conclude Criteria Criticize Decide Deduct Defend Determine Disprove Estimate Evaluate Explain Importance Influence Interpret Judge Justify Mark Measure Opinion Perceive Prioritize Prove Rate Recommend Rule on Select Support Value	Adapt Build Change Choose Combine Compile Compose Construct Create Delete Design Develop Discuss Elaborate Estimate Formulate Happen Imagine Improve Invent Make up Maximize Minimize Modify Original Originate Plan Predict Propose Solution Solve Suppose Test Theory

Appendix 5: Types of Knowledge, Skills, Attitudes and Values (KSAV)

Types of Knowledge

There are different types of knowledge. These include:

• Public and private (privileged) knowledge • Specialised knowledge • Good and bad knowledge • Concepts, processes, ideas, skills, values, attitudes • Theory and practice • Fiction and non-fiction • Traditional, modern, and postmodern knowledge	• Subject and discipline-based knowledge • Lived experiences • Evidence and assumptions • Ethics and Morals • Belief systems • Facts and opinions • Wisdom • Research evidence and findings • Solutions to problems

Types of Processes

There are different types of processes.
These include:

- Problem-solving
- Logical reasoning
- Decision-making
- Reflection
- Cyclic processes
- Mapping (e.g. concept mapping)
- Modeling
- Simulating

Types of Skills

There are different types of skills. These include:

Cognitive (Thinking) Skills

Thinking skills can be categorized into **critical thinking** and **creative thinking** skills.

Critical Thinking Skills

A person who thinks critically always evaluates an idea in a systematic manner before accepting or rejecting it. Critical thinking skills include:

- Attributing
- Comparing and contrasting
- Grouping and classifying
- Sequencing
- Prioritising
- Analysing
- Detecting bias
- Evaluating
- Metacognition (Thinking about thinking)
- Making informed conclusions.

Creative Thinking Skills

A person who thinks creatively has a high level of imagination, able to generate original and innovative ideas, and able to modify ideas and products. Creative thinking skills include:

- Generating ideas
- Deconstruction and reconstruction
- Relating
- Making inferences
- Predicting
- Making generalisations
- Visualizing
- Synthesising
- Making hypothesis
- Making analogies
- Invention
- Transformation
- Modeling
- Simulating

Reasoning Skills
Reason is a skill used in making a logical, just, and rational judgement.

Decision-Making Skills
Decision-making involves selection of the best solution from various alternatives based on specific criteria and evidence to achieve a specific aim.

Problem Solving Skills
Problem solving skills involve finding solutions to challenges or unfamiliar situations or unanticipated difficulties in a systematic manner.

High Level Thinking Skills
High level thinking skills include analysis, synthesis, and evaluation skills.

Analysis Skills
Analysis skills involve examining in detail and breaking down information into parts by identifying motives or causes, underlying assumptions, hidden messages; making inferences and finding evidence to support generalisations, claims, and conclusions.

Synthesis Skills
Synthesis skills involve changing or creating something new, compiling information together in a different way by combining elements in a new pattern proposing alternative solutions.

Evaluation Skills
Evaluation skills involve justifying and presenting and defending opinions by making judgements about information, validity of ideas or quality of work based on set criteria.

Types of Values

Personal Values **(Importance, worth, usefulness)** **Core Values** • Sanctity of life • Truth • Aesthetics • Honesty • Human • Dignity • Rationality • Creativity • Courage • Liberty • Affectivity • Individuality	Sustaining Values • Self-esteem • Self-reflection • Self-discipline • Self-cultivation • Principal morality • Self-determination • Openness • Independence • Simplicity • Integrity • Enterprise • Sensitivity • Modesty • Perseverance

Social Values Core Values	Sustaining Values
• Equality • Kindness • Benevolence • Love • Freedom • Common good • Mutuality • Justice • Trust • Interdependence • Sustainability • Betterment of human kind • Empowerment	• Plurality • Due process of law • Democracy • Freedom and liberty • Common will • Patriotism • Tolerance • Gender equity and social inclusion • Equal opportunities • Culture and civilisation • Heritage • Human rights and responsibilities • Rationality • Sense of belonging • Solidarity • Peace and harmony • Safe and peaceful communities

Types of Attitudes

Attitudes (Ways of thinking and behaving, points of view)	
• Optimistic • Participatory • Critical • Creative • Appreciative • Empathetic • Caring and concern • Positive • Confident • Cooperative	• Responsible • Adaptable to change • Open-minded • Diligent • With a desire to learn • With respect for self, life, equality and excellence, evidence, fair play, rule of law, different ways of life, beliefs and opinions, and the environment.

Appendix 6: STEAM and STEM Education

- By exposing students to STEAM and giving them opportunities to explore STEAM-related concepts, they will develop a passion for it and, hopefully, pursue a job in a STEAM field.
- Providing real life experiences and lessons, e.g., by involving students to actually solve a scientific, technological, engineering, or mathematical, or Arts problem, would probably spark their interest in a STEAM career path. This is the theory behind STEAM education.
- By integrating STEAM content and real life learning experiences at different levels of the curriculum process (e.g., Curriculum frameworks, content standards, benchmarks, syllabi, teachers' guides and students' books, curriculum design and development, annual and term school programs and lesson plans, teaching methodologies.
- Teaching methodologies – Problem and project-based learning, partnerships with external stakeholders e.g., high education institutions, private sector, research and development institutions, and volunteer and community development organizations.
- They underpin STEM education. They are the main enablers of STEM education.
- The **21st century skills** movement, which broadly calls on schools to create academic programs and learning experiences that equip students with the most essential and in-demand knowledge, skills, and dispositions they will need to be successful in higher-education programs and modern workplaces.
- The term **21st century skills** refers to a broad set of knowledge, skills, work habits, and character traits that are believed—by educators, school reformers, college professors, employers, and others—to be critically important to success in today's world, particularly in collegiate programs and contemporary careers and workplaces.
- Generally speaking, 21st century skills can be applied in all academic subject areas, and in all educational, career, and civic settings throughout a student's life.
- The skills students will learn will reflect the specific demands that will be placed upon them in a complex, competitive, knowledge-based, information-age, technology-driven economy and society.

Appendix 7: Additional information on rubric

The rubric communicates what the outcome really means because it specifies the criteria for assessing its mastery.

What are rubrics?
Rubrics provide the criteria for assessing students' work. They can be used to assess virtually any product or behavior, such as essays, research reports, portfolios, work of art, recitals, oral presentations, performances, and group activities. Judgments can be self-assessments by students; or judgments can be made by others, such as faculty, other students, fieldwork supervisors, and external reviewers.

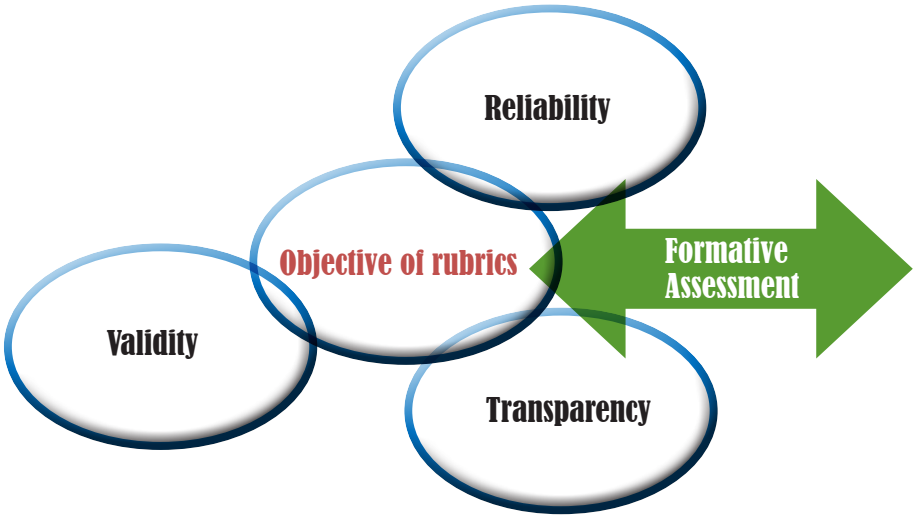
Rubrics can be used to clarify expectations to students, to provide formative feedback to students, to grade students, and/or to assess courses and programs.

Types of rubrics
There are two major types of rubrics:

1. Holistic rubric — one global, holistic score for a product or behavior
2. Analytic rubric — separate, holistic scoring of specified characteristics of a product or behavior.

Why use rubrics?

- A way to provide feedback
- Defines characteristics of high quality assignment
- Establishes a range of performance categories
- Helps students understand expectations
- Provides students with a way to evaluate their own performance (self-assessment, reflection)



Parts of a rubric

Criteria/Dimensions (Rows)
Elements that characterise good performance of task

Descriptors
Specify the meaning of each criterion, describe levels of performance

Levels of Mastery/Scales (Columns)

a. Numerical
   (For example; 1-5 or actual point's value)
b. Qualitative

For example;

- exemplary, acceptable, unacceptable
- distinguished, proficient, basic, unacceptable
- novice, apprentice, expert

Creating a rubric for your assessment

Step 1: Choose an assessment method i.e essay, lab-work, presentations, portfolios, etc.

Step 2: Identify 3 critical criteria you want to evaluate (rows)

Step 3: Identify a scale (levels of mastery/proficiency/expectations) of at least 3 levels (columns)

Step 4: For each of the criterion, describe skills/knowledge/behaviours that represent each level of quality.

Appendix 8: Good teaching practices for special needs students

Teachers are often asked to modify instruction to accommodate special needs students. In fact, all students will benefit from the following good teaching practices. The following article takes the mystery out of adapting materials and strategies for curriculum areas.

If the student has difficulty learning by listening, then try…	
Before the lesson	**During the lesson**
• Pre-teach difficult vocabulary and concepts • State the objective, providing a reason for listening • Teach the mental activities involved in listening — mental note-taking, questioning, reviewing • Provide study guides/worksheets • Provide script of film • Provide lecture outlines	• Provide visuals via the board or overhead • Use flash cards • Have the student close his eyes and try to visualize the information • Have the student take notes and use colored markers to highlight • Teach the use of acronyms to help visualize lists (Roy G. Biv for the colors of the spectrum: red, orange, yellow, green, blue, indigo, violet) • Give explanations in small, distinct steps • Provide written as well as oral directions • Have the student repeat directions • When giving directions to the class, leave a pause between each step so student can carry out the process in his mind • Shorten the listening time required • Provide written and manipulative tasks • Be concise with verbal information: “Jane, please sit.” instead of “Jane, would you please sit down in your chair.”

If the student has difficulty learning by listening, then try…

To accept an alternate form of information sharing, such as the following:

- Written report
- Artistic creation
- Exhibit or showcase
- Chart, graph, or table
- Photo essay
- Map
- Review of films
- Charade or pantomime
- Demonstration
- Taped report
- Ask questions requiring short answers
- Provide a prompt, such as beginning the sentence for the student or giving a picture cue
- Give the rules for class discussion (e.g., hand raising)
- Give points for oral contributions and preparing the student individually
- Teach the student to ask questions in class
- Specifically teach body and language expression
- Wait for students to respond — don't call on the first student to raise his hand
- First ask questions at the information level — giving facts and asking for facts back; then have the student break in gradually by speaking in smaller groups and then in larger groups

If the student has difficulty reading written material, then try…

- Find a text written at lower level
- Provide highlighted material
- Rewrite the student's text
- Tape the student's text
- Allow a peer or parent to read text aloud to student
- Shorten the amount of required reading
- Look for same content in another medium (movie, filmstrip, tape)
- Provide alternative methods for student to contribute to the group, such as role playing or dramatizing (oral reading should be optional)
- Allow extra time for reading
- Omit or shortening the reading required
- Substitute one-page summaries or study guides which identify key ideas and terms as the reading assignment
- Motivate the student, interesting him
- Provide questions before student reads a selection (include page and paragraph numbers)
- Put the main ideas of the text on index cards which can easily be organized in a file box and divided by chapters; pre-teaching vocabulary
- Type material for easier reading
- Use larger type
- Be more concrete-using pictures and manipulatives
- Reduce the amount of new ideas
- Provide experience before and after reading as a frame of reference for new concepts
- State the objective and relating it to previous experiences
- Help the student visualize what is read

If the student has difficulty writing legibly, then try…

- Use a format requiring little writing
- Multiple-choice
- Programmed material
- True/false
- Matching
- Use manipulatives such as letters from a Scrabble™ game or writing letters on small ceramic tiles
- Reduce or omit assignments requiring copying
- Encourage shared note-taking
- Allow the use of a tape recorder, a typewriter, or a computer
- Teach writing directly
- Trace letters or writing in clay
- Verbalize strokes on tape recorder
- Use a marker to space between words
- Tape the alphabet to student's desk
- Provide a wallet-size alphabet card
- Provide courses in graph analysis or calligraphy as a motivator
- Use graph paper to help space letters and numbers in math
- Use manuscript or lined ditto paper as a motivation technique (brainstorm the advantages of legibility with the class)

If the student has difficulty expressing himself in writing, then try…

- Accepting alternate forms of reports:
- Oral reports
- Tape-recorded report
- Tape of an interview
- Collage, cartoon, or other art
- Maps
- Diorama, 3-D materials, showcase exhibits
- Photographic essay
- Panel discussion
- Mock debate
- Review of films and presentation of an appropriate one to the class
- Have the student dictate work to someone else (an older student, aide, or friend) and then copy it himself
- Allow more time
- Shorten the written assignment (preparing an outline or summary)
- Provide a sample of what the finished paper should look like to help him organize the parts of the assignment
- Provide practice using:
- Story starters
- Open-ended stories
- Oral responses (try some oral spelling tests)

If the student has difficulty spelling, then try…

- Dictate the work and then asking the student to repeat it (saying it in sequence may eliminate
  errors of omitted syllables)
- Avoid traditional spelling lists (determine lists from social needs and school area needs)
- Use mnemonic devices (“A is the first capital letter,” “The capitol building has a dome”)
- Teach short, easy words in context:
- On and on
- Right on!
- On account of
- Have students make flashcards and highlight the difficult spots on the word
- Give a recognition level spelling test (asking the student to circle correct word from three or four choices)
- Teach words by spelling patterns (teach “cake,” “bake,” “take,” etc. in one lesson)
- Use the Language Master for drill
- Avoid penalizing for spelling errors
- Hang words from the ceiling during study time or posting them on the board or wall as constant visual cues
- Provide a tactile/kinesthetic aid for spelling (sandpaper letters to trace or a box filled with salt or cereal to write in)