Science

Teacher Guide

Grade 8

Standards Based

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.

This grade 8 Teacher Guide has been realigned, repositioned and replaced with standard 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 8.

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 8 teachers in Papua New Guinea, every success in their teaching of Science.

I commend and approve this Grade 8 Science Teacher Guide to be used in all Primary and Junior high Schools throughout Papua New Guinea.

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DR. UKE W. KOMBRA, PhD
Secretary for Education

Introduction

The Grade 8 Science Teacher Guide is developed as a support curriculum material for the Science syllabus for grade 6, 7 and 8 level. The information and guidelines provided in this book are translated from the content standards and benchmarks prescribed in the Grade 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 and
- resources and
- appendices

Purpose

The main purpose is to implement the grade 8 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 8 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 8 contents as prescribed in the Grade 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.

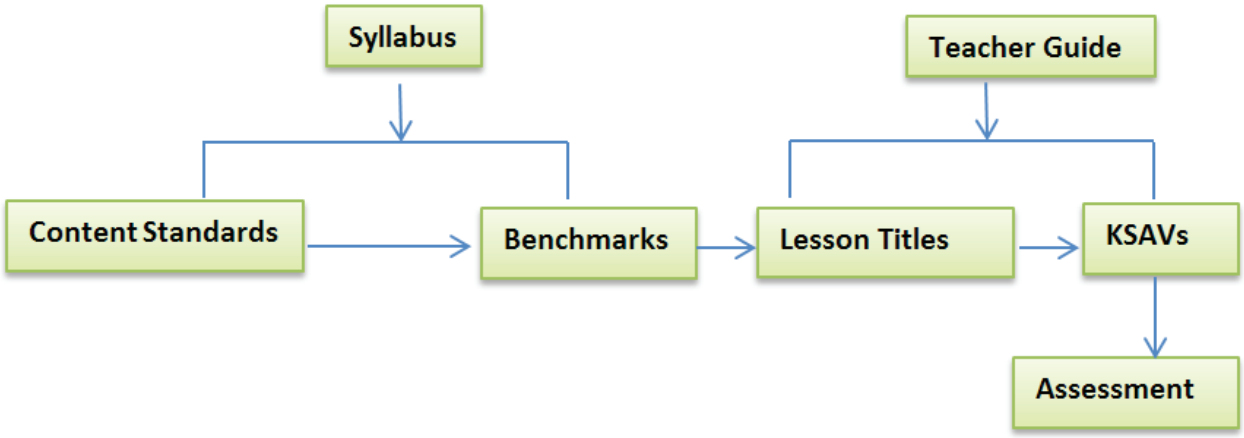


Figure 1.1: The organization chart above illustrates the link between the science syllabus and the teacher guide.

Key Features

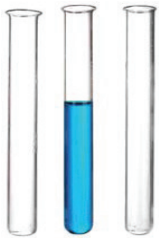
The key features outlined in this section are identified as unique to Science are important in the planning and teaching of Science. The key features of Grades 6, 7 and 8 Science Curriculum emphasizes recommended knowledge and skills and processes and provide ideas on how to teach practical science and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

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

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.

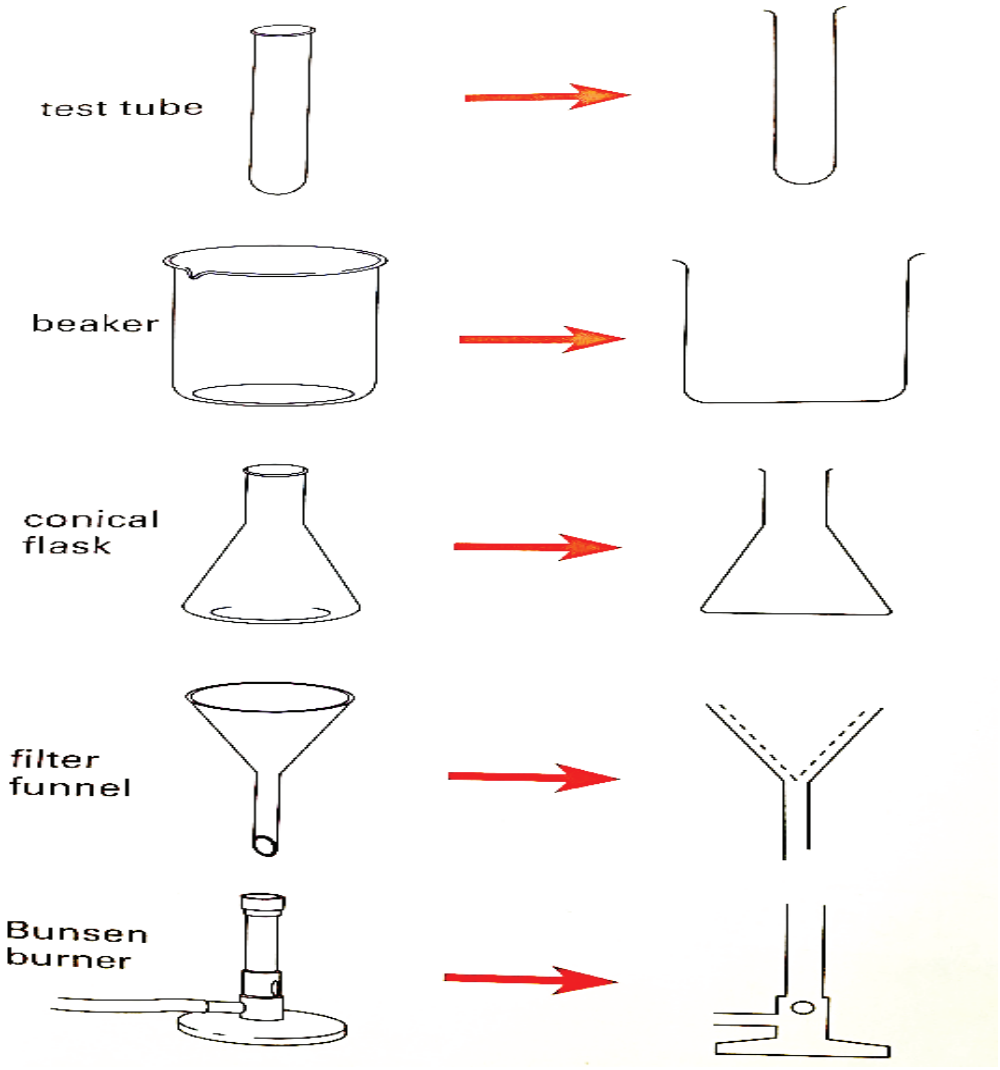
Besides these equipment, there are other like test tube brush, beehive shelf, cork borer, etc. that are used in a chemistry laboratory.

Test tube brush

Beehive shelf

Cork borer

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



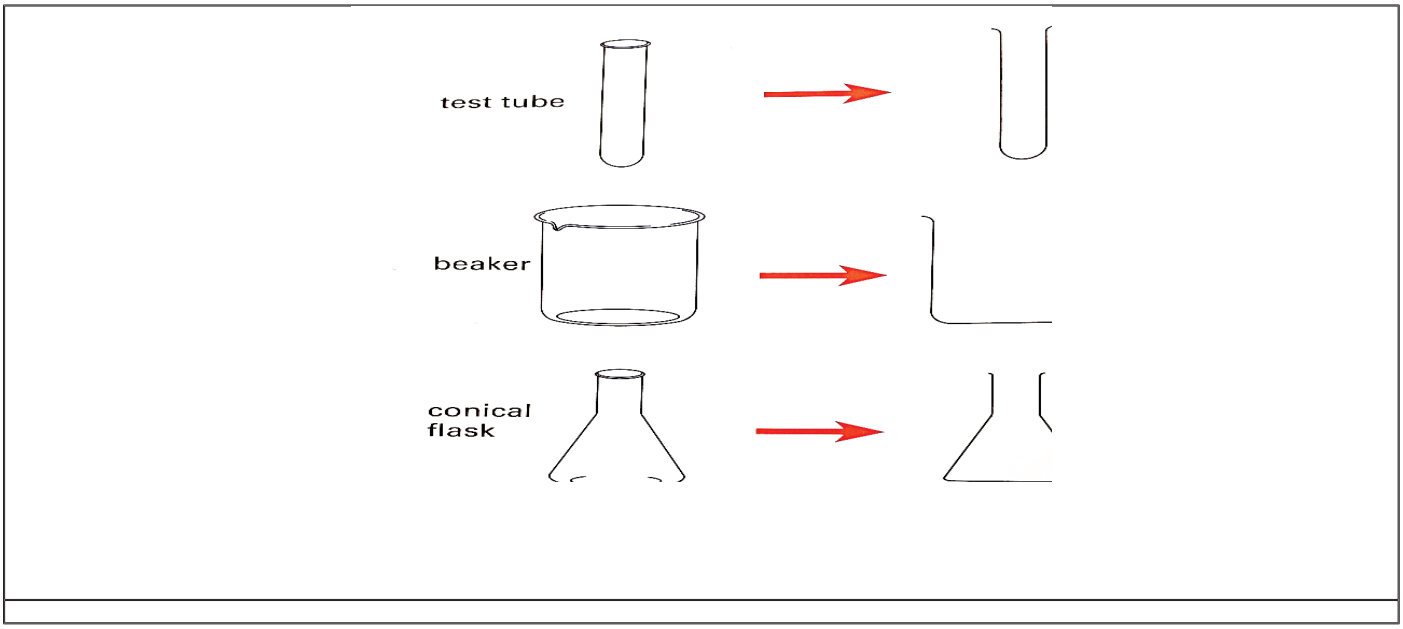
Drawing science equipment

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 three-dimensional and two-dimensional science equipment



1.2 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 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

1.3 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.

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.

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:
1. Students can usually make several different inferences from the same observation.
2. 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.
3. 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 30cm 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.

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

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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.

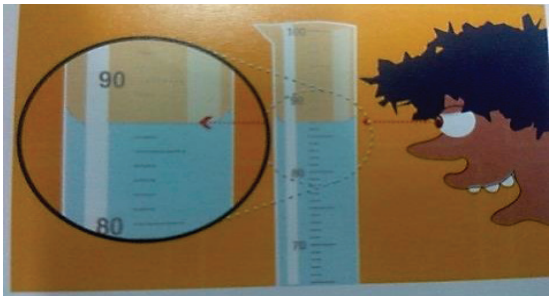
Parallax error

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.

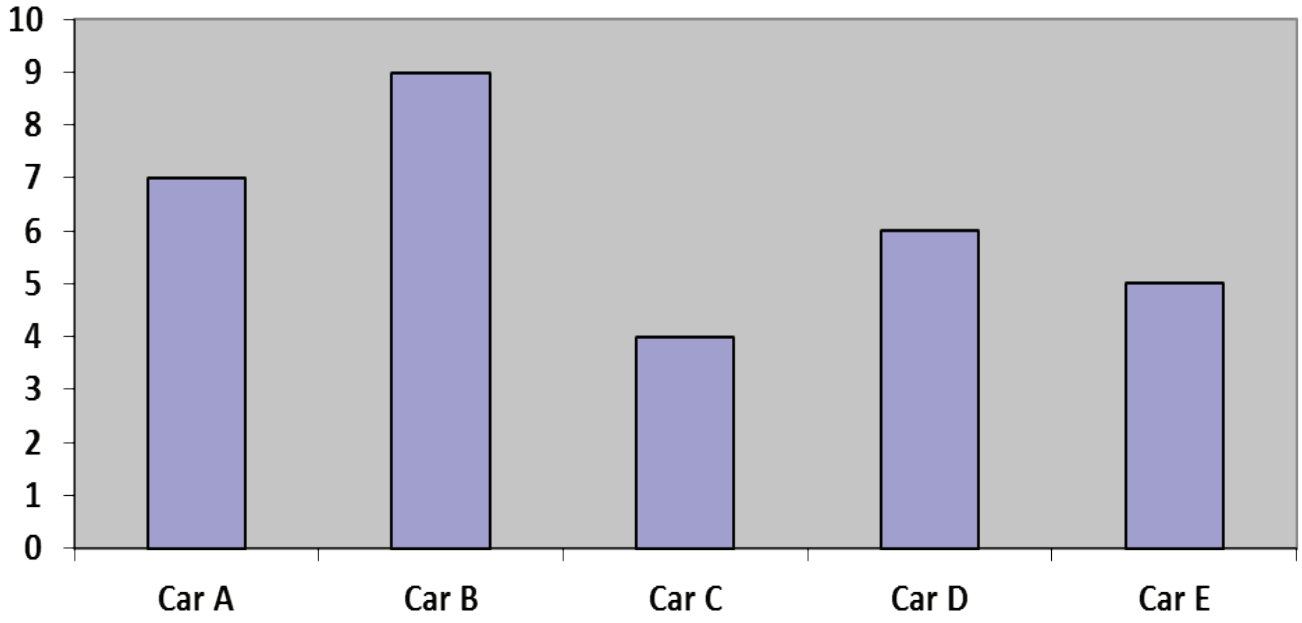
Bar graphs

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



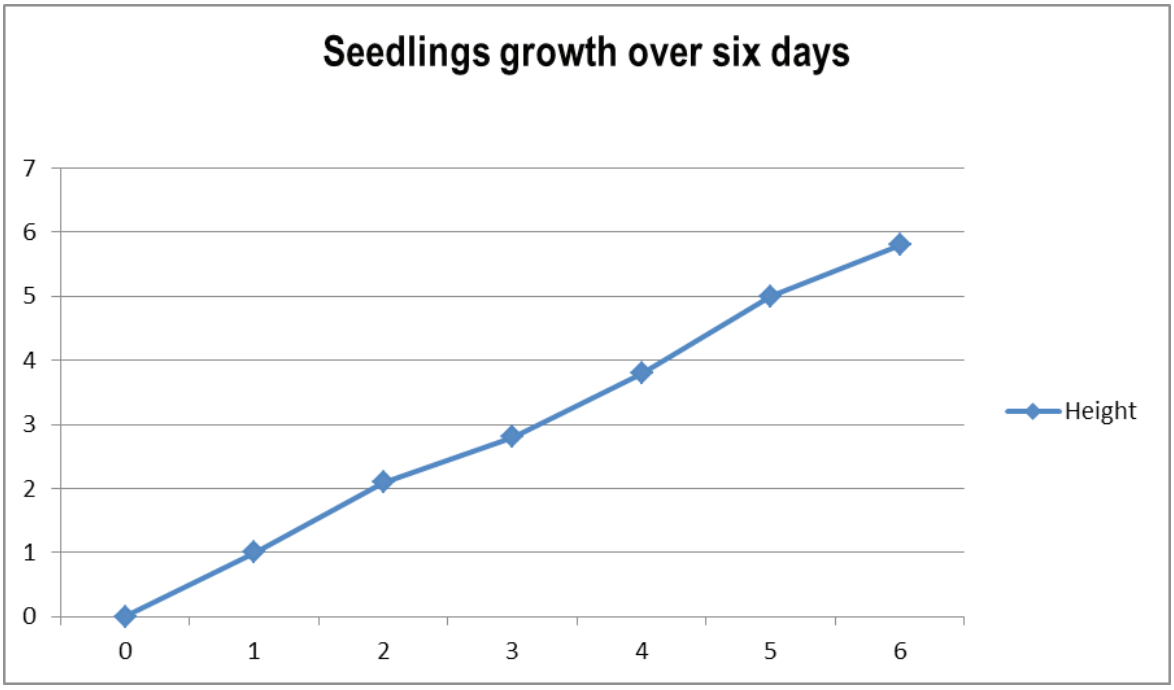
Line graphs

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, students cut an apple and leave it for few hours, the white flesh inside starts to turn brown. You 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?

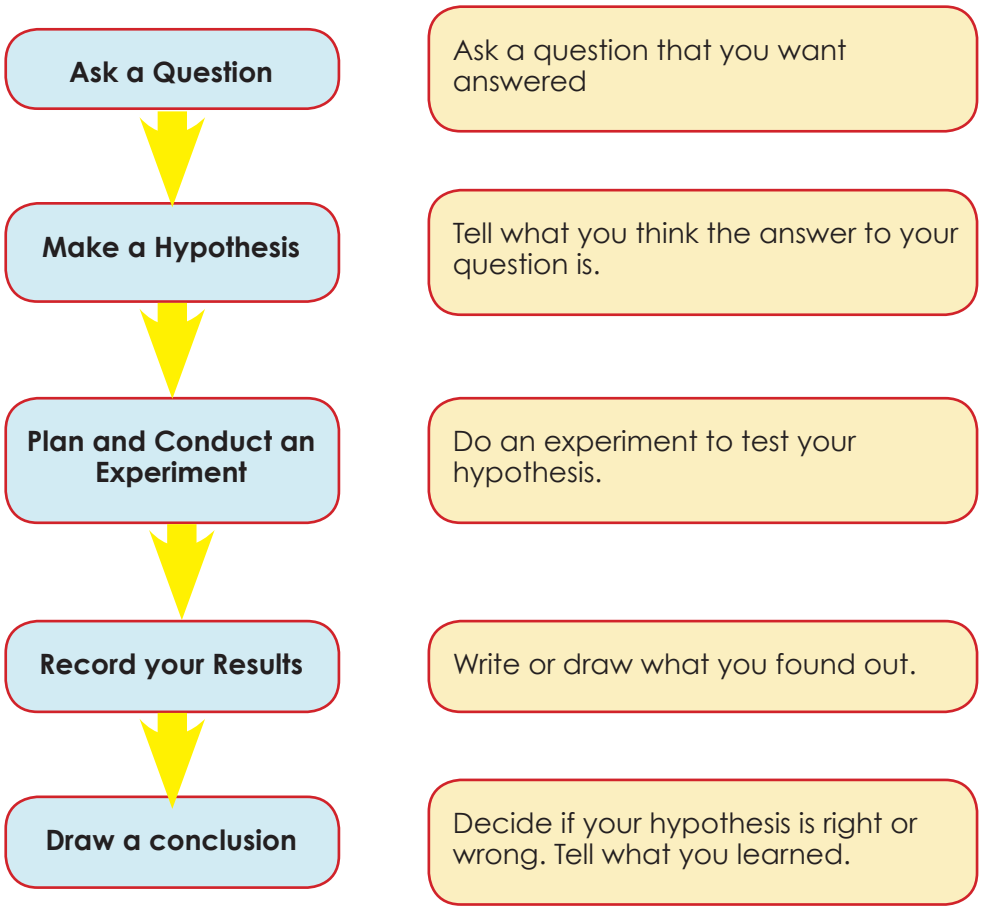
Social/ Affective strategies:
Students interact with other to assist learning, or use attitudes and feelings to help their learning.

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?

APPLYING LEARNING STRATEGIES TO SCIENCE

THE SCIENTIFIC METHOD

Science Problem-Solving Steps



5 Learning Cycle

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.

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

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

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

Elaborate

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

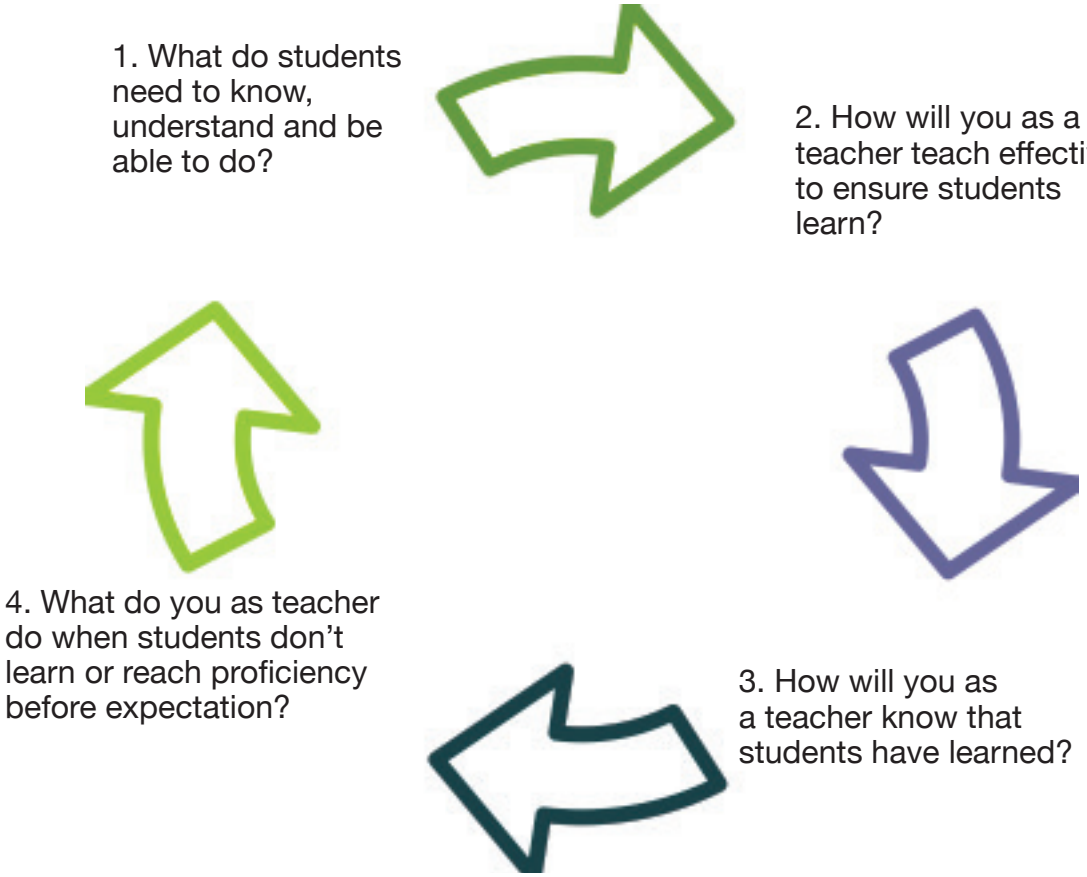
Teaching Methods should allow students to:

- 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; and
C. Student ownership of learning

A. ORGANISATION OF THE CLASSROOM
1. **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.
2. 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

3. 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.

4. **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.

5. 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.

6. 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.

7. 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.

8. 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.

9. 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.

10. 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.

11. 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.

12. 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).

13. 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.

14. 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
15. 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).
16. 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 and
- 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 grade 6, 7 and 8 level.

Content Overview

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

- Life
- Physical Science and
- 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 Senior Primary – Science for Grade 8

Grade	Grade 6		Grade 7		Grade 8	
Strand: Life Science						
Unit	**Topic**	**Sub-topic**	**Topic**	**Sub-topic**	**Topic**	**Sub-topic**
Plants	**Reproduction and heredity of plant**	• 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
Animals			**Groups of animals**	• Vertebrates and invertebrates • Classification of vertebrates	**Cells**	• Properties of cells • Animal cells
Human Body	**Respiratory System**	• Breathing	**Digestive System**	• Nutrients • Digestion		
	Circulatory System	• Circulation				
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

Strand : Physical Science						
Unit	**Topic**	**Sub-topic**	**Topic**	**Sub-topic**	**Topic**	**Sub-topic**
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		
Force and motion	**Earth's gravity**	• Weight • Gravity • Mass	**Pressure**	• Pressure	**Force and work**	• Work and Power
			Density	• Properties of density		
	Force	• Types of forces • Forces				
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
					State changes	• State change and Heat
			Atoms, molecules and compounds	• Atoms • Molecules • Compounds		

Strand : Earth and Space						
Unit	**Topic**	**Sub-topic**	**Topic**	**Sub-topic**	**Topic**	**Sub-topic**
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
					Rock Cycle	• How rocks form • How rocks change
			Natural Resources	• Natural resources		
Weather and climate			**Weather Change**	• Atmosphere • Cloud and Fog • Weather in Papua New Guinea	**Weather and Climate**	• Climate • Climate changes
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 8 students in primary schools. It is a plan developed from the content overview of learning given in the grade 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 & 2: Plants & Animals

Cells</td><td>Life

Unit 1: Plants

Gas exchange system</td><td rowspan="2">Physical Science

Unit 3: Matter

Chemical changes

State changes</td><td>Life

Unit 4: Interaction and relationship in the environment

Changes in the environment</td></tr>
<tr><td>3</td></tr>
<tr><td>4</td><td rowspan="2">Physical Science

Unit 2: Force and Motion

Force and Work</td><td rowspan="3">Earth and Space

Unit 3: Space

Exploring Space</td></tr>
<tr><td>5</td><td rowspan="5">Physical Science

Unit 1:Energy

Electric current and magnetic field</td><td rowspan="5">Earth and Space

Unit 2: Weather and Climate

Weather and Climate</td></tr>
<tr><td>6</td><td rowspan="4">Earth and Space

Unit 1: Our Earth

Volcano and Igneous rocks

Rock cycle</td></tr>
<tr><td>7</td></tr>
<tr><td>8</td><td rowspan="2">Assessment & Report Writing</td></tr>
<tr><td>9</td></tr>
<tr><td>10</td><td colspan="3">Testing and compiling of Assessment</td><td>Speech Day preparation</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	**Life**	Unit 1: Plants	Cells	What are cells?	
				Properties of cells	
				Structure of plant cell	
				Function of plant cell	
				Structure of animal cell	
				Function of animal cell	
				Similarities and differences in plant and animal cells	
				Topic Review	
4 5 6 8 9	Physical Science	Unit 1: Energy	Electric current and magnetic field	What are magnetic fields?	
				What are the properties of Magnetic fields?	
				What are magnetic forces and lines of Magnetic forces?	
				What is the relationship between Magnetic forces and lines of magnetic forces	
				How to express magnetic fields with magnetic force	
				What is the direction of Magnetic field around the electric current?	
				What is the relationship among the Direction of Force, the Direction of Magnetic Fields and the Direction of Electric Current?	
				What is Induction Current?	
				Mechanism of Electromagnetic Induction	
				How do we strengthen Induction Current?	
				Difference between Direct Current and Alternating Current	
				How are Electromagnets used in Motors?	
				How do Electromagnets generate Electricity?	
				Topic Review	
				Unit Review	
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	**Life**	Unit 1: Plants	Gas exchange in plants	What is Respiration?	
				Parts and Functions of Respiration?	
				Roles of Leaf Stomata in Respiration in Plants	
				Process of Respiration in Plants	
				What is Photosynthesis?	
				Parts and Functions of Photosynthesis	
				Process of Photosynthesis in Plants	
				System of gas exchange in plants	
				Topic Review	
				Unit Review	
4 5	**Physical Science**	Unit 2: Force and Motion	Force and Work	What is work in Physics	1
				What is the Relationship between Force, Work and Distance?	1
				Units of Force and Work	2
				Calculating Work	1
				What is Power in Physics?	1
				Units of Power	1
				Measuring Force with a spring balance	1
				Hooke's Law	
				Topic review	1
				Unit Review	1
6 7 8	**Earth and Space**	Unit 1: Our Earth	Volcano and Igneous Rocks	What is volcano?	1
				Types of volcano?	1
				Mechanism of Volcano?	1
				Types of Igneous rocks – Volcanic	1
				Types of Igneous rocks - Plutonic	1
				Characteristics of Igneous Rocks	2
				Classification of Igneous Rocks	1
				Formation of Igneous Rocks	
				Topic Review	1

			Rock cycle	Types of rocks	
				Characteristics of three types of rocks - Igneous	
				Characteristics of three types of rocks - Sedimentary	
				Characteristics of three types of rocks - Metamorphic	
				Definition of rock cycle	
				Process of rock cycle	
				Causes of rock cycle – weathering, heat and pressure	
				Topic review	
				Unit review	
Week 10: Testing and compiling of Assessment					

Term 3: Overview

Week	Strand	Unit	Topic	Lesson Title	Periods (40 Mins)
Week 1: Revision Work					
2	Physical Science	Unit 3: Matter	Chemical Changes	Types of Chemical Changes – Oxidation and reduction	1
				Types of Chemical Changes – Burning (combustion)	
3				Relationship between chemical changes and heat	1
4				Expressing chemical changes with models and symbols	
				Chemical changes and Energy	
5				Conservation of Mass	
				Regularity of Mass Changes	
				Topic Review	
6			State changes	Properties of Solid, Liquid and Gas in Volume	
				Effect of Heat on the Motion of Particles (atoms & molecules) in Solids	
				Effects of Heat on the Motion of Particles (atoms and molecules) in Liquid	
				Effects of Heat on the Motion of Particles (atoms and molecules) in Gas	
				Melting and Boling Point of Matter	
				Arrangement of Atoms and Molecules explaining the changes of States of Matter by using Particle Models	
				Process of Changes in States of Matter	
				Physical Changes and Energy	
				Topic Review	
				Unit Review	

7 **8** **9**	**Earth and Space**	Unit 3: Weather and Climate	Weather and Climate	Definition of Climate	1
				Factors of Climate	1
				Differences and Similarities between Weather and Climate	2
				Types of Climate	2
				Climate in Papua New Guinea	2
				Effects of Climate on the Earth	1
				Effects of Climates on Human Activities	1
				What is Climate Change?	2
				Types of Climate Changes	2
				Causes of Climate Changes	
				Effects of Climate Changes on the Earth	
				Protections of Climate Changes	
				Topic Review	
				Unit Review	
Week 10: Testing and compiling of Assessment					

Term 4: Overview

Week	Strand	Unit	Topic	Lesson Title	Periods (30 Mins)
				Week 1: Revision Work	
2	Life	Unit 4: Interaction and relationship in the environment	Changes in the Environment	What is an Environmental Change?	
				Causes of Environmental Changes	
3				Causes of Environment Changes – Natural Events	
				Causes of Environment Changes – Human Activities	
				Effects of Environment Changes on Environment – Species and Extinctions	
4				Effects of Environment Changes on Environment – Fossils	
5				Positive and Negative Effects of Environment Changes caused by Human Activities	
				What is Pollution?	
				Types of Pollution	
				Types of Pollution – Air Pollution	
				Types of Pollution – Water Pollution	
				Types of Pollution – Soil Pollution	
				Causes and Effects of Air Pollution	
				Causes and Effects of Water Pollution	
				Causes and Effects of Soil Pollution	
				What is Conservation?	
				How do we conserve the Environment?	
				Topic review	
				Unit Review	
6	Earth and Space	Unit 3: Space	Exploring Space	What is a Universe?	
				How do we study the Universe?	
7				History of Space Exploration	
				What is a Solar System?	
8				Components of Solar System – Sun	
				Components of Solar System – Planets	
				Components of Solar System – Satellite (Moon)	
				Structure of Solar System	
				Motion of Objects in the Solar System	
				What is a Galaxy?	
				Topic Review	
				Unit Review	
				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
Life	Unit 1 & 2: Plants and Animals	Cells	Properties of Cells		What are cells?
					Properties of cells
			Plant Cells		Structure of plant cell
					Function of plant cell
			Animal Cells		Structure of animal cell
					Function of animal cell
					Similarities and differences in plant and animal cells
					Topic Review
Physical Science	Unit 1: Energy	Electric current and magnetic field	Electric Current and Magnetic Field		What are magnetic fields?
					What are the properties of Magnetic fields?
					What are magnetic forces and lines of Magnetic forces?
					What is the relationship between Magnetic forces and lines of magnetic forces
					How to express magnetic fields with magnetic force
			Magnetic Field around electric current		What is the direction of Magnetic field around the electric current?
					What is the relationship among the Direction of Force, the Direction of Magnetic Fields and the Direction of Electric Current?
			Electromagnetic induction and Power Generation		What is Induction Current?
					Mechanism of Electromagnetic Induction
					How do we strengthen Induction Current?
					Difference between Direct Current and Alternating Current
			Application of Electromagnets		How are Electromagnets used in Motors?
					How do Electromagnets generate Electricity?
					Topic Review
					Unit Review

Life	Unit 1: Plants	Gas exchange in plants	Respiration of Plants		What is Respiration?
					Parts and Functions of Respiration?
					Roles of Leaf Stomata in Respiration in Plants
					Process of Respiration in Plants
			Photosynthesis		What is Photosynthesis?
					Parts and Functions of Photosynthesis
					Process of Photosynthesis in Plants
			Gas exchange in plants		System of gas exchange in plants
					Topic Review
					Unit Review
Physical Science	Unit 2: Force and Motion	Force and Work	Work and Power		What is work in Physics?
					What is the Relationship between Force, Work and Distance?
					Units of Force and Work
					Calculating Work
					What is Power in Physics?
					Units of Power
			Measuring Forces		Measuring Force with a spring balance
					Hooke's Law
					Topic review
					Unit Review
Earth and Space	Unit 1: Our Earth	Volcano and Igneous Rocks	Volcano		What is volcano?
					Types of volcano?
					Mechanism of Volcano?
			Igneous Rocks		Types of Igneous rocks – Volcanic
					Types of Igneous rocks – Plutonic
					Characteristics of Igneous Rocks
					Classification of Igneous Rocks
					Formation of Igneous Rocks
					Topic Review
		Rock Cycle	How rocks form		Types of rocks
					Characteristics of three types of rocks – Igneous
					Characteristics of three types of rocks - Sedimentary
					Characteristics of three types of rocks - Metamorphic
			How rocks change		Definition of rock cycle
					Process of rock cycle
					Causes of rock cycle – weathering, heat and pressure
					Topic review
					Unit review

Physical Science	Unit 3: Matter	Chemical changes	Chemical reaction		Types of Chemical Changes – Oxidation and reduction
					Types of Chemical Changes – Burning (combustion)
					Relationship between chemical changes and heat
					Expressing chemical changes with models and symbols
					Chemical changes and Energy
			Chemical changes and mass of substances		Conservation of Mass
					Regularity of Mass Changes
					Topic Review
		State Changes	State Change and Heat		Properties of Solid, Liquid and Gas in Volume
					Effect of Heat on the Motion of Particles (atoms & molecules) in Solids
					Effects of Heat on the Motion of Particles (atoms and molecules) in Liquid
					Effects of Heat on the Motion of Particles (atoms and molecules) in Gas
					Melting and Boling Point of Matter
					Arrangement of Atoms and Molecules explaining the changes of States of Matter by using Particle Models
					Process of Changes in States of Matter
					Physical Changes and Energy
					Topic Review
					Unit Review

Earth and Space	Unit 3: Weather and Climate	Weather and Climate	Climate		Definition of Climate
					Factors of Climate
					Differences and Similarities between Weather and Climate
					Types of Climate
					Climate in Papua New Guinea
					Effects of Climate on the Earth
					Effects of Climates on Human Activities
			Climate Change		What is Climate Change?
					Types of Climate Changes
					Causes of Climate Changes
					Effects of Climate Changes on the Earth
					Protections of Climate Changes
					Topic Review
					Unit Review
LIFE	Interaction and relationship in the environment	Changes in the environment	Environmental changes by human activities		Causes of Environment Changes – Natural Events
					Causes of Environment Changes – Human Activities
					Effects of Environment Changes on Environment – Species and Extinctions
					Effects of Environment Changes on Environment – Fossils
					Positive and Negative Effects of Environment Changes caused by Human Activities
			Pollution		What is Pollution?
					Types of Pollution
					Types of Pollution – Air Pollution
					Types of Pollution – Water Pollution
					Types of Pollution – Soil Pollution
					Causes and Effects of Air Pollution
					Causes and Effects of Water Pollution
					Causes and Effects of Soil Pollution
			Conservation of Environment		What is Conservation?
					How do we conserve the Environment?
					Topic review
					Unit Review

Earth and Space	Unit 3: Space	Exploring Space	Space		What is a Universe?
					How do we study the Universe?
			Solar System		History of Space Exploration
					What is a Solar System?
					Components of Solar System – Sun
					Components of Solar System – Planets
					Components of Solar System – Satellite (Moon)
					Structure of Solar System
					Motion of Objects in the Solar System
			Galaxy		What is a Galaxy?
					Topic Review
					Unit Review

Content background Information

The background information will assist teachers who are not familiar with the content of a particular unit or topics 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 background content information for the teachers to use. 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 Junior Science Teacher Guide to develop daily teaching plan mainly in terms of content delivery to the students in the classroom.

STRAND: LIFE

UNIT 1: PLANTS

Topic: Gas Exchange System

Respiration of Plants

All living things need food as a source of energy for movement, growth and other body functions. The process of getting energy from food is called respiration.

Respiration occurs in cells. Here glucose, the fuel, reacts with oxygen to release energy. Carbon dioxide and water are given off.

RESPIRATORY

glucose + Oxygen → carbon dioxide + water

What is respiration? The process of **respiration in plants** involves using the sugars produced during photosynthesis plus oxygen to produce energy for **plant** growth

How does respiration take place?
Plants need oxygen for respiration process to take place. Respiration normally takes place in the nights through different plant parts such as roots, stem or leaves.

What happens during respiration?
During the respiration, plants take in molecules of oxygen (O2) produced by photosynthesis process to make water, carbon-dioxide and energy. They form the products of respiration to help in the plant growth.
Water, carbon dioxide (CO2) are seen as the products of respiration process.
Each plant manages its own gas exchange.
The plants respire at very slow rates than those of animals.

Photosynthesis

Photosynthesis only occurs in the green parts of the plants where chlorophyll is present, such as the leaves. The sugars that are produced are then converted to starch and usually transported to other parts of the plant, such as roots and tubers, for storage.

The plants contain the green pigment chlorophyll. This substance is able to absorb energy from sunlight. The plants use this energy to make food, in the form of sugars, from carbon dioxide and water, and give off oxygen. This process is called photosynthesis. The word is made up from the words photo, meaning 'light', and synthesis, meaning to 'make'.

The main products of photosynthesis are simple sugars such as glucose, which are then converted to starch for storage. The other important product made in photosynthesis is oxygen. This is released into the air, or into the water if the plant lives in water.

PHOTOSYNTHESIS

carbon dioxide + water → glucose + oxygen

glucose → starch

Gas Exchange System in Plants

Gas Exchange in Plants. Plants obtain the gases they need through their leaves. They require oxygen for respiration and carbon dioxide for photosynthesis. The gases diffuse into the intercellular spaces of the leaf through pores, which are normally on the underside of the leaf - stomata.

Topic: Cells

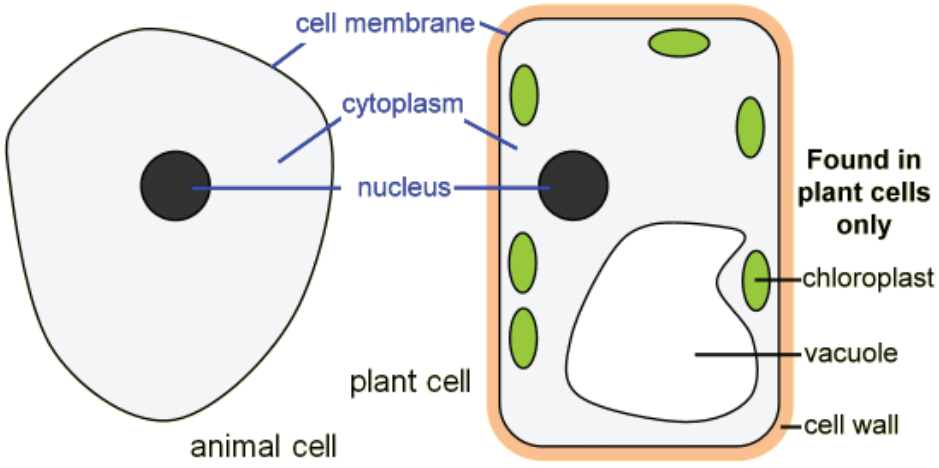
Plant Cells

All living things are made of cells. To stay alive and healthy, cells need food, water, and a way to eliminate waste.

A single cell is the smallest structure that carries out the activities necessary for life. A cell is like a tiny factory. Different parts of the factory produce or control different things. One part gets food or water. Another part keeps the cell clean. Still other parts are in charge of reproducing. Like parts of a factory, all parts of the cell must work together to run smoothly. An organism cannot survive without a cell doing their work.

All cells have structures that perform certain functions. Animal cells and plant cells look different, but they share many similar features. They have at least three features in common: a cell membrane, a nucleus, and a cytoplasm.

The cell membrane is the outer covering of the cell. Water and food enter through the cell membrane, and wastes leave through it. Plant cells have an additional structure called the cell wall. The cell wall gives extra support to a plant cell.



Reference: http://biology4alevel.blogspot.com/2014/07/4-cell-structure-and-function.html

UNIT 2: ANIMALS

Topic: Cells

Animal Cells

Animal cells are found within every animal. The main difference between an animal cell and a plant cell is that animal cells are not able to make their own food. There are trillions of cells in the animal body and each one is different depending on its function and type. Most animal cells have at least the three main parts: nucleus, cell membrane, and cytoplasm.

The nucleus of the cell gives the cell direction. It directs all activity of the cell. You can think of the nucleus as the brain of the cell for without it, the cell could not function. The nucleus has the ability to make other cell organelles as needed. The nucleus of animal cells is bound by a membrane.

Cell membranes protect animal cells. They keep harmful objects out of the cell and allow helpful objects to enter. You can think of the cell membrane as a guard for the cell.

Cytoplasm is what fills the majority of an animal cell. It helps give the cell shape and keeps organelles in their correct place. When organelles need to transport materials around the cell, cytoplasm allows this process to occur smoothly. It also helps to break down cell waste.

UNIT 4: INTERACTION AND RELATIONSHIP IN THE ENVIRONMENT

Topic: Changes in the Environment

Environmental Changes by Human Activities

Humans have huge effect on ecosystems by destroying habitats. In fact, habitat loss is the main reason why rates of extinction are rising. Not only are rain forests affected. Other ecosystems are impacted, too. Wetlands for example, are sometimes drained and filled in to provide land for farms, businesses, and housing developments. Until recently, people did not understand the importance of wetlands. These ecosystems filter harmful chemicals from ground water.
Negative impacts include pollution, deforestation, global warming and depletion of the ozone layer. Excessive hunting and fishing practices pose another threat to many ecosystems. When a species is close to becoming extinct, it is called endangered species. When a species is close to becoming endangered, it is called threatened species. These categories are important. They let everyone know which species need the most protection.

Pollution

Burning fossil fuels is one example. Fossil fuels include oil, gas, and coal. These fuels contain a lot of energy and are easy to use. However, burning them can cause pollution. Pollution is the addition of harmful substances to the environment.

When fossil fuels are burned, certain gases and solid particles are released into the air. These pollutants can make the air unhealthy to breathe. Some combine with water droplets to form acids. They fall to the ground as acid rains. Fossil fuels do not have to be burned to pose a threat to the environment. Oil, for example, is often transported on big ships called tankers. Accidental spills can damage the environment and be expensive to clean.

Human activities can also pollute the land. Each year people produce hundreds of millions of tons of solid waste, including paper, plastics, and metals. Most solid waste is buried in sanitary landfills, and some is burned. However, people sometimes carelessly dump solid waste along roadsides or in bodies of water.

Some farming and lawn-care practices can also cause pollution. Rain can wash fertilizers into rivers and streams, where they may damage the ecosystem.

There are many forms of pollution such as land, water, air and noise pollution.

Types of Pollution:

Land Pollution

Irresponsible dumping of rubbish results in land being polluted. Rotting rubbish gives off a bad smell and breeds germs. Piles of rubbish also take up space and are unsightly.

Leakage of nuclear waste from nuclear reactors or industrial chemicals from factories may also pollute the land. Such leakages are very toxic and harmful to living things. They may cause birth defects, strange diseases and even death.

Mining of metals from the earth results in large amounts of soil being dug up and dumped

Water Pollution

Seas and oceans may be polluted by oil spills from ships. The layer of oil is toxic to marine life. Oil may stick to the feathers of birds, making them unable to fly, hunt fish or escape predators.

Rivers and lakes may be polluted by excessive use of chemicals are washed off when it rains, and the surface run-off flows into the water bodies.

- Insecticides and weed killers may kill marine life.
- Fertilizers, however, may encourage algae growth. An overgrowth of algae covers the surface of ponds and lakes. This blocks sunlight from reaching other water plants. As a result, these plants cannot photosynthesize and will die. Marine animals depending on these plants for food will also die.
- Untreated chemical waste or hot water discharged by factories into water bodies may kill or harm marine life.
- Untreated sewage is toxic to marine life and can also encourage algae growth.

Air Pollution

Burning any object releases carbon dioxide and soot into the air.

- Many things are burnt daily. Fossil fuels are burnt to generate electricity and to supply power to vehicles.
  - Rubbish is incinerated.
  - Trees are burnt in the "slash and burn" method of clearing forests to make way for plantations.
- The pollutants released into the air may cause breathing difficulties and also result in haze forming.
- Under certain weather conditions, factory pollutants may be trapped in the air near the ground, forming thick, yellow smog. This causes breathing difficulty and may even result in death.
- In addition burning of fossil fuels releases sulphur dioxide and nitrogen dioxide. When sulphur dioxide and nitrogen dioxide dissolve in rainwater, they form acids, which then fall as acid rain.
  - Acid rain is corrosive and can damage buildings and stone monuments.
  - Acid rain may also damage plants.
  - If acid rain collects in lakes, it can kill marine life.

Conservation of Environment

Some of our natural resources, such as fossil fuels and metals are non-renewable.

- Fossil fuels will take billions of years to be replaced by nature once they are used up.
- Metals which are mined from the earth's crust cannot be replaced once they used up.

In order to conserve the conserve fossil fuels and reduce pollution caused by burning them, Man can switch to using other renewable sources of energy such as solar power, wind, and water to generate electricity.

As metal can be easily melted down and reshaped, scrap metal can be recycled to reduce the need to mine more metals.

Man can also set aside forests as nature reserves to protect plants and animals living within it from being destroyed by deforestation.

Reduce, Reuse and Recycle

The use of disposable items such as plastic cutlery and disposable chopstick contributes to the amount of rubbish generated.

Not only does producing these items deplete our natural resources, disposing the can also cause pollution, as mentioned above.

We can reduce the waste generated by reusing or recycling some of these items.

Items made from glass, metal, or paper may also be recycled to conserve our natural resources.

UNIT: ENERGY

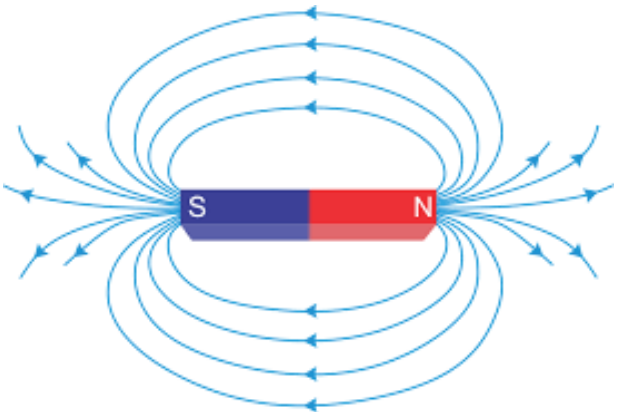
Topic: Electric Current and Magnetic Fields

Magnetic Fields and Magnetic Forces

A magnet is called a magnetic dipole, because it has two poles, called a north and south pole. In magnetic substances, most of the magnetic dipoles line up in one direction. In nonmagnetic substances, the dipoles are aligned randomly. Their effects cancel each other out.

Figure 1.

The lines of force run from the north pole of a bar magnet toward south pole.



A magnet does not have to touch a piece of iron to affect it. When iron comes close to the magnet, the magnet's force of attraction will act on the iron. The region around a magnet in which its magnetic force can be felt is called the magnetic field of the magnet.

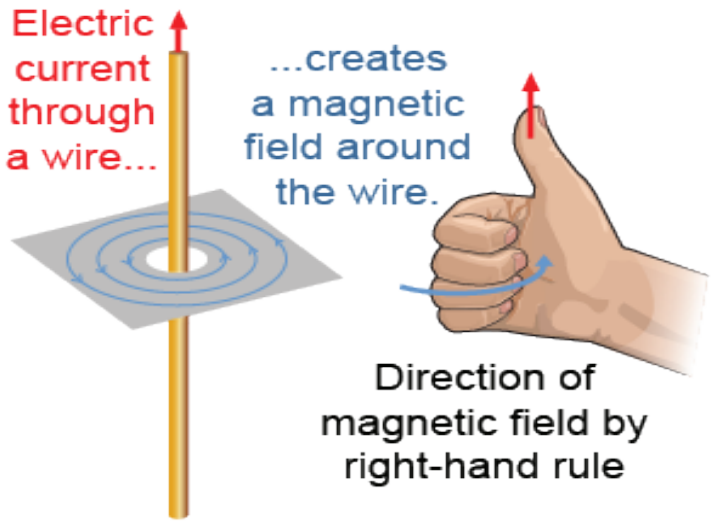
The way the dipoles are aligned in a magnet creates lines of force around it. The lines of force make up the magnetic field. Notice that these lines of force are closest together near the magnet's poles. These are the areas where the magnetic field is strongest.

Figure 2.

Magnetic Fields Around Electric Current

A current carrying conductor creates a magnetic field around it, which can be comprehended b using magnetic lines of force or magnetic field lines.
The nature of the magnetic field lines around a straight current carrying conductor is concentric circles with centre at the axis of the conductor.
The strength of the magnetic field created depends on the current through the conductor.
The direction of the magnetic field lines of force around a conductor is given by the Maxwell's right hand grip rule or the right handed corkscrew rule. Imagine that you are holding a current-carrying straight conductor in your right hand such that the thumb points towards the direction of current. Then your fingers will wrap around the conductor in the direction of the field lines of the magnetic field (See Fig.1). This is known as right hand thumb rule.

Magnetic field around a current-carrying wire



Electromagnetic Induction and Power Generation

An electromagnet is an example of how electric current can create a magnetic field. The opposite is also possible. When a moving conductor cuts across the lines of force surrounding a permanent magnet, an electric current is induced, or set in motion, in the conductor. This interaction between electricity and magnetism can be used to produce electric power. An electric generator is a device that converts mechanical energy into electrical energy.

In a generator, a coil or loop of copper wire is placed between the poles of a permanent magnet. When the coil is rotated, it cuts across the magnetic field lines, this action creates an electric current in the coil. The ends of the coil contact collector rings, which transfer the moving charges to conductors, which carry the current away from the generator.

Power plants use a source of mechanical energy, such as rushing water and wind, to turn large turbines. The turbines are connected to electric coils, causing them to rotate inside a magnetic field.

In an AC generator, slip rings are used to collect an alternating current, which is then transmitted down power lines, or other wires. An AC generator is also called an alternator.

Power plants throughout the world use AC generators to generate electricity. Many small, portable generators are also AC generators.

(insert diagrams of Electromagnetic Induction and Power Generation)

Application of Electromagnets

An electric motor is a device that converts electrical energy into mechanical energy. This is the opposite of what a generator does.

There are two types of electric motors: AC motors and DC motors. Bothe types have several common parts. In each type, a thin insulated copper wire is coiled around a metal bar. This structure is called an armature. The armature is positioned so that it is free to rotate between the poles of permanent magnet. When current from an outside source moves through the wire coil, the armature becomes an electromagnet.

Recall that the direction of moving charges in alternating current is always changing. Thus, in AC motor, the poles of the armature are always reversing. Attraction and repulsion between the poles of the armature and the poles of the permanent magnet cause the armature to rotate.

A DC motor works slightly different. With direct current, electric charges move in only on direction. So, the poles of the electromagnet produced by the direct current do not revers continuously, as they do in an AC motor.

To reverse the poles, a DC motor uses a special device called a commutator. This device acts like a switch that reverses the direction of the current in the armature.

The job of any motor is to spin the armature, a changing electrical energy into mechanical energy. The mechanical energy can then be transferred to the moving parts of a machine. In this way, motors power machines such as fans, drills, refrigerators, and water pumps.

In an electric motor the electromagnet rotates between the poles of a permanent magnet. Electrical energy is converted into mechanical energy.

(Insert diagram of an electric motor rotating between the poles of a permenant magnet and also the direction of the electric current in AC motor and DC motor)

How does an electric motor work?

UNIT: FORCE AND MOTION

Topic: Force and Work

Work and Power

Work

Work done is defined as product of the force and the distance over which the force is applied.

When you lift a load you are applying a force over a distance, so you are doing work

Work is done when a force is applied to an object and the object is moved through a distance. For example, when you lift a load you are applying a force over a distance so you are doing work.

In science, work is done when a force moves an object over a distance. What happens if you apply a force to something, but it does not move? According to Newton's law of motion, another equal force must be opposing your force. For example, if the person does not move the car, then no work has been done. Even though the person the person has exerted a force, he has done no work.

But if two people apply enough force to the car to move it some distance the will have done work. The greater the distance, through which a force is applied, the more work is done. For example, think about picking up a book from the floor. To lift the book, you apply a force equal to its weight. If you raise the book over your head, you do more work than if you just lift it to your waist.

We can use a formula to calculate work done. W = Fd

Work (W) equals the amount of force (F) times the distance (d) that the object is moved. Work is measured in units of force times the units of distance. The standard unit is called a newton-meter (N.m). If you apply force of 10 N to lift a book a distance of 1 m, you have done 10 N.m of work. Another name for a newton-meter is the joule (J).

- Work is measured in joules.
- Force is measurd in newtons.
- distance is measured in metres.

When work is done, energy is transferred.

Power is the rate of doing work.

Power = work done (energy)

Time taken (time)

Measuring Forces

A spring scale or spring balance or newton meter is a type of weighing scale. It consists of spring fixed at one end with a hook to attach an object at the other. It works by Hooke's Law, which states that the force needed to extend a spring is proportional to the distance that spring is extended from its rest position. Therefore, the scale markings on the spring balance are equally spaced. A spring scale can not measure mass, only weight.

A spring scale is one of the most basic tools used to measure the weight of an object. In its simplest form, it is just a spring attached at one end and a pointer on a scale at the other. The lower end often has a hook to attach the object that has to be weighed.

Hooke's Law is a principle of physics that states that the that the force needed to extend or compress a spring by some distance is proportional to that distance. The law is named after 17th century British physicist Robert Hooke, who sought to demonstrate the relationship between the forces applied to a spring and its elasticity.

Hooke's law is the first classical example of an explanation of elasticity – which is the property of an object or material which causes it to be restored to its original shape after distortion. This ability to return to a normal shape after experiencing distortion can be referred to as a "restoring force". Understood in terms of Hooke's Law, this restoring force is generally proportional to the amount of "stretch" experienced.

The spring will go back to its original length when the force is removed. So long as we do not exceed elastic limit.

UNIT: MATTER

Topic: Chemical Changes

Chemical Reactions

A chemical change is a change in matter that results in new substances being formed. Chemical changes involve breaking these bonds and forming new bonds. This creates new substances with new chemical properties.

A chemical reaction is a specific example of one or more chemical changes. All chemical changes occur as a result of chemical reactions. Burning wood is one example of a chemical change. Other chemical changes give off energy in the form of heat or light. Whenever you ignite wood in a campfire, natural gas on the stove, or the wick of a candle, you are setting in motion a chemical change that gives off energy.

Chemical Changes and the Mass of Substances

Regardless of the kind of change taking place in a sample of matter, the amount of matter stays the same. When matter changes, mass is always conserved, meaning that is neither created nor destroyed.

In a chemical change, this means that the mass of the materials before a chemical change is equal to the mass afterwards. This is true even if you cannot see the materials that form, such as when gas is produced.
Matter is also conserved in all physical changes. When you place water in the freezer, it undergoes a physical change. The water freezes and becomes ice.

As you may know, the volume of water increases when it freezes. But that does not mean that matter was created. Instead, the arrangement of the water molecules takes up more space in ice than in water. We can use scale to prove that mass is conserved when matter changes. For example, fruit changes chemically when it either ripens or decays. Tissues change, new materials form, and gases are released. By covering the fruit and placing it on a scale, you can observe that the mass stays the same even the fruit changes.

Sometimes the conservation of mass is hard to see. For example, when a log burns in the fireplace, only few ashes remain.

Topic: State Changes

State Change and Heat

A state of matter is the physical form that matter takes. Three familiar states of matter are solids, liquids, and gases.

Solid:

Ice is an example of matter is the solid state. Ice is the form of water. The ocean water is in the liquid state. The air above the water is a mixture of invisible gases. One of these gases is water vapor. Water vapor is water in the gas state.

A solid is a form of matter that has a definite shape and volume. The way that particles in solids are arranged and the way that they vibrate in place give solids certain properties. One property is that solids keep their shapes. If you move a solid, or place it into a container, its shape will stay the same.

Another property is that they have definite volume. That is, they take up the same amount of space wherever they are. The volume of a solid object stays the same unless you remove a part of the object. For example, consider a wood block that has a volume of $30cm^3$. Where ever you move it, the volume will still be $30cm^3$. You can even compress the rock, which means to squeeze it. The volume will not change much, it at all.

Many solids might appear to change shape and volume. For example, you can squeeze a foam ball into a smaller volume, and a pillow dents easily when you rest your head on it. In both cases, however, solid matter is surrounded by “pockets” of air. The air changes its shape and volume, not the solid parts.

Liquids:

A liquid is a form of matter that has a definite volume, but no definite shape. A liquid will change shape to match the shape of its container. Contrast liquid water with ice, which is a solid. When you place an ice cube in a glass, it keeps its cube shape – that is until it melts into a liquid. Then it takes on the shape of its container.

Liquids have no definite shape because their particles are not rigidly held in place. The particles of a liquid are able to flow past one another to take on the shape of its container. Any substance whose particles can flow freely is called a fluid.

Like solids, liquids have a definite volume. To prove this, pour a liquid sample into different containers. Each time, the liquid will take the shape of the container, but its volume will never change. Also, like solids, liquids are not very compressible. Because the particles are close together, liquids do not easily compress into smaller volumes.

Gas

A gas is a form of matter that has no definite shape or volume. The particles that make up gases can move about freely. Particles of a gas are constantly moving about and bouncing off one another.

When a sample of gas is placed in a closed container, the particles spread out to fill the container and take its shape. Because the particles are free to move about and flow, all gases are fluids.

Unlike solids and liquids, gases are very compressible. Their particles are so far apart that they can easily be pressed closer together into a smaller volume. For example, helium gas is often compressed and kept in metal tanks. The helium inside the tank has the shape and volume of the tank.

Gases have much lower densities than liquids and solids. A balloon filled with helium will float in air.

This is because the helium-filled balloon is less dense than the air. Objects with lower densities float in fluids that have higher densities. For example, ice is less dense than liquid water. So, an ice cube will float in a glass of water.

Melting and Freezing:

Matter can change from one state to another when energy is added or removed. Changes of sate are always physical changes.

A change of state is a physical change. The substance involved keeps its identity, and matter is always conserved. When energy is added to a solid, its temperature will rise to a certain point. The solid starts melting or changing from a solid to liquid, at its melting point.

The process is reversed when energy is removed from a liquid. The temperature drops to the freezing point. The temperature stays the same while the liquid freezes. For any substance, the melting point and the freezing point are the same. Both the melting point and the freezing point of water are 0^0Cn or (32^0F).

Vaporizing and Condensing:

Watch a drop of water on a hot frying pan. It sizzles, pops, and disappears. The change of state is caused by a rapid increase in temperature.

Adding energy to a substance makes its particles speed up, raising the temperature. At some point, the particles have so much energy that they break the forces that keep them in liquid state. The water vaporizes. Vaporization is the change of state from a liquid to a gas.

Rapid vaporization is called boiling. The boiling points of a substance us the temperature at which rapid vaporization occurs. Boiling points can be slightly different from place to place because of air pressure. The boiling point for water at sea is 100^0C (212^0F).

Slow or gradual vaporization is called evaporation. Evaporation takes place at the surface of a liquid. The higher the temperature of the surroundings, the faster evaporation takes place.

When energy is removed from a gas, it will undergo condensation, a change of state from a gas to a liquid. We can observe condensation on a hot day when you make a pitcher or ice-cold lemonade. The pitcher will begin to “sweat” as water droplets form on the outside of the glass. The droplets come from water vapor in the air condensing in the cold glass.

STRAND: EARTH AND SPACE

UNIT: OUR EARTH

Topic: Volcano and Igneous Rocks

Volcano

A volcano is an opening in Earth's surface through which melted rock, hot gases, rock fragments, and ash burst forth, or erupt. A violent eruption can release rivers of red-hot molten rock, hissing jets of poisonous gas, curling clouds of thick gray ash, and explosions of scorched rock.

Volcanoes come from Earth's hot interior. Most volcanoes start 37 to 100 miles below the surface. At these depths, rock can be become so hot it melts. Melted rock below Earth's surface is called magma.

When rock melts, it releases gases. These gases mix with the magma, making it lighter than the solid rock around it. Slowly, the gas-filled magma rises toward the surface. As it rises, it melts rock around it, gradually forming a large chamber. This chamber may be only a few kilometers below the surface.

Under pressure from the weight of the surrounding rock, the magma is forced to find an escape. It melts or forces a channel into weak or cracked rock. Within this channel, it pushes upward. Once near the surface, gas and magma burst through a central opening, or vent. The erupting material builds up, forming a volcanic mountain, or volcano.

After an eruption, a volcano usually collapses into a bowl-shaped mouth called crater. At the bottom of the crater lies the central vent. Many volcanoes have repeated eruptions. In these later eruptions, some of the volcanic material in the channel may remain below the surface. It may also push out through side vents.

There are different classes of volcanoes and volcanic cones.

1. Shield volcanoes form when a lot of lava flows smoothly from a vent and spreads out to cover a wide area. This action creates a broad, low, dome-shaped volcano.

2. Cinder cones form when mostly rock fragments erupt and are deposited around the vent. This creates a cone-shaped volcano with steep sides.

3. Composite volcanoes are also cone-shaped. The sides of these volcanoes are steeper than those of a shield cone, but not as steep as a cinder cone.

Volcanoes may also be classified by how often they erupt. Volcanoes that have erupted recently are described as active. Dormant volcanoes may erupt in the future. Extinct volcanoes have stopped erupting altogether.

Many volcanoes occur around the edges of the Pacific Ocean. They form a long arc from New Zealand to Japan to the west coasts of North and South America. Because of its shape, this area is called the Ring of Fire. |

Igneous Rocks

As magma cools beneath Earth's surface, it hardens it into igneous rocks. The size of the crystals in an igneous rock depends on how fast the magma cools. Magma that is trapped underground may take thousands of years to cool. The mineral have time to form very large crystals.

Like magma underground, lava also forms igneous rocks as it cools on Earth's surface. Because it cools quickly, lava forms rock with small grains. Basalt is a common rock that is formed from lava.

Lava sometimes cools so rapidly that crystals do not have time to form. This is how volcanic glass, or obsidian, is formed. Pumice forms when lava containing gas bubbles is thrown from a volcano and cools in the air. Pumice can be light enough to float on water.

Topic: Rock Cycle

How Rocks Form

Sedimentary Rocks:

Sediments are deposited in water over millions of years. As layers of sediment build up, the weight of the layers causes pressure to increase. The pressure turns the sediments into rock. This forces out the water and slowly changes the sediments into sedimentary rock. Depending on the size if the particles, different types of rock will form.

Fine silt and mud will turn into sandstone. Coarser sediments, such as pebbles, will cement together with sand and dissolved minerals to form conglomerate.

Limestone forms from the calcite shells of corals, plankton, and other marine animals. Fossil shells of sea animals can be found in limestone. Chalk is a very fine-grained limestone made of microscopic shells.

Sedimentary rock may also form from chemical deposits. In dry climates, for example, lakes and seas may dry up periodically. They leave behind layers of minerals that were dissolved in water. The layers will form a type of sedimentary rock called evaporite. Rock gypsum and rock salt are examples of evaporites.

Characteristics of Rock:

Rocks are mixtures of two or more minerals. The properties of a rock depend in part on the properties of minerals it contains.

How Rocks Change

Metamorphic Rocks:

The term to metamorphose means to change form. Metamorphic rock is a new rock that forms from new igneous, sedimentary, or even other metamorphic rock that has been exposed to high temperature, high pressure, or both.

Temperature and pressure both increase as you go deeper beneath Earth's surface, softening and squeezing large regions of buried rock. High pressure is also created by geologic processes such as mountain building. Because such metamorphism takes place on a large scale, it is called regional metamorphism.

Metamorphism can also occur on a smaller scale when cooler rock is heated by near by magma. This is called contact metamorphism. During metamorphism, both the texture and mineral composition of the rock may change.

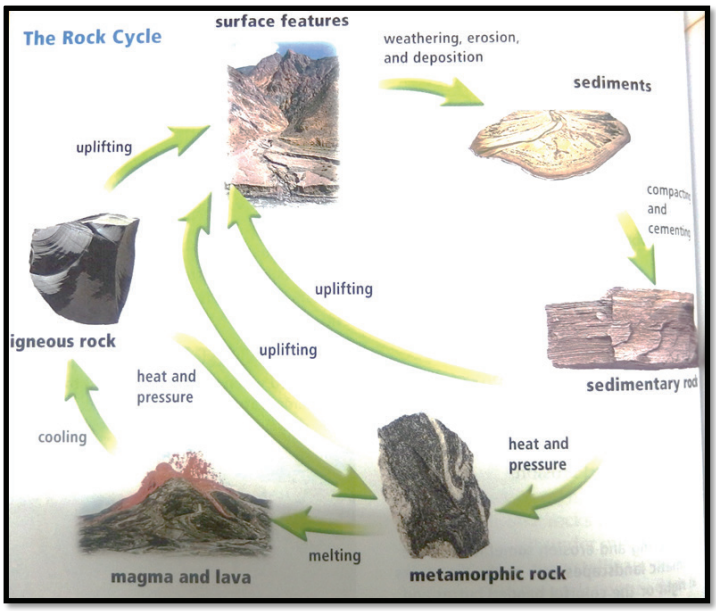
Metamorphic rocks formed at high temperature but under moderate pressure show recrystallization of minerals, but the rock texture does not change much.

Most metamorphic rocks that form under conditions of both high temperature and high pressure show layers. The pressure causes recrystallized new mineral to be arranged in layers.

Metamorphic rock formed deep beneath mountains may show both layers and folds. This can result in colourful metamorphic rocks with a flowing, banded appearance. A good example is gneiss.

Characteristics of Rocks:

Rocks are mixtures of two or minerals. The properties of a rock depend in part of the properties of minerals it contains



Rock can be changed to a new rock in different ways. This process is called the rock cycle.

Weathering and erosion turn any type of rock – igneous, metamorphic, or sedimentary – into sediments. Deposited sediments are compacted and cemented into sedimentary rock. Heat and pressure within Earth can change any type of existing rock into metamorphic rock. Deep in earth's mantle, rock melts into magma. When the magma cools, it crystallizes into igneous rock. Uplifting brings buried rocks of all three types to the surface, and the process begins anew.

UNIT: WEATHER AND CLIMATE

Topic: Weather and Climate

Climate

The word ‘climate’ describes the usual weather of a particular place. If a place usually has cold weather, then we say that place has a cold climate. If a place usually has hot weather, we say it has a hot climate.

Climate is the normal pattern of weather in an area over many years. Earth’s shape, the tilt of its axis, and its geographic features affect the climate of an area.

Uneven heating of Earth’s surface by the Sun creates three major climate zones:

1. Tropical climate zone
2. Temperate climate zone
3. Polar climate zone

The major difference among the climate zones is their yearly average temperature and amount of precipitation. Precipitation, is any type of water-rain, snow, sleet, or hail-that falls from clouds.

Tropical climates occur at the equator and in areas just north and south of it. The temperatures in these climates are very warm year round.

Weather is the overall condition of the atmosphere at a given time and place.

Climate Changes

Today the Earth's average surface temperature is 15^{0}C.

The Earth has been warming and cooling over millions of years. During the ice ages, large areas of Europe and Canada were covered in ice and the Earth's climate was 3-5^{0}C cooler than it is today. The most recent ice age ended 20 000 years ago.

Across the world, temperatures are rising at a rate faster than ever before. The Earth's average temperature has risen by 0.6^{0}C in the past 100 years. The ten hottest years on record occurred in the last 14 years, and 2005 was the hottest year recorded. This global warming may be enough to cause changes in weather patterns, which we refer to climate change.

Global warming is caused by the **greenhouse effect. Greenhouse gases** trap the heat from the Sun in the Earth's **atmosphere**. This heat leads to an increase in the Earth's surface temperature.

Greenhouse gases occur naturally in the Earth's atmosphere, but human activities contribute to these gases. These human activities are increasing as the world's population increases. Scientists now agree that in recent decades the amount of greenhouse gases in the atmosphere has increased. More of the Sun's heat is being trapped, leading to further global warming.

Some greenhouses gases generated by human activities:

Gas	Human Activity
Carbon Dioxide	• Burning fossil fuels such as coal and oil to produce electricity and for transport • Clearing forest
Methane	• Livestock farming with cows and sheep • Using flooded land called paddy fields for growing rice
Nitrous Oxide	• Using fertilizers

UNIT: SPACE

Topic: Exploring Space

Solar System

The Sun, eight orbiting planets and their moons, and other objects that orbit the Sun make up the Solar System.

The Sun is the nearest star to Earth. Like all stars, the Sun is a huge sphere of hot gases that gives off heat and light. Earth is one of nine planets that move around the Sun. A planet is a large body in space that moves around a star. A planet does not produce light of its own.

Earth and eight other planets each orbit, or move in path, around the Sun. A planet's path around the Sun is an oval.

Most planets have one or more moons. A moon is a small, rounded body in orbit around a planet. A moon does not produce its own light. The Sun, planets, moons, and other objects that orbit the Sun make up the solar system.

The farther a planet is from the Sun, the longer it takes to orbit the Sun. The time it takes to complete one trip around the Sun is called a year. Earth's year is about 365 days long. Mercury, the planet closest to the Sun, makes a complete orbit in just 88 Earth days.

As it orbits the Sun, each planet also spins like a top. This spinning causes the cycle of daytime and nighttime. Earth's day, one full turn is 24-hours long. Some planets spine more slowly than Earth. It takes 243 Earth days for Venus to complete one full turn.

Insert diagram of nine planets orbiting the Sun in the Solar system.

Planets of the solar systemName

Name	Mean Distance from the Sun	Mass 10^{24}	Diameter (km)	Period of Rotation	Length of Year	Number of Known Moons
Mercury	0.4	0.3302	4,880	58.6 Earth days	88 Earth days	0
Venus	0.7	4.8685	12,103	243 Earth days	225 Earth days	0
Earth	1	5.9736	12,756	23 hrs 56 mins	365.242 Earth days	1
Mars	1.5	0.64185	6, 794	24.6 Earth days	687 Earth days	1
Jupitor	5.2	1.898.6	142, 984	9 hrs, 55 mins	11.86 Earth days	62
Saturn	9.5	568.46	120, 536	10 hrs, 40 mins	29.46 Earth days	35
Uranus	19.2	86.832	51, 118	17 hours, 14 mins	84. 07 Earth days	27
Neptune	30.1	102.43	49, 532	16 hrs	164.8 Earth days	13
Pluto (Dwarf planet)	39.5	0.0125	2, 274	6.4 Earth days	248.53 Earth days	1

The Inner Planets
Mercury, Venus, Earth, and Mars are called the inner planets. These planets get a lot of heat and light because they are close to the Sun. The inner planets are small and are made of solid rock materials. Their surfaces have mountains and craters.

The Outer Planets
Jupiter, Saturn, Uranus, Neptune, and Pluto are called the outer planets. They are cold and dark because they are far from the Sun. Jupiter, Saturn, Uranus, and Neptune are large. They are made of gases and have many moons. Each of these four planets also has solar system of rings. Pluto is small and is made of rocks and frozen gases. It has no rings and only one moon.

The Asteroid Belt
The asteroid belt is an area between the inner planets and outer planets. An asteroid is a piece of rock that orbits the Sun. There are thousands of asteroids within the asteroid belt. An asteroid can be as small as a grain of sand or almost as large as the state of California.
Sometimes a piece of asteroid breaks off and moves close to Earth. As it moves through Earth's

Galaxy

A galaxy is a collection of both old and new stars, as well as large volume of gases and dust held together by gravity. Some galaxies contain thousands to billions of stars.

Earth's local star – the Sun – is only one of the billions of stars that belong to the Milky Way Galaxy. The Milky Way has three main parts:

1. A bulge
2. A halo
3. A disk

The bulge is the center of the galaxy and is a region of gases, dust, and older stars.

The diameter of the Milky Way's bulge is approximately 10,000 light years. A light year is the distance light travels in a year – approximately 9.5 trillion km.

Encircling the Milky Way's bulge is a region called a halo, which is made of old stars and a type of matter called dark matter. The Milky Way's halo is more than 130,000 light years wide.

In addition to a bulge and a halo, the Milky Way has a region called a disk. The disk is made up of the spiral arms that spread outward from the bulge and contain young stars and other types of matter.

Earth's solar system is located within the galaxy's disk, approximately 28,000 light-years from the central bulge.

Galaxies can be classified into three main groups:

1. Spiral galaxies
2. Elliptical galaxies
3. Irregular galaxies

Some spiral galaxies, like our own, have arms that extend directly outward from the bulge.

Elliptical galaxies, as their names suggest, are shaped like ellipsoids, or footballs. Irregular galaxies with no definite shape or structure.

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 for 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?
	TEACHERS NOTES
	SAFETY
	ASSESSMENT
	LESSON PROCEDURE
	KEY QUESTION
	BLACK BOARD PLAN
	CHALLENGE FOR STUDENTS

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

Guided lessons sample 1

Lesson Title: Comparing plant and animal cell	**Lesson No: 15**
Strand: Life	Unit: Plants
Topic: Cells	Sub-topic: Comparing plant and animal cell.
Content Standard:	8.1.2 Students will be able to investigate the structure of plant and animal cells.
Benchmark:	8.1.2.3. Compare and contrast similarities and the differences between plant cells and animal cells.
Key Question:	What is the difference between plant and animal cell?
Lesson objective:	By the end of the lesson the students can; • Identify the similarities and differences in plant and animal cells.
Teaching period:	40 minutes
Preparations:	Diagram of plant and animal cell structure with labels of the parts
Key word(s):	Similarities and differences

Learning content

Knowledge	Skills	Attitudes and Values
• Plant cells have chloroplasts and cell wall. • Animal cells don't contain chloroplasts and cell wall. • Both have nucleus, cytoplasm, cell membrane, mitochondria, and ribosomes.	• Research and construct two models of plant and animal cell and infer on their similarities and differences by observing their physical appearance.	• Appreciate the similarities and differences of plant and animal cell.

Teacher's Notes:

Students compare similarities and differences on structures and also physical appearances.
Eg: box like for plant and oval shape for animal.

Teacher's Notes:

• Draw, Label and identify similarities and differences of diagrams correctly.

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 "Functions of animal cells"? • (functions of anima cell are) Nucleus-control center of the cell. Stores information for cell functions. • Chloroplasts-contain green pigment chlorophyll need in photosynthesis. • Cytoplasm-Jelly-like where cell activity takes place. • Cell membrane-thin, control the substance that enter or exit the cells. • Cell wall-stiff wall gives plant cell their shape.	**Key Question** What are the similarities and differences of plant and animal cell?	Students will use their understanding from the previous lesson "functions of animal cell"

<table>
<tr>
<td>Body

35 mins</td>
<td>Predictions
Give any similarities or differences you know or guess for plants or animals. Write the predictions on the Blackboard

Activity:
Look at diagrams of plant and animal cell structure.

1. Complete table of comparison.
<table><tr><th>Plant</th><th>Animal</th></tr><tr><td></td><td></td></tr><tr><td></td><td></td></tr><tr><td></td><td></td></tr><tr><td></td><td></td></tr></table>
Introduce the key phrase for the lesson “similarities and differences of plant and animal cells”</td>
<td>Predictions
Allow students to discuss in groups and provide their predictions with justifications

Activity:
Look at pictures or diagrams of plant and animal cell.

1. Complete table of comparison.
<table><tr><th>Plant</th><th>Animal</th></tr><tr><td></td><td></td></tr><tr><td></td><td></td></tr><tr><td></td><td></td></tr><tr><td></td><td></td></tr></table>
Key phrase for the lesson “similarities and differences of plant and animal cells”</td>
<td>Concepts and Misconceptions

Strategy:

Groups</td>
</tr>
<tr>
<td>Conclusion
5 mins</td>
<td>✧ In our today’s lesson, what did you discover or learn from this lesson?

Guide students by having them to summarize what they have learnt about similarities and differences of plant and animal cell.</td>
<td>Summary:
• Both have nucleus, cytoplasm, cell membrane, mitochondria, and ribosomes.
• Plant cells have chloroplasts and cell wall.
• Animal cells don’t contain chloroplasts and cell wall.</td>
<td>The students’ conclusion should reflect the key concepts in the lesson.</td>
</tr>
</table>

BLACK BOARD PLAN

Title: Comparing plant and animal cells.

Key question: What are the similarities and differences of plant and animal cell?

Activity:

Look at pictures or diagrams of plant and animal cell.

1, Complete table of comparison.

Plant	Animal

Discussion on similarities and differences of plant and animal cell.

Summary

Similarities

- Both have nucleus, cytoplasm, cell membrane, mitochondria, and ribosomes.

Differences

- Animal cells don’t contain chloroplasts and cell wall.
- Plant cells have chloroplasts and cell wall.

Challenge for students:
Find out the similarities and differences of physical appearances of plant and animal cells?

Guided lesson sample 2

Lesson Title: Differences and Similarities between weather and climate	**Lesson No: 96**
Strand: Physical Science	**Unit:** Weather and Climate
Topic: Weather and climate	**Sub-topic:** Weather
Content Standard:	**8.3.3** Students will be able to investigate weather, climate and the effects of climate change.
Benchmark:	**8.3.3.2** Compare the differences and similarities between weather and climate.
Key Question:	What are the differences and similarities between weather and climate?
Lesson objective:	**By the end of the lesson the students can;** • Identify the differences between weather and climate. • Identify similarities in weather and climate.
Teaching period:	40 minutes
Preparations:	Picture of weather and climate patterns
Key word(s):	Differences and Similarities between weather and climate

Learning content

Knowledge	Skills	Attitudes and Values
• Weather covers the conditions of the atmosphere for a short space of time and climate covers how the atmosphere behaves over a longer period of time. • Differences between weather and climate are the measure of time. Shorter and longer time. • Similarities measured in the same way temperature,humidity,atmosheric circulation and precipitation	• **Observe the weather** today and keep records for a week. • **Keep record** of the weeks, months and years to identify the climate of Papua New Guinea.	• Appreciate weather daily and climate over a period of time.

Definitions
Weather covers the daily conditions for a short space of time such as temperature, humidity, atmospheric circulation, precipitation as atmosphere while climate covers how the atmosphere behaves for a longer period of time.
For example: Today the weather is sunny day. Papua New Guinea's climate is hot and humid.

1. Keep a daily record of the weather patterns in your area.
2. Find out the climate of Papua New Guinea.

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 "Factors on climate"? (Factors affecting climate Distance from the sun Ocean currents Direction of prevailing winds Shape of the land Distance from the equator	**Key Question** What are the differences and similarities of weather and climate?	Students will use their understanding from the previous lesson "Factors on climate"
Body **35 mins**	**Predictions** What would be the weather tomorrow from your observations today? If today's weather is sunny, what will happen tomorrow? Write the predictions on the Blackboard **Activity:** 1. Look at the pictures below and identify and describe the types of weather shown in your own words.  2. From the pictures above what do you think is the climate of Papua New Guinea. 3. Discuss and Describe the differences and similarities in weather and climate. Key phrase Introduce the key phrase for the lesson "Difference and Similarities in Weather and Climate"	**Predictions** Allow students to discuss in groups and provide their predictions with justifications **Activity:** 1. Look at the pictures below and describe the types of weather shown.  2. From the pictures above what do you think is the climate of Papua New Guinea? 3. Discuss and Describe the differences and similarities in weather and climate. Key phrase Difference and Similarities in Weather and Climate"	**Concepts and Misconceptions** Weather is the daily patterns of a day while climate covers a longer period of time. **Strategy:** Groups

Conclusion **5 mins**	✧ **In our today's lesson, what did you discover or learn from this lesson?** Guide students by having them to summarize what they have learnt about similarities and differences in weather and climate	**Summary:** • Weather is everything that happens in the atmosphere, temperature, rain, humidity, cloudiness; brightness covers the conditions of the atmosphere for a short space of time while climate covers how the atmosphere behaves over a longer period of time. • A difference between weather and climate is the measure of time. Shorter and longer time. • Similarities measured in the same way temperature,humidity,atmosheric circulation, precipitation	The students' conclusion should reflect the key concepts in the lesson.

BLACK BOARD PLAN SAMPLE

Title: Differences and Similarities in weather and climate **Key question:** What is the difference and similarities in weather and climate? **Activity:** 1. Look at the pictures below and identify and describe the types of weather shown in your own words  2. From the pictures above what do you think is the climate of Papua New Guinea.	**Discussion** Discuss and Describe the differences and similarities in weather and climate.	**Summary** • Weather is everything that happens in the atmosphere, temperature, rain, humidity, cloudiness; brightness covers the conditions of the atmosphere for a short space of time while climate covers how the atmosphere behaves over a longer period of time. • A difference between weather and climate is the measure of time. Shorter and longer time. • Similarities measured in the same way temperature,humidity,atmosheric circulation, precipitation

Challenge for students:

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Guided lesson sample 3

Lesson Title: Types of Pollution	Lesson No: 23
Strand 1: Life	**Unit 4:** Interaction and relationship in the environment
Topic: Changes in the Environment	**Sub-topic:** Environmental changes by human activities
Content Standard:	**8.1.3** Students will be able to investigate environmental changes, evaluate their effects, and analyse strategies for conserving the environment.
Benchmark:	**8.1.3.3.** Probe the different types of pollution and evaluate their effects on the ecosystem.
Key Question:	What are some types of air pollution?
Lesson objective:	**By the end of the lesson, the students can;** • Identify and list the different types of air pollution.
Teaching period:	40 minutes
Preparations:	Pictures of the different types of air pollution
Key word(s):	Pollution, Air pollution

Learning content

Knowledge	Skills	Attitudes and Values
• Air pollution occurs when things that are not normally there are added to the air.	• Infer about the types of air pollution • Identify and list the different types air pollution • Predict the effects of the different types of air pollution	• Appreciate learning about the different types of air pollution and take responsibility in helping to create a cleaner air

Teacher's Notes:

It is important that teachers revise the definition of pollution and pollutants and create handouts and worksheets for students on this lesson.

LESSON PROCEDURE

Time section	Teacher activity	Student activity	Points to notice
Intro **5 mins**	**Access prior knowledge** Ask students to pair with a friend and answer the revision question. What is air pollution?	**Key Question** What are some types of air pollution?	Students will use their prior knowledge about air pollution to link to today's lesson.
Body **35 mins**	**Predictions** Have partners share their knowledge of air pollution, recording key ideas on a piece of paper. After two minutes, tell them to identify three main things they know about air pollution. **Activity:** Now ask students these questions: 1. What is air pollution? 2. Where does air pollution come from? 3. What are some types of air pollution? **Discussion questions on findings** Based on their answers to the activity questions, ask question as discussion point. What are some of the dangerous gases that pollute the air?	**Predictions** The students identify three main things from their brainstorming and give it to the teacher to write on the board as the three main concepts. **Activity:** Answer the following questions. 1. What is air pollution? 2. Where does air pollution come from? 3. What are some types of air pollution? **Discussion questions on findings** Students discuss on the question and give feedback to the teacher. **Key words:** 1. Pollution 2. Air Pollution	**Concepts and Misconceptions** **Strategy:** **Students work in pairs/groups** Teacher introduces the key words for the lesson before summarizing the lesson.
Conclusion **5 mins**	✧ **In our today's lesson, what did you discover or learn from this lesson?**	**Summary:** • Air pollution occurs when things that are not normally there are added to the air.	The students' conclusion should reflect the key concepts and also the students' prediction in the lesson.

BLACK BOARD PLAN SAMPLE

Lesson Title: Types of air pollution **Key question:** What are some types of air pollutions **Prediction:**	**Activity:** 1. What is air pollution? 2. Where does air pollution come from? 3. What are some types of air pollution? **Discussion** Q: What are some of the dangerous gases that pollute the air?	**Summary** • Air pollution occurs when things that are not normally there are added to the air.

Challenge for students:

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Guided lesson sample 4

Lesson Title: Respiration in plants	Lesson No: 04
Strand: Life	Unit: Plants
Topic: Gas exchange system in Plants	Sub-topic: Respiration in plants
Content Standard:	8.1.1 Students will be able to Investigate the respiration and photosynthesis, and gas exchange systems of plants.
Benchmark:	8.1.1.1. Investigate the process of respiration in plants.
Key Question:	How does respiration take place in a plant?
Lesson objective:	By the end of the lesson, the students can; • Describe how respiration takes place in a plant.
Teaching period:	40 minutes
Preparations:	Flask, germinating bean seed, cotton wool and thermometer
Key words:	Respiration, Oxygen, Carbon-dioxide, Energy

Learning content

Knowledge	Skills	Attitudes and Values
What is respiration? Respiration is a process in which plants absorb free molecules of oxygen (O2) and use them to create water, carbon dioxide, and energy, which helps the plant grow. How does respiration take place? Plants need oxygen for respiration process to take place. Respiration normally takes place in the nights through different plant parts such as roots, stem or leaves.	Predicting Hypothesising Asking questions Testing ideas scientifically Summarizing main ideas from a problem	Value the biological process involved for supporting the growth of plants. Respect and take care of plants. Develop curiosity, open-mindedness, perseverance, a positive approach to errors and mistakes in experiences

Teacher's Notes:

It is important that teachers revise the definition of pollution and pollutants and create handouts and worksheets for students on this lesson.

1. Explain respiration process in plants
2.

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 respiration. "What is the role of stomata?"	**Key Question**  How does respiration take place in plants?	Students will use their prior knowledge about respiration to link to today's lesson.
Body **35 mins**	**Predictions** Allow students to discuss their views about how respiration takes place in a plant. Collect and acknowledge all the response. Do not indicate whether it's a correct or wrong answer. Encourage the students to write down their ideas in their books. **Activity:** **Conduct experiment to test students' ideas.** Lead the students into the main experiment by asking these questions What helps plants to break down the energy in the food taken in/ absorbed? (chemical reaction) Inform the students that the chemical reaction is referred to as: Respiration. **Discussion questions on findings** Lead the students through the discussion about their findings. Main questions for students to discuss. 1. What happens to the temperature when the seeds are heated? 2. What do the germinating seeds represent? 3. Why do we use germinating seeds? 4. What will happen to the germinating seeds after the experiment? Introduce the key words for the lesson "Respiration in plants"	**Predictions** Discuss and their views about how respiration takes place in a plant. Present to their view and ideas to the whole class. **Activity:** **Conduct experiment to test their ideas.** Respond to the lead up question for the experiment. **Answer:** Chemical reaction Observe the experiment in which germinating bean seeds. The thermometer is used to take the temperature readings before and after heating of the germinating bean seeds. Students discuss their findings. **Discussion questions on findings** Engage students to go through discussions on the findings. Answer the discussion questions based on the findings. 1. The temperature increased when the seeds are heated. 2. The germinating seeds represent the plant. 3. We use germinating seeds to see how process of respiration in plants. 4. The germinating seeds will eventually grow into seedlings. Key words "Respiration, Oxygen, Carbon-dioxide and Energy"	**Concepts and Misconceptions** Common misconception Emphasize that respiration is not the same as breathing. Breathing is the physical process whereby intercostal muscle and diaphragm takes air in and out of the lungs. On the other hand, respiration is the release of air, energy or water from a certain substance such as food in all living organisms **Strategy:** Groupings

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 respiration take place in plants? Guide students by having them to summarize what they have learnt about "respiration in plants.	**Summary:** • In the process of respiration for plants, the plants take in oxygen, and release carbon dioxide. • Carbon dioxide from respiration is used for photosynthesis while Oxygen released from photosynthesis is used for respiration. This process continues day and night.	The students' conclusion should reflect the key concepts in the lesson.

BLACK BOARD PLAN SAMPLE

Title: Respiration in plants	**Discussion**	**Summary**
Key question: How does respiration takes place in plants? **Activity:** **Lead-up question to the experiment.** **What helps plant**s to break down the energy in the food taken in/ absorbed? (chemical reaction)	1. The temperature increased when the seeds are heated. 2. The germinating seeds represent the plant. 3. We use germinating seeds to see how process of respiration in plants. 4. The germinating seeds will eventually grow into seedlings.	• In the process of respiration for plants, the plants take in oxygen, and release carbon dioxide. • Carbon dioxide from respiration is used for photosynthesis while Oxygen released from photosynthesis is used for respiration. This process continues day and night.

Challenge for students:

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Guided lesson sample 5

Lesson Title: Relationship between the Strength of Electric Currents and Magnetic Fields	Lesson No: 38
Strand: Physical Science	**Unit:** Energy
Topic: Electric Current and Magnetic Fields	**Sub-topic:** Magnetic Fields around Electric Currents
Content Standard:	**8.2.1** Investigate the relationship between the electric current and the magnetic field
Benchmark:	**8.2.1.3** Examine the direction of magnetic field around the electric current
Key Question:	What is the relationship between the strength of Electric Currents and Magnetic Fields?
Lesson objective:	By the end of the lesson the students can; • Identify what determines the direction of magnetic field around the electric current
Teaching period:	40 minutes
Preparations:	Magnets, Iron filings, Simple electromagnet, Small compass
Key word(s):	• Strength of Electric Currents • Strength of Magnetic Fields

Learning content

Knowledge	Skills	Attitudes and Values
• Magnetic materials are attracted to the magnet before they touch. • Magnets produce an invisible field of attraction which is called the magnetic field. • Magnetic fields	• Identify how this magnetic fields are created • Identify the flow of magnetic field around an electric current	• Appreciate magnetic fields and electric currents

Teacher's Notes:

Electric current produces a **magnetic field**. This **magnetic field** can be visualized as a pattern of circular **field** lines surrounding a wire. One way to explore explore the direction of a **magnetic field** is with a compass, as shown by a long straight **current** carrying wire in.

Teacher's Notes:

3.
4.

LESSON PROCEDURE

Time section	Teacher activity	Student activity	Points to notice
Introduction **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 "Direction of magnetic Field around Electric Current"?	**Key Question** What determines the direction of magnetic field around the electric current	Students will use their understanding from the previous lesson
Body **35 mins**	**Predictions** Iron filing will show shape of magnets Write the predictions on the Blackboard **Activity**: Give some examples of the presence of magnetic field being represented by iron filings For example; Iron filings represent the magnet Introduce the key word for the lesson "electric current"	**Predictions** Allow students to discuss in groups and provide their predictions with justification. **Activity:** Give examples of the presence of magnetic field in different situations For example; • Iron filings will represent the shape of magnet…straight magnet or U shaped magnet **Key word** "magnetic field"	Concepts and Misconceptions Magnets field are not created but touch each other **Strategy:** Groups
Conclusion **5 mins**	✧ **In our today's lesson, what did you discover or learn from this lesson?** Guide students by having them to summarize what they have learnt about direction of magnetic field in relation to electric currents.	**Summary**: • Magnets field are not created but touch each other	The students' conclusion should reflect the key concepts in the lesson.

Teacher's Notes:

Hooke's Law
A low in physical that states that the strain in a solid is proportional to the applied stress within the elastic limit of that solid. For relatively small deformation of an object, the displacement or size of the deformation is directly proportional to the deforming force

BLACK BOARD PLAN SAMPLE

Title: Relationship between the Strength of Electric Currents and Magnetic Fields Key question What is the relationship between the strength of Electric Currents and Magnetic Fields? Activity: Give some examples of the presence of magnetic field being represented by iron filings	**Discussion** Iron filings will represent the shape of magnet…straight magnet or U shaped magnet	**Summary** Magnets field are not created but touch each other

Challenge for students:

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Guided lesson sample 6

Lesson Title: Relationship between the Strength of Electric Currents and Magnetic Fields	Lesson No: 53
Strand: Physical Science	**Unit:** Energy
Topic: Force and Work	**Sub-topic:** Work and Power
Content Standard:	8.2.2 Investigate the relationship between force and work
Benchmark	8.2.2.4 Apply Hooke's law to demonstrate that the extension of the spring is proportional to the load applied.
Key Question:	How can force be measured?
Lesson objective:	By the end of the lesson the students can; • Correctly restate how force can be measured.
Teaching period:	40 minutes
Preparations:	Spring , load,
Key word(s):	• Object, load, deformation,

Learning content

Knowledge	Skills	Attitudes and Values
Hooke's Law A law in physics that states that the strain in a solid is proportional to the applied stress within the elastic limit of that solid	Develop the ability to correctly demonstrate and explain Hooke's Law using a spring and load.	Appreciate and value Hooke's Law

Teacher's Notes:

Hooke's Law
A low in physics that states that the strain in a solid is proportional to the applied stress within the elastic limit of that solid. For relatively small deformation of an object, the displacement or size of the deformation is directly proportional to the deforming force

LESSON PROCEDURE

Time section	Teacher activity	Student activity	Points to notice
Introduction **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 "calculating power"?	 **Key Question** How can force be measured?	Students will use their understanding from the previous lesson
Body **35 mins11**	**Predictions** What is it that puts a dent in an empty can drink when we squeeze it? Write the predictions on the Blackboard **Activity:** Give some examples of the situations where force is exerted on a solid. • Springs on a vehicle absorb the weigh and therefore a flat when weight is removed they are bended	**Predictions** Allow students to discuss in groups and provide their predictions with justifications **Activity:** Give examples of the displacement or size of deformation when force is exerted on the object Use a weighing scale to demonstrate hooke's law **For example;** Squeezing an empty can of drink **Key word** Force, deformation	**Concepts and Misconceptions** the strain in a solid is proportional to the applied stress within the elastic limit of that solid **Strategy:** Groups
Conclusion **5 mins**	✧ **In our today's lesson, what did you discover or learn from this lesson?** Guide students by having them to summarize what they have learnt about measuring force.	**Summary:** the strain in a solid is proportional to the applied stress within the elastic limit of that solid	The students' conclusion should reflect the key concepts in the lesson.

BLACK BOARD PLAN SAMPLE

Title:	Discussion	Summary
Measuring force (using a spring **Key question** How can force be measured? **Activity:** Give some examples of the situations where force is exerted on a solid.	Give examples of the displacement or size of deformation when force is exerted on the object Use a weighing scale to demonstrate hooke's law Use a weighing scale to demonstrate hooke's law For example; Squeezing an empty can of drink	• The strain in a solid is proportional to the applied stress within the elastic limit of that solid

Challenge for students:

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Guided lesson sample 7

Lesson Title: Conserving mass of a substance	**Lesson No: 77**
Strand: Physical Science	**Unit:** Matter
Topic: Chemical changes	**Sub-topic:** Chemical changes and the mass of substances
Content Standard:	**8.2.3** Students will be able to investigate the different types of chemical change and their properties
Benchmark:	**8.2.3.3.** Describe conservation and regularity of mass in chemical changes.
Lesson Title:	Conserving mass of a substance
Key Question:	What is the relationship between the mass before the chemical change and after the chemical change?
Lesson objective:	**By the end of the lesson the students can;** • Discover that the sum for the mass of the reactant is equal to the sum total for the mass of the product material. • Conduct experiments to measure the mass of substances before and after the chemical change
Teaching period:	**40 minutes**
Key words:	Reactant , Product

Learning content

Knowledge	Skills	Attitudes and Values
• The law of conservation of matter states that matter cannot be created or destroyed. • The sum of the mass of reactant is equal to the sum total of the product material	• Conduct experiments to measure the mass of substances before and after chemical changes. • Use chemical symbols to write chemical equations	Show curiosity to learn about conservation of mass before and after a chemical reaction.

Teacher's Notes:

This lesson requires trialling. Students will come with the misconception that some mass is lost during the chemical change. Therefore necessary matierals should be prepared before-hand. Ensure that reactants used are not dangerous.

1. Be careful not to spill liquid on the bench when pouring liquid into a measuring cylinder
2. Handle apparatus with care when handling them

1.
2.

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 prior knowledge and experience on the conservation of mass of a substance.</td><td>Key Question

What is the relationship between the mass before the chemical change and after the chemical change?</td><td>Students will use their prior knowledge about chemical change to link to today's lesson.</td></tr>
<tr><td>Body

35 mins</td><td>Predictions

Allow students to discuss their views and ideas on what will happen to the mass of a substance before and after the chemical change.

Activity:
Find the mass of the substances before and after chemical change.

<table><tr><th>Mass of Reactant (g)</th><th>Mass of Reactant (g)</th><th>Mass of Product (g)</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></table>
Discussion questions on findings

Lead the students through the discussion about their findings.

Main questions for students to discuss.
1. Why is there no difference in the mass of the substance before and after the chemical change?

Introduce the key words for the lesson "reactant and product"</td><td>Predictions

Discuss and their views and ideas about what will happen to the mass of a substance before and after the chemical change.

Present to their view and ideas to the whole class.
Activity:
Find the mass of the substance before and after chemical change.

In groups measure the mass of the different reactants and record them in their exercise books

Discussion questions on findings
Engage students to go through discussions on the findings.

Answer the discussion questions based on the findings.
1. Why is there no difference in the mass of the substance before and after the chemical change?

Compare their predictions with their results
Key words
"Reactant and Product"</td><td>Concepts and Misconceptions

Students will come with the misconception that some mass is lost during the chemical change.

Strategy:

Groupings</td></tr>
<tr><td>Conclusion

5 mins</td><td>✧ 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 relationship between the mass before the chemical change and after chemical change?

Guide students by having them to summarize what they have learnt about "Conserving mass of a substance".</td><td>Summary:
• The mass of the substance is the same before and after the chemical change.
• The law of conservation of matter states that matter cannot be created or destroyed.</td><td>The students' conclusion should reflect the key concepts in the lesson.</td></tr>
</table>

BLACK BOARD PLAN SAMPLE

Title: Conserving mass of a substance

Key question:

What is the relationship between the mass before the chemical change and after the chemical change?

Activity:
Find the mass of the substances before and after chemical change.

Mass of Reactant (g)	Mass of Reactant (g)	Mass of Product (g)

Discussion

1. Why is there no difference in the mass of the substance before and after the chemical change?

Summary

- The mass of the substance is the same before and after the chemical change.
- The law of conservation of matter states that matter cannot be created or destroyed.

Challenge for students:

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Guided lesson sample 8

Lesson Title: Process of Rock Cycle	**Lesson No: 04**
Strand: Earth and Space	**Unit:** Our Earth
Topic: Rock Cycle	**Sub-topic:** How rocks form
Content Standard:	**8.3.2** Students will be able to investigate the gas exchange system in plants
Benchmark:	**8.3.2.4** Describe the process of rock cycle.
Key Question:	What are some processes that change one rock to another?
Lesson objective:	**By the end of the lesson, the students can;** • Describe the process of rock cycle.
Teaching period:	**40 minutes**
Preparations:	Chart with diagram showing the process of rock cycle.
Key words:	Rock cycle

Learning content

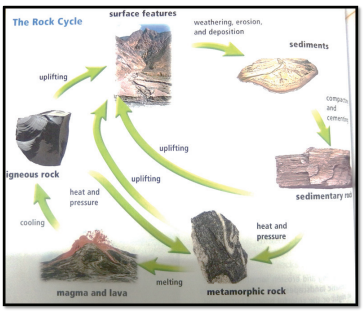
Knowledge	Skills	Attitudes and Values
The three processes that change one rock to another are crystallization, metamorphism, and erosion and sedimentation. Any rock can transform into any other rock by passing through one or more of these processes. This creates the rock cycle.	Observing Inferring Predicting	Appreciate the processes that change one rock to another.

Teacher's Notes:

The students will have known the three types of rocks with their characteristics by now. In this lesson, students will come to realize that the process of rock cycle involves the whole process of each of the three types of rock combined. This lesson is more or less like a summary lesson based on the formation of the three types of rocks learned earlier in the unit.

1. Outline the process of rock cycle using a flow chart with description

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 rocky cycle. "What are some characteristics of the three types of rocks?"	**Key Question** What are some processes that change one rock to another?	Students will use their prior knowledge about rock cycle to link to today's lesson.
Body **35 mins**	**Predictions** Allow students to discuss their views and ideas on processes that change one rock to another. Ask the students present their views and ideas to the whole class by writing on the black board. **Activity**: Study the rock cycle process in the diagram on the chart and describe the process of how rock can change in different ways. Ask students to present their work to the whole class. Discussion questions on findings Lead the students through the discussion about their findings. Main questions for students to discuss. 1. Name the three processes or causes that change one rock to another during the rock cycle process. Introduce the key words for the lesson "Rock Cycle"	**Predictions** Discuss their views and ideas about processes that change one rock to another. Present to their views and ideas to the whole class by writing on the blackboard. **Activity:** Study the rock cycle process in the diagram on the chart and describe the process of how rock can change in different ways.  Present their work the whole class. **Discussion questions on findings** Engage students to go through discussions on the findings. Answer the discussion questions. 1. Name the three processes or causes that change one rock to another during the rock cycle process. Compare their predictions with their results **Key words** "Rock Cycle"	**Concepts and Misconceptions** Rock can change to new rock in different ways. This process is called rock cycle. **Strategy:** Groupings
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 do rocks formed? Guide students by having them to summarize what they have learnt about "Process of rock cycle".	Summary: • Rock can change to new rock in different ways. This process is called rock cycle. • The three processes that change one rock to another are crystallization, metamorphism, and erosion and sedimentation.	The students' conclusion should reflect the key concepts in the lesson.

BLACK BOARD PLAN SAMPLE

Title: Process of Rock Cycle **Key question:** What are some processes that change one rock to another? **Activity:** Study the rock cycle process in the diagram on the chart and describe the process of how rock can change in different ways.	**Discussion Question:** 1. Name the three processes that change one rock to another during the rock cycle process. **Answer:** 1. Crystallization 2. Metamorphism 3. Erosion and sedimentation	**Summary** • Rock can change to new rock in different ways. This process is called rock cycle. • The three processes that change one rock to another are crystallization, metamorphism, and erosion and sedimentation.

Challenge for students:

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Guided lesson sample 9

Lesson Title: Components of solar system satellite (moon)	Lesson No: 112
Strand: Physical science	**Unit:** Space
Topic: Exploring space	**Sub-topic:** Space
Content Standard:	**8.3.4.** Students will be able to exploring space, solar system and the galaxy.
Benchmark:	**8.3.4.4.** Explain the solar system and its components.
Key Question:	What are the components in the solar system satellite?(moon)
Lesson objective:	By the end of the lesson the students can; • Identify the components in the solar system the moon.
Teaching period:	**40 minutes**
Preparations:	Pictures of the moons and components of the solar system
Key word(s):	Moon, solar system

Learning content

Knowledge	Skills	Attitudes and Values
• The moon is the fifth largest natural satellite in the solar system. • Earth has one moon rotates 27, 3 days. • The moon is a natural satellite orbits the earth and sun.	• Do hypothesis on how long the moon orbits the sun. • Make sketches of the appearance.	• Appreciate the moon as main source and component of the solar system.

Teacher's Notes:

Follow up on students doing research on how the moon orbits the sun.

1. Draw and label diagram on how the moon orbits the earth
2. Draw and label diagram on how the moon orbits the sun.

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 "Components of Solar system planets"? (Planets are components of the solar system they orbit the sun.	Key Question What are the satellite components of the solar system?	Students will use their understanding from the previous lesson "Components of solar system planets"
Body **35 mins**	**Predictions** Are there also other satellite components apart from the planets in the solar system? Write the predictions on the Blackboard Activity: Eg: Does earth have a moon in the solar system? Yes/no 1. Does the moon orbit the earth and the sun? 2. Do other planets have moons? **Key word** Introduce the key word for the lesson "Moon"	**Predictions** Allow students to discuss in groups and provide their predictions with justifications **Activity:** Eg: Does earth have a moon in the solar system? Yes/no Does the moon orbit the earth and the sun. 2. Do other planets have moons? **Key word** "Moon"	**Concepts and Misconceptions** Does the moon orbit the earth and the sun? Yes it does. **Strategy:** Groups
Conclusion **5 mins**	✧ In our today's lesson, what did you discover or learn from this lesson? Guide students by having them to summarize what they have learnt about moon.	Summary: • The moon is the fifth largest natural satellite in the solar system. • Earth has one moon. • Moon orbits earth 27.3 days and orbits sun too. • Other planets may have moons.	The students' conclusion should reflect the key concepts in the lesson.

BLACK BOARD PLAN SAMPLE

Title:	Discussion	Summary
Key question: What are the satellite components of the solar system? **Activity:** Eg: Does earth have a moon in the solar system? Yes/no 1. Does the moon orbit the earth and the sun? 2. Do other planets have moons?	**Activity:** Eg: Does earth have a moon in the solar system? Yes/no 1. Does the moon orbit the earth and the sun? 2. Do other planets have moons?	• The moon is the fifth largest natural satellite in the solar system. • Earth has one moon. • The moon is a natural satellite it orbits the earth and sun. • Other planets may have moons

Challenge for students:

The moon orbits the earth 27.3 days. How long does the moon take to orbit the sun?

Guided lesson sample 10

Lesson Title: Effects of heat on volume	Lesson No: 62
Strand: Physical Science	**Unit:** Force and Motion
Topic: State Changes	**Sub-topic:** State Change and Heat
Content Standard:	**8.2.4** Students will be able to investigate the arrangement of particles when heat is applied in matter.
Benchmark:	**8.2.4.2.** Analyse the effect of heat on volume and the motion of particles in solid, liquid and gas.
Key Question:	What happens to the volume of solids, liquids and gases when heat is added?
Lesson objective:	By the end of the lesson, the students can; • Investigate the effects of heat on volume of different states.
Teaching period:	**40 minutes**
Preparations:	stove, 2x empty pet bottle, water, ice , 2 x bowl / pot match
Key words:	Volume of solid, volume of liquid, volume of solid

Learning content

Knowledge	Skills	Attitudes and Values
• In a solid when heat is added the space between the particles increases so its volume increases. • When heat is added in a liquid at the surface some particles are able to escape into the air while others do not have enough energy and remain in the liquid. As the liquid expands so does its volume • In the case of gas, there is one condition. As the pressure is maintained constant, then increase in temperature will also increase volume.	• Explain the effect of heat on the volume of solid, liquid and gas • Use given materials to model the effects of heat on the volume of matter	

Teacher's Notes:

In order to fully understand the concept of the effects of heat on volumes of solids, liquid and gas, students must firstly understand the concept of the arrangement of particles in the different states of matter. It is also important that students learn the effects of heat on solid, liquid and gas. This will give them a clear picture to learn about the effects of heat on volumes of solid, liquid or gas.

1. Take extra care when using fire
2. Use a thong to hold hot objects

1. Explain the effect of heat on volume in solid, liquid and gas.
2. Model the effects of heat on the volume of matter.

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. Introduce the lesson by asking the students the following questions. • *How are particles in solids arranged?* • *How are particles in solids arranged?* • *What happens to the water if heat is added?*	 **Key Question** What happens to the volume of solids, liquids and gases when heat is added?	Students will use their prior knowledge on arrangement of particles and effects of heat on matter to link to today's lesson.
Body **35 mins**	***Predictions*** What will happen to volume of this container if heat is added? Explain the activity steps and safety rules to the students. **Activity 1:** 1. Observe the shape of the container and draw it in your exercise book. 2. Pour some ice cubes into a bowl or pot. 3. Place the empty container into the ice cubes. (Ensure that the lid is tightly closed and sits firmly in the ice.) 4. Tell the students to observe and record what they see in their book. **Activity 2:** 1. Use another empty container 2. Pour some water into a bowl or pot. 3. Light the stove and place the pot on the stove 4. Place the empty container into the pot of water. (Ensure that lid is closed tightly) 5. Tell the students to observe and record what they see in their exercise **Discussion questions on findings** Lead the students through the discussion about their findings. 1. What happens to the container when it is placed into the ice? 2. What happens to the container when the container is placed in the pot of boiling/hot water? **Key word** Introduce the key word for the lesson "Volume"	***Predictions*** *Students discuss and provide feedback on the question.* **Activity 1:** 1. Observe the shape of the container and draw it in your exercise book. 2. Pour some ice cubes into a bowl or pot. 3. Place the empty container into the ice cubes. (Ensure that the lid is tightly closed and sits firmly in the ice.) 4. Tell the students to observe and record what they see in their book. **Activity 2:** 1. Use another empty container 2. Pour some water into a bowl or pot. 3. Light the stove and place the pot on the stove 4. Place the empty container into the pot of water. (Ensure that lid is closed tightly) 5. Observe and record what you see in your exercise **Discussion questions on findings** Answer the discussion questions. 1. What happens to the container when it is placed into the ice? 2. What happens to the container when the container is placed in the pot of boiling/ hot water? **Key word** "Volume"	**Concepts and**

Conclusion **5 mins**	✧ **In our today's lesson, what did you discover or learn from this lesson?** Guide students by having them to summarize what they have learnt about effects of heat on the volume.	**Summary:** • If the temperature of gas increases, the particles move faster and strike the sides of the container more often and with more force. The container expands due to increased pressure • When the temperature of gas decreases, the energy of the particles decreases and they move slowly. The lowering of the temperature lowers the temperature therefore can cause the side of the container to crumple inwards. The pressure inside the bottle becomes lower than the air pressure outside the bottle.	The students' conclusion should reflect the key concepts in the lesson.

KSAVs for the Lessons for grade 8 lessons

STRAND: Life	UNIT: Plants & Animals	TOPIC: Cells
CONTENT STANDARD: 8.1.2. Students will be able to investigate the structure of plant and animal cells.		

Lesson Title: What are cells? **Lesson No.01**

Benchmark: 8.1.2.1. Investigate the structure of plant and animal cells, and draw appropriate conclusions.

Key question: What are cells?

Lesson objective: By the end of the lesson, the students can;

- Identify cells

Knowledge	Skills	Attitudes
Cells are the smallest structural and functional unit of an organism, microscopic has cytoplasm and nucleus in a membrane.	Research and make infer of cells.	Accept and appreciate the value of cells.

Lesson Title: Properties of cells **Lesson No.02**

Benchmark: 8.1.2.1. Investigate the structure of plant and animal cells, and draw appropriate conclusions.

Key question: What are the properties of cells?

Lesson objective: By the end of the lesson, the students can;

- Identify properties of cells

Knowledge	Skills	Attitudes
Properties of cells • Cells acquire and utilize energy. • Cells carry out a variety of chemical reactions • Cells engage in mechanical activities • Cells are able to respond to stimuli.	Do a **hypothesis** on the different properties functions.	Accept and appreciate the properties of cells.

Lesson Title: Structure of plant cells **Lesson No.03**

Benchmark: 8.1.2.1. Investigate the structure of plant and animal cells, and draw appropriate conclusions.

Key question: Do you know the structure of plant cells?

Lesson objective: By the end of the lesson, the students can;

- Identify the structure of the plant cells.

Knowledge	Skills	Attitudes
Structure of the plant cell. • Cell wall • Vacuole • Chloroplasts • Cell membrane • Nucleus • Tonoplasts	**Draw** diagrams of plant structure and **label correctly**.	Appreciate and value the structure of the plant cells.

Lesson Title: Functions of plant cells **Lesson No.04**

Benchmark: 8.1.2.2. Examine the functions of parts of plant cells and animal cells.

Key question: Do you know the function of plant cells?

Lesson objective: By the end of the lesson, the students can;

- Identify the functions of plant cells.

Knowledge	Skills	Attitudes
Plant cell functions **Nucleus**-control center of the cell. Stores information for cell functions. **Chloroplasts**-contain green pigment chlorophyll need in photosynthesis. **Cytoplasm**-Jelly-like where cell activity takes place. **Cell membrane**-thin, control the substance that enter or exist the cells. **Cell wall**-stiff wall gives plant cell their shape.	**Make models** of the plant cells and labeling parts and functions.	Accept and Appreciate the functions of cells.

Lesson Title: Structure of animal cells **Lesson No.05**

Performance standards: 8.1.2.1. Investigate the structure of plant and animal cells, and draw appropriate conclusions

Key question: What is the animal structure?

Lesson objective: By the end of the lesson, the students can;

- Identify the structure of the animal cell.

Knowledge	Skills	Attitudes
Animal cell structure has the following: • Nucleus • Cell membrane • Cytoplasm • Mitochondria	**Research and make models** of the animal cell structure and **label.**	Accept and appreciate animal cells.

Lesson Title: Functions of animal cells **Lesson No.06**

Performance standards: 8.1.2.2. Examine the functions of parts of plant cells and animal cells.

Key question: What are the functions of animal cells?

Lesson objective: By the end of the lesson, the students can;

- Identify the functions of animal cells.

Knowledge	Skills	Attitudes
Function of animal cells **Nucleus-**control center of the cell stores information for cell function. **Cytoplasm**-Jelly-like where cell activities take place. **Cell membrane**-thin controls the substances that enter or exit the cells.	**Research make models and label animal cell.**	Accept and appreciate the properties of cells.

STRAND: Earth and Space	UNIT: Space	TOPIC: Exploring space
CONTENT STANDARD: 8.3.4. Students will be able to explore space, the solar system, and the galaxy.		

Lesson Title: What is a Universe? **Lesson No.122**
Benchmark: 8.3.4.1. Examine the universe.
Key question: What is a universe?
Lesson objective: By the end of the lesson, the students can;

- Identify a universe.

Knowledge	Skills	Attitudes
The Universe is all of space, time, planets, stars, galaxies, and other forms of matter and energy.	**Research and make models** of the universe.I**nfere** on what makes up the universe.	Accept and appreciate the universe.

Lesson Title: How do we study the Universe? **Lesson No.114**

Benchmark: 8.3.4.2. Investigate different ways of observing the universe and evaluate their effectiveness.

Key question: How do you study the Universe?

Lesson objective: By the end of the lesson, the students can;

- Identify different ways on how to study the universe.

Knowledge	Skills	Attitudes
The study of the universe is called cosmology which is related to large scale proportions of the universe as a whole. Use scientific method to understand the origin, evolution, and ultimate fate of the universe. **WAYS (modern)** Optical Telescopes. Radio Telescopes. Space Telescopes. Space Probes, space shuttles, Computers.Theories.Mathematical Models.	Use **Observation skills** to study the universe by **constructing models** of different methods.	Accept and appreciate the different ways the universe is studied.

Lesson Title: History of space exploration **Lesson No.115**
Benchmark: 8.3.4.3. Use basic research skills to investigate and report on the history of space exploration.
Key question: Do you know when space was explored?
Lesson objective: By the end of the lesson, the students can;

- Identify when space was explored.

Knowledge	Skills	Attitudes
History of space exploration On **Oct. 4, 1957**, the Soviets launched the first artificial satellite, Sputnik 1, into space. Four years later on **April 12, 1961**, Russian Lt. Yuri Gagarin became the first human to orbit Earth in Vostok 1. His flight lasted 108 minutes, and Gagarin reached an altitude of 327 kilometers (about 202 miles).	Develop ideas or skills on how to explore space. **Infer** if you can explore space.	Appreciate and value space exploring.

Lesson Title: What is solar system? **Lesson No.116**
Benchmark: 8.3.4.4. Explain the solar system and analyse its components.
Key question: What is a solar system?
Lesson objective: By the end of the lesson, the students can;
- Identify the solar system and its components.

Knowledge	Skills	Attitudes
The solar system consists of planets,moons, comets, asteroids, minor planets, and dust and gas. Planets close to the sun formed from heavy rocky material has one or no moons. Further away held onto lighter gases to form larger planets and have more moons.	Make models of the solar system by having the sun as the main source and make **hypothesis of components in the solar system.**	Appreciate and accept that the sun is the center of the solar system.

Lesson Title: Components of the solar system- Sun **Lesson No.117**
Benchmark: 8.3.4.4. Explain the solar system and analyse its components.
Key question: What are the components in the solar system?
Lesson objective: By the end of the lesson, the students can;
- Identify components in the solar system.

Knowledge	Skills	Attitudes
Components in the solar system 1.Sun: The sun lies in the heart of the solar system, where it is the largest object. Its components are: (8) planents,dwarf planents, asteroids, comets, meteoroids.	**Research and make models** of the components in the solar system the sun in the center.	Accept and appreciate the solar system and its components.

Lesson Title: Components of the solar system-planets **Lesson No.118**

Benchmark: 8.3.4.4. Explain the solar system and analyse its components.

Key question: What are the components of the solar system?

Lesson objective: By the end of the lesson, the students can;

- Identify components of the solar system-planets

Knowledge	Skills	Attitudes
Components in the solar system-planets The next largest objects in the **Solar System** are the **planets**. There are generally considered to be eight **planets** in the **Solar System**. Two types: (1) the gas giant **planets**, which include Jupiter, Saturn, Uranus, and Neptune and (2) the terrestrial **planets** Mercury, Venus, Earth, and Mars.	Use **Observation skills** to **construct models** of different planets in the solar system from their order from the sun and further.	Accept and appreciate the components of the solar system the planets.

Lesson Title: Structure of solar system **Lesson No.120**

Benchmark: 8.3.4.4. Explain the solar system and analyse its components.

Key question: Do you know the structure of the solar system?

Lesson objective: By the end of the lesson, the students can;

- Identify the structure of the solar system.

Knowledge	Skills	Attitudes
Solar System Structure. It consists of one small star (the Sun), eight planets, a few billion asteroids and billion comets and masses of dust and gas.	Develop and draw **ideas or skills make** structure of the solar system.	Appreciate and value the structure of the solar system.

Lesson Title: Motion of objects in the solar system **Lesson No.121**

Benchmark: 8.3.4.5. Probe the motion of objects in the solar system.

Key question: Do you kånow the movement of objects in the solar system?

Lesson objective: By the end of the lesson, the students can;

- Identify the motion of objects in the solar system.

Knowledge	Skills	Attitudes
Motion of the solar system. Newton realized that the planets orbit the Sun is **related** to why objects fall to Earth when we **drop** them. The Sun's gravity pulls on the planets, just as Earth's gravity pulls down anything that is not held up by some other force and keeps you and me on the ground.	**Make models** of the solar system by having the sun as the main source and the planets orbit the sun and infer.	Appreciate and accept that the sun is the center of the solar system and planets orbit the sun.

Lesson Title: What is a Galaxy? **Lesson No.122**

Benchmark: 8.3.4.6. Examine the galaxy.

Key question: What is a Galaxy?

Lesson objective: By the end of the lesson, the students can;

- Identify a galaxy.

Knowledge	Skills	Attitudes
Galaxy contains stars, gas and dust. In a spiral **galaxy** like the **Milky Way**, the stars, gas, and dust are organized into a "bulge," a "disk" containing "spiral arms," and a "halo." Elliptical **galaxies** have a bulge-like central region and a halo, but **do** not have a disk. Two main parts a bulge and a halo. Three main galaxies Spiral, Elliptical and Irregular galaxy.	**Research and make models** of the milky way galaxy and **infer** of the position of the solar system.	Accept and appreciate that we live in the galaxy. eg: milky way galaxy.

STRAND: PHYSICAL SCIENCE	UNIT: Weather and Climate	TOPIC: Weather and Climate
CONTENT STANDARD: 8.3.3. Students will be able to investigate weather, climate, and the effects of climate change.		

Lesson Title: Definition of climate **??** **Lesson No. 80**

Benchmark: a) Identify factors that determine climate.

Key question: What is climate?

Lesson objective: By the end of the lesson, the students can;

- Identify and Define climate.

Knowledge	Skills	Attitudes
Climate is - Weather conditions of a region such as temperature, air pressure, humidity, precipitation, sunshine, cloudiness and winds throughout the year.	Read and answer questions on a climate graph.	Appreciate and accept the weather and climate conditions in their own areas.

Lesson Title: Factors of climate. **Lesson No. 81**

Benchmarks: 8.3.3.1. Investigate the factors that determine climate and draw appropriate conclusions.

Key question: What are the factors of climate?

Lesson objective: By the end of the lesson, the students can;

- Identify factors that affect climate.

Knowledge	**Skills**	**Attitudes**
Climate has (6) major factors: Latitude, Ocean currents, Winds and Air masses, Elevation, (Altitude), Relief, Near water.	**Observe** and record the (6) major factors and **infer** if they affect the climate.	Accept and Appreciate that climate is determined by the factors over a period of time.

Lesson Title: Types of climate **(**globally) **Lesson No. 83**

Benchmark: 8.3.3.4. Analyse the causes and the effects of the different types of climate change.

Key question: What are the types of climate globally?

Lesson objective: By the end of the lesson, the students can;

- Identify the characteristics of climate globally.

Knowledge	Skills	Attitudes
Characteristics of climate globally: Polar and Tundra. Polar climates are cold and dry, with long, dark winters. ... Boreal Forest. Mountain Temperate forest Mediterranean Desert Dry grassland Tropical grassland	Research and predict the type of climate for other parts of the world.	Accept and appreciate characteristics of climate globally.

Lesson Title: Climate in Papua New Guinea **Lesson No. 84**

Benchmark: 8.3.3.3. Examine the characteristics of climate in Papua New Guinea.

Key question: What are the types of climate in Papua New Guinea?

Lesson objective: By the end of the lesson, the students can;

- dentify the types of climate in Papua New Guinea.

Knowledge	Skills	Attitudes
Climate in Papua New Guinea -Wet and dry humid climate -Tropical climate in coastal 28 C -Inland and mountain areas 26 C - Higher mountains 23 C -Humidity is 70-90 percent	**Research & Predict the types** of climate for coastal, inland and mountain areas and higher mountain areas.	Accept and appreciate the type of climate in different areas of PNG.

Lesson Title: Effects of climate on the earth. **Lesson No.85**

Benchmark: 8.3.3.4. Analyse the causes and the effects of the different types of climate change.

Key question: What are the effects of climate on the earth?

Lesson objective: By the end of the lesson, the students can;

- Identify effects of climate on the earth.

Knowledge	Skills	Attitudes
Effects of climate on the earth. - **Natural** - Global warming, forest fire, volcanic eruptions, ocean currents, methane emissions from animals, sunspots & solar cycle. - **Anthropogenic (caused by men)** - Chemical fertilizers,Deforestation,Increased vehicles, Emissions of GHG,Industries,Emissions of CO2	**Research and record** the effects of climatic change on the earth. Do a **hypothesis** on how to overcome these effects.	Be aware of effects and take precautions on climate change around the world.

Lesson Title: Effects of climate on Human activities **Lesson No. 86**

Benchmark: 8.3.3.4. Analyse the causes and the effects of the different types of climate change.

Key question: What are the effects of climate on human activities?

Lesson objective: By the end of the lesson, the students can;

- Identify effects of climate on human activities.

Knowledge	Skills	Attitudes
Effects of climate on human activities Heat waves, floods, droughts, fire, crop decline and food shortages, Infectious disease, mental illness, violence & conflict.	**Inferring** that climate change can also affect humans by for example food shortages. Do a **hypothesis** on how to overcome food shortages.	Develop positive mindset on how to minimize or cater to accommodate this problem.

Lesson Title: Causes of Climate change **Lesson No. 89**

Benchmark: 8.3.3.4. Analyse the causes and the effects of the different types of climate change.

Key question: What are the causes of climate change?

Lesson objective: By the end of the lesson, the students can;

- Identify causes of climate change.

Knowledge	Skills	Attitudes
Causes of Climate change - Human activities - Greenhouse gas emissions from cars and power plants - Carbon dioxide - Electricity transportation - Cutting down trees	Look at the problem on human activities and **create hypothesis** on how to minimize the causes.	Develop positive mindset with little steps on how to minimize causes of climate change.

Lesson Title: Effects of climate change on the earth **Lesson No.90**

Benchmark: 8.3.3.4. Analyse the causes and the effects of the different types of climate change.

Key question: What are the effects of climate change on the earth?

Lesson objective: By the end of the lesson, the students can;

- Identify effects of climate change on the earth.

Knowledge	Skills	Attitudes
Effects of Climate Change Human, Plants, animals, places are affected by Water flooding, droughts, storms, rising sea levels, wreak people's livelihood and communities.	**Observing** current change and research and **collect data** on effects of climate change.	Develop positive attitudes to eradicate climate change effects.

Lesson Title: Protection of climate change **Lesson No.91**

Benchmark: 8.3.3.5. Evaluate the strategies for mitigating climate change and propose ways of improving them.

Key question: How do we protect our climate?

Lesson objective: By the end of the lesson, the students can;

- Identify ways to protect the climate.

Knowledge	Skills	Attitudes
Use protective ways. - Buy energy efficient products. - Conserve energy at home, work and school. - Plant trees - Reduce, reuse and recycle. - Wise transport choice eg: riding a bicycle.	Look at the problems, and reason out or carry out protective ways. Make a **hypothesis,** ask a question and try to answer it.	Appreciate and use strategies as future leaders to protect the climate.

STRAND: LIFE	UNIT: Interaction and relationship in the environment	TOPIC: Changes in the environment
CONTENT STANDARD: 8.1.3. Students will be able to Investigate environmental changes, evaluate their effects, and analyse strategies for conserving the environment.		

Lesson title: What is an environment change?**??** **Lesson No. 94**

Performance standard:

Key question: What is an environmental change?

Lesson objective: By the end of the lesson the students will be able to:

- Explain clearly what an environmental change is.

Knowledge	Skills	Attitudes and Values
• An environmental change occurs when a natural occurrence or human activity causes difference to the characteristics or features of an environment or the natural surroundings of an organism. • Often several changes occur at once. For example, in some freshwater environments like lakes and ponds, some species respond to environmental change with decreases in their numbers, even to the point of extinction, while others may benefit to excess, becoming so dominant that they present problems, as in the case of harmful algal blooms stimulated by nutrient enrichment or climate warming. • All of the environments on Earth change over time. Some changes are caused by the slow movement of the continents and take millions of years. Other changes are caused by variations in Earth's climate and take thousands of years. • Some changes are caused by people, and these usually occur in relatively short periods of time. For example, a forest can be changed into a farm in just a few months. Every time a physical environment is changed, all the plants and animals in that environment must adapt to the changes or become extinct. Slow changes give living things time to adapt by the process of evolution over many generations. Fast changes usually don't give living things time to adapt, so they must either move elsewhere or become extinct.	• Infer about what an environmental change is. • Conclude that an environmental change occurs when a natural occurrence or human activity causes difference to the characteristics or features of an environment or the natural surroundings of an organism.	• Appreciate learning about what an environmental change is

Lesson title: Causes of environmental changes **Lesson No. 95**

Benchmark: 8.1.3.1. Use basic research skills to investigate the environmental changes caused by human activity and natural events, and draw appropriate conclusions.

Key question: What are some causes of environmental changes?

Lesson objective: By the end of the lesson, the students will be able to identify and discuss some causes of environmental change.

Knowledge	Skills	Attitudes and Values
• Environmental changes are most often caused by human influences and natural ecological processes. Environmental changes can include many numbers of things, including natural disasters, human interferences or animal interaction. • Environmental change does not only include much of physical changes, but it can be things like an infestation of invasive species as well. For example, when a species of plants or animals overrun a place or site in large numbers and become threatening, harmful or unpleasant.	• Infer about the causes of environmental changes. • Observe environmental changes in different environments. • Predict the causes and effects of environmental changes.	• Value the natural environment as important and changing it can have advantages as well as disadvantages.

Lesson title: What is Pollution? **Lesson No. 101**

Benchmark: 8.1.3.3. Probe the different types of pollution and evaluate their effects on the ecosystem.

Key question: What is pollution?

Lesson objective: By the end of the lesson, the students will be able to explain what pollution is.

• Pollution is the contamination of the environment due to harmful substances released through irresponsible human activities. These harmful substances are called pollutants.	• Define and explain the term pollution and pollutants. • Predict what will happen to the environment when it is polluted.	• Value the natural environment and take good care of it.

Lesson title: Types of pollutions **Lesson No.102**

Benchmark: 8.1.3.3. Probe the different types of pollution and evaluate their effects on the ecosystem.

Key question: What are the different types of pollutions?

Lesson objective: *By the end of the lesson, the students will be able to identify and list the different types of pollution.*

Knowledge	Skills	Attitudes and Values
• Land Pollution is the destruction or decline in quality of the Earth's land surfaces in terms of use, landscape and ability to support life forms. • Soil pollution takes place when chemical pollutants contaminate the soil or degraded by acts such as mining, clearance of vegetation cover, or topsoil erosion. • Water pollution happens when water bodies including rivers, oceans, lakes, streams and groundwater are contaminated. It occurs when foreign harmful materials like chemicals or dangerous foreign substances, sewage, pesticides and fertilizers from agricultural runoff, or metals like lead or mercury are directly or indirectly discharged into water bodies. • Air pollution is the contamination of the natural air by mixing it with different pollutants such as harmful fuel and chemicals.	• Observe the types of pollution. • Infer about the effects of the types of pollution.	• Value the natural environment and take good care of it.

Lesson title: Types of pollution – Water pollution **Lesson No. 104**

Benchmark: 8.1.3.3. Probe the different types of pollution and evaluate their effects on the ecosystem.

Key question: What is water pollution?

Lesson objective: By the end of the lesson, the students will be able to explain water pollution.

Knowledge	Skills	Attitudes and Values
• Water pollution is another one of the main types of pollution of the environment. • Water pollution could be in the form of any change in the physical, chemical and biological properties of water which has a harmful effect on living things. It could take place in various water sources, like ponds, lakes, rivers, seas, and oceans.	• Make observations of water sources that were once clean but are now polluted • Predict what will happen if all the water sources were polluted	• Value water as important for survival and take care of it.

Lesson title: Types of pollution – Soil Pollution **Lesson No. 105**

Benchmark: 8.1.3.3. Probe the different types of pollution and evaluate their effects on the ecosystem.

Key question: What is soil pollution?

Lesson objective: By the end of the lesson, the students will be able to explain soil pollution.

Knowledge	Skills	Attitudes and Values
• Land or soil pollution is another of the main types of pollution to the environment. Land or soil pollution is mainly about the contamination and degradation of Earth's land surfaces. • It occurs when waste from various sources – domestic waste, industrial waste, and other wastes are not properly disposed of, causing harmful substances and chemicals to leach into the ground.	• Infer about how soil pollution occurs. • Predict what will happen if all the soil were polluted.	• Value soil as important and polluting it can affect plants, animals and human.

Lesson title: Causes and effects of air pollution **Lesson No. 106**

Benchmark: 8.1.3.3. Probe the different types of pollution and evaluate their effects on the ecosystem.

Key question: What are some causes of air pollution and its effects?

Lesson objective: By the end of the lesson, the students will be able to identify some causes of air pollution and its effects.

Knowledge	Skills	Attitudes and Values
• The most common sources of air pollution include the burning of fossil fuels and from factories and power plants that burn coal and oil. Smoke from factories and power plants can mix with water in the air to make acid rain. Air pollution also comes from cars and other vehicles that burn gasoline. Fumes from aerosols and chemicals like paint also cause air pollution. • Anything people do that involves burning things, using household industrial chemicals or producing large amounts of dust has the potential to cause air pollution. • The higher the concentration of air pollutants, the harder it is to remove it effectively through natural cycles like carbon cycles. • The higher concentration also results in breathing problems for living things. Some effects include increase in smog, higher rain acidity, crop depletion from inadequate oxygen, and higher rates of asthma. Many scientists believe that global warming is also related to increased air pollution. • The main types of pollution gases in the air are carbon dioxide, carbon monoxide, methane, sulphur dioxide, chlorofluorocarbons (CFCs) and nitrogen oxides. • Exposure to air pollution may cause a wide range of health effects. These vary from mild symptoms such as irritation of eyes, nose and throat, to more serious conditions such as lung (respiratory) and heart (cardiovascular) diseases.	• Infer about how air pollution occurs. • Identify and name the main types of pollution gases. • Predict the causes and effects of air pollution.	• Appreciate learning about the causes and effects of air pollution and do their bit to prevent air pollution.

Lesson title: What is Conservation? **Lesson No. 109**

Benchmark: 8.1.3.4. Analyse ways of managing and conserving the natural environment, and propose strategies for improvement.

Key question: What is conservation and management?

Lesson objective: By the end of the lesson, the students will be able to discuss conservation and management and its importance.

Knowledge	Skills	Attitudes and Values
• Everywhere on Earth, people are affecting their environment by farming the land, harvesting the forests, fishing the seas and mining the Earth's surface • To save our environment from destruction, we must manage it well. • Managing the environment is very important. The reason is to maintain and improve the state of an environment that is affected by human activities. It is the process where we take positive steps and behaviours to have a positive effect on the environment. • To conserve natural resources means to protect them from loss or danger. It also means when using natural resources, you think and use them wisely so that you do not waste them or use them up completely. • Conserving natural resources can help them to last and be available for future generations. • Conservation is important to ensure that changes do not happen too quickly. Rapid change can force animals and plants to become endangered and extinct.	• Identify and give examples of the human activities that are affecting the natural environment. • Define and explain the term conservation. • Predict what will happen if the natural environment is completely destroyed by human activities.	• Value our natural environment and take good care of it so that it can be preserved for future generations. • Take positive steps and behaviours to have a positive effect on the environment.

Lesson title: How do we conserve the environment? **Lesson No. 110**

Benchmark: 8.1.3.4. Analyse ways of managing and conserving the natural environment, and propose strategies for improvement.

Key question: What are some ways in which we can conserve the natural environment?

Lesson objective: By the end of the lesson, the students will be able to discuss some of the ways in which the natural environment can be conserved.

Knowledge	Skills	Attitudes and Values
• As the human population is continuously growing, the consumption of natural resources is also increasing. If these resources are not used properly and managed well, we will run out of them. Therefore, we need to conserve the natural resources. • There are so many different kinds of plants and animals found in the natural environment but because the human population is increasing so fast, there is a great need for land to use for farming, industry, reservoirs and houses. Many of the animals and plants which we still have are under threat and we must do all we can to conserve them. • Conservation is practiced in different ways in different situations. Below are some of the ways of conserving and managing natural environments. • We all need clean water for drinking and cooking. Rivers must not be regarded as dumping sites for household and poisonous wastes. These actions can pollute the water. • The natural environment can be protected and managed by setting up National Parks where people are not allowed to hunt in these parks and rangers are employed to make sure this law is strictly followed and enforced. • The seas are an important resource as they are full of a large numbers of sea creatures. Some of these sea creatures are a valuable source of food while others are economically important. Strict control over the activities of fishing companies is necessary to safeguard our marine resources for the future	• Explain how different environments can be conserved • Predict what will happen if the natural environment is not conserved	• Value our natural environment and take good care of it.

STRAND: LIFE	UNIT: Plants	TOPIC: Gas exchange system in plants
CONTENT STANDARD: 8.1.1. Students will be able to investigate the respiration and photosynthesis, and gas exchange systems of plants.		

Lesson title: What is respiration **Lesson No. 24**

Benchmark: 8.1.1.1. Investigate the process of respiration in plants.

Key question: How does plant take in its water and food?

Lesson objective: By the end of the lesson, the students will be able to explain how respiration occurs in plants.

Knowledge	Skills	Attitudes and Values
Respiration is a process in which plants absorb free molecules of oxygen (O2) and use them to create water, carbon dioxide, and energy, which helps the plant grow.	Reasoning Exploring Explaining	Value the biological process that maintains plants life.

Lesson title: Parts and function of respiration in plants **Lesson No. 25**

Performance standard:

Key question: What is the function of respiration in plants?

Lesson objective: By the end of the lesson, the students will be able to explain the parts and function of respiration in plants.

Knowledge	Skills	Attitudes and Values
Respiration ensures that energy is present for the plant living cells. Energy for plants are made by oxidizing carbohydrate particles (molecules) into simple particles. Slowly the energy is released through the enzymes to the plant.	Exploring Explaining Reasoning	Value the biological process that maintains plants life.

Lesson title: Roles of leaf stomata in respiration for plants **Lesson No. 26**

Benchmark: 8.1.1.1. Investigate the process of respiration in plants.

Key question: What is the work of stomata in a plant respiration?

Lesson objective: By the end of the lesson, the students will be able to describe the work of stomata for the respiration for a plant.

Knowledge	Skills	Attitudes and Values
How Do Stomata Work? Stomata is like pores in the skin. It is located in the leaf. Their primary function is to take in carbon dioxide and release oxygen. The stomata open and close to allow gas and water exchange or transpiration. Plants take in the carbon dioxide and separate it into carbon dioxide atoms and oxygen atoms. The plant takes in the carbon, essential to its life and growth, and then the oxygen atoms attach to free hydrogen atoms, creating water. This water and the oxygen in it are then released into the atmosphere via the stomata.	Articulating main ideas clearly. Reasoning Explaining	Value the biological process of managing and survival of life in plants

Lesson title: Process of respiration in plants **Lesson No. 27**

Benchmark: 8.1.1.1. Investigate the process of respiration in plants.

Key question: How does respiration take place in a plant?

Lesson objective: By the end of the lesson, the students will be able to explain the process for respiration in plants.

Knowledge	Skills	Attitudes and Values
What is respiration? Respiration is a process in which plants absorb free molecules of oxygen (O2) and use them to create water, carbon dioxide, and energy, which helps the plant grow. **How does respiration take place?** Plants need oxygen for respiration process to take place. Respiration normally takes place in the nights through different plant parts such as roots, stem or leaves. **What happens during respiration?** During the respiration, plants take in molecules of oxygen (O^2) produced by photosynthesis process to make water, carbon-dioxide and energy. They form the products of respiration to help in the plant growth. Water, carbondioxide (CO^2) are seen as the products of respiration process. Each plant manages its own gas exchange. The plants respire at very slow rates than those of animals. The respiration process involves a simple yet important equation: CO^2 $+H^2O$+Energy are the products from O2+ glucose often referred to as raw materials.	Predicting Hypothesizing Asking questions Testing ideas scientifically Summarizing main ideas from a problem	Value the biological process involved for supporting the growth of plants. Respect and take care of plants. Develop curiosity, open-mindedness, perseverance, a positive approach to errors and mistakes in experiences

Lesson title: What is Photosynthesis? **Lesson No. 28**

Benchmark: 8.1.1.3. Examine the process of photosynthesis in plants.

Key question: What is photosynthesis?

Lesson objective: By the end of the lesson, the students will be able to define the term photosynthesis.

Knowledge	Skills	Attitudes and Values
Photosynthesis is the process by which green plants manufacture their own food. The process takes place in small structures within the plant's cells called chloroplasts. Photosynthesis an important process that occurs in green plants and algae. The process uses the sunlight and combines with carbon dioxide, water and a chemical called chlorophyll to produce simple sugars. These sugars provide the plants with an energy source, which is then passed on to other living things through the food chain process. Photosynthesis is necessary because it forms the basis of the food chain. Leaves typically have a large surface area that contains chloroplasts to absorb sunlight for the process of zphotosynthesis. The chloroplasts contain a substance called chlorophyll. Chlorophyll is the substance that makes leaves appear green and allows them to absorb sunlight easily	Articulating ideas clearly Explaining Discussing	Value the biological process involved for supporting the growth of plants. Respect and take care of plants.

STRAND: Physical Science	UNIT: Matter	TOPIC: State changes
CONTENT STANDARD: 8.2.4. Students will be able to investigate the arrangement of particles when heat is applied in matter.		

Lesson title: Properties of Solid, Liquid and Gas in Volume **Lesson No. 70**

Benchmark: 8.2.4.1. Examine the properties of solid, liquid, and gas in relation to volume.

Key question: How are solids, liquids and gases different from each other?

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

- State that all matter is made up of particles
- Compare the differences in the arrangement of particles in solids, liquids and gases

Knowledge	Skills	Attitudes and Values
• Solids have a fixed shape and occupy a fixed volume. • Liquids, because they flow, can occupy whatever shape their container has, so they do not have a fixed shape. Because the particles in liquids are very close together (barely further apart than in solids) liquids do not easily compress, so their volume is fixed. • Gases can also flow, so they occupy the shape of the whole container. They do not have a fixed shape. Because the particles in gases are much further apart than in liquids or solids, they can be squeezed closer together. Gases therefore can be compressed or expanded. They do not have a fixed volume.	• Compare and discuss the behaviors of particles in solid, liquid and gas • Draw diagrams or make models to illustrate the behavior of particles in solids, liquids and gases	Show curiosity to learn about the properties of solids, liquids and gases in volume.

Lesson title: Arrangements of particles in matter **Lesson No. 75**

Benchmark: 8.2.4.5. Examine the difference in the arrangement of the particles (atoms and molecules) using particles model.

Key question: How are particles arranged matter?

Lesson objective: By the end of the lesson, the students will be able to know the arrangements of particles in solid, liquid and gas.

Knowledge	Skills	Attitudes and Values
• In solids, molecules are tightly packed together and vibrating in a fixed position. • In liquids particles are not packed too closely together so they are able to flow and move around. • In gases particles are far apart and there is a lot of space between the particles which allows them to move freely as well.	• Role play or use materials to model the arrangements of particles in solid, liquid or gas	• Appreciate learning Science

Lesson title: Effects of Heat on the Motion of Particles in solids **Lesson No. 71**

Benchmark: 8.2.4.2. Analyse the effect of heat on volume and the motion of particles in solid, liquid, and gas.

Key question: How do the particles in solids behave when heat is added?

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

• Investigate the arrangement of particles in solids.
• Describe the movement of particles in solids when heat is added.

Knowledge	Skills	Attitudes and Values
• In solid strong attractions between the particles hold them tightly packed together and vibrating at a fixed spot. • When heat is added the particles gain energy and start to vibrate faster and faster. As atoms vibrate faster, the space between them increase. Further heating provides more energy until the particles start to break free from the structure. This results in the solid melting.	• Draw diagrams or make models to illustrate the behavior of particles in solids when heat is added • Dramatize the behavior of solids when heat is added.	Show curiosity to learn about the effects of heat on solids

Lesson title: Effects of Heat on the Motion of Particles in Liquids **Lesson No. 72**

Benchmark: 8.2.4.2. Analyse the effect of heat on volume and the motion of particles in solid, liquid, and gas.

Key question: How do the particles in liquids behave when heat is added?

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

• Identify the arrangement of particles in liquids.
• Describe the movement of particles in liquids when heat is added.

Knowledge	Skills	Attitudes and Values
• The particles in the liquid are the same as in the solid but they have more energy. • When heat is added in a liquid, the particles vibrate faster and become more energetic. The space between atoms also increases as they move far apart. This results in the liquid changing to gas.	• Draw diagrams or make models to illustrate the behavior of particles in liquids when heat is added • Dramatize the behavior of liquids when heat is added • Compare the movement of particles in solids and liquids when heat is added.	Show curiosity to learn about the effects of heat on liquids

Lesson title: Effects of Heat on the Motion of Particles in Gas **Lesson No. 73**

Benchmark: 8.2.4.2. Analyse the effect of heat on volume and the motion of particles in solid, liquid, and gas.

Key question: How do the particles in gases behave when heat is added?

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

- Identify the arrangement of particles in gas.
- Describe the movement of particles in gas when heat is added.

Knowledge	Skills	Attitudes and Values
• The particles in gases are far apart. They are moving at very high speed colliding with each other and bouncing off any surfaces they may hit. When heat is added the particles move faster.	• Draw diagrams or make models to illustrate the behavior of particles in gas when heat is added • Dramatize the behavior of gases when heat is added • Compare the movement of particles in solids, liquids and gases when heat is added.	Show curiosity to learn about the effects of heat on gases

Lesson title: Diffusion in Liquids and Gas **Lesson No. 61**

Benchmark: 8.2.4.3. Investigate the diffusion process in liquids and gases.

Key question: What happens to the liquid and gas during the diffusion process?

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

- explain the process of diffusion in liquids and gas.

Knowledge	Skills	Attitudes and Values
• Diffusion is the process that spreads substances through a gas or liquid. • Substances diffuse from regions of high concentrations to regions of low concentration • Particles in liquids and gases are constantly moving and therefore can spread out evenly over time.	• Use the diffusion process to make known solutions • Draw diagrams or use models to explain / illustrate the concept of diffusion	

Lesson title: Melting and boiling point of matter **Lesson No. 74**

Benchmark: 8.2.4.4. Observe the melting and boiling point of matter and draw appropriate conclusions.

Key question: When will a substance change state?

Lesson objective: By the end of the lesson, the students will be able to define melting and boiling point of a substance.

Knowledge	Skills	Attitudes and Values
• When enough energy is added to a solid, it melts to form a liquid. The temperature at which a solid substance changes into a liquid is called the *melting point* • When enough energy is added to a liquid, it changes to gas. The temperature at which this happens is called the boiling point	• Use a thermometer to measure the melting and boiling point of different substance • Use the data collected to draw a line graph	• Show curiosity to learn about melting and boiling point of matter.

Lesson title: Physical Change and Energy **Lesson No. 77**

Benchmark: 8.2.4.6. Explain the physical change that occurs to substances during the process of change of state in matter.

Key question: How is energy used in a physical change?

Lesson objective: By the end of the lesson, the students will be able explain the relationship between energy and physical change.

Knowledge	Skills	Attitudes and Values
• n a physical change the particles of a substance are not broken up. These particles may be rearranged to change the form of a substance but the substance itself is never changed into another substance • Energy may be released or absorbed when a substance changes from one physical state to another	• Describe the relationship between physical change and energy	• Appreciate the relationship between physical change and energy.

STRAND: PHYSICAL SCIENCE	UNIT: ENERGY	TOPIC: Electric Current and Magnetic Fields
CONTENT STANDARD: 8.2.1 Investigate the relationship between the electric current and the magnetic field		

Lesson Title: What are magnetic fields? **Lesson No. 09**

Benchmark: 8.2.1.1 Describe the characteristics of magnetic field.

Key question: What are the characteristics of magnetic field?

Lesson objective: By the end of the lesson, the students can;

- dentify characteristics of magnetic field

Knowledge	Skills	Attitudes
Magnetic fields - are produced by magnets - can be weak and strong	Identify weak and strong magnetic fields Identify magnetic materials	Beware of how magnetic fields are created.

Lesson Title: What are the properties of Magnetic Fields? **Lesson No. 10**

Benchmark: 8.2.1.1 Describe the characteristics of magnetic fields?

Key question: What are the characteristics of magnetic field?

Lesson objective: By the end of the lesson, the students can;

- Identify Properties of Magnetic fields

Knowledge	Skills	Attitudes
Properties of magnetic field. - Magnetic materials are attracted to a magnet when near it. - The force of attraction is present.	Identify the force of attraction and magnetic field using iron filings.	Beware of how magnetic fields behave.

Lesson Title: What are magnetic force and magnetic lines? **Lesson No. 11**

Benchmark: 8.2.1.2 Examine the relationship between magnetic force and lines of magnetic force.

Key question: How are magnetic forces different from magnetic lines?

Lesson objective: By the end of the lesson, the students can;

- Identify characteristics of magnetic forces and magnetic lines

Knowledge	Skills	Attitudes
Magnetic forces and lines - are produced by magnets - can be weak and strong	Identify weak and strong magnetic fields Identify behavior of weak and strong magnet	Beware of how magnetic fields behave

Lesson Title: What is the Relationship between Magnetic Forces and Lines of Magnetic Forces? **Lesson No. 12**

Benchmark: 8.2.1.2 Examine the relationship between magnetic force and lines of magnetic force.

Key question: What is the relationship between magnetic forces and lines of magnetic forces?

Lesson objective: By the end of the lesson, the students can;

- Identify the relationship between magnetic force and lines of magnetic force.

Knowledge	Skills	Attitudes
Properties of magnetic force and magnetic lines.	Identify magnetic poles The direction of the north pole and the south pole	Beware of how magnetic fields behave.

Lesson Title: How to express magnetic fields with magnetic forces **Lesson No. 13**

Benchmark: **8.2.1.2** Examine the relationship between magnetic force and lines of magnetic force.

Key question: How are magnetic fields different from magnetic forces?

Lesson objective: By the end of the lesson, the students can;

- Differentiate magnetic fields from magnetic forces

Knowledge	Skills	Attitudes
Magnetic fields - magnetic lines of force Magnetic forces - are produced by magnets - Can be weak and strong	Identify weak and strong magnetic fields Discussion different uses of magnets	Beware of how magnetic fields behave.

Lesson Title: Direction of magnetic fields around Electric Current **Lesson No. 14**

Benchmark: 8.2.1.3 Examine the direction of magnetic field around the electric current

Key question: What is the direction of magnetic fields around an Electric Current?

Lesson objective: By the end of the lesson, the students can;

- Predict the direction of magnetic fields around an Electric current.

Knowledge	Skills	Attitudes
-Direction of magnetic fields around an electric current -Magnets are always attracted to the North	Identify magnetic fields. Predict the direction of the magnetic field	Beware of how magnetic fields are created and can behave.

Lesson Title: What is the relationship among the Direction of force, the Strength of Electric Current and Magnetic Fields **Lesson No. 15**

Benchmark: 8.2.1.3 Examine the direction of magnetic field around the electric current

Key question: Is the Direction of force related to the Strength of Electric Current and the Strength of Magnetic Fields?

Lesson objective: By the end of the lesson, the students can;

- Identify the **relationship** between the *Strength* of Electric Current and *Strength* of Magnetic Fields to the *Direction of Force*

Knowledge	Skills	Attitudes
Magnetic fields - are produced by magnets - are weak and strong - have a direction of flow	Identify weak and strong magnetic fields	Beware of how magnetic fields behave.

Lesson Title: What is induction current? **Lesson No. 16**

Benchmark: Discover that an electric current can be obtained by moving coils and magnets?

Key question: How is induction current produced?

Lesson objective: By the end of the lesson, the students can;

- Correctly explain and demonstrate how induction current is produced by an electromagnet

Knowledge	Skills	Attitudes
- Induction currents are produced by electromagnets - It is an electromotive force(voltage)	Demonstrate correctly the presence of induction current using a volt meter.	Beware of how magnetic fields behave.

Lesson Title: Mechanism of Electromagnetic Induction **Lesson No. 17**

Benchmark: 8.2.1.4 Discover that an electric current can be obtained by moving coils and magnets?

Key question: What is electromagnetic induction?

Lesson objective: By the end of the lesson, the students can;

- Correctly restate what electromagnetic induction is?

Knowledge	Skills	Attitudes
-Electromagnetic induction is a *force* produced by electromagnetic currents -Electromagnetic currents are produced by electromagnets	Identify that increasing the number of coils and battery will increase the strength of induction current	Beware of how magnetic fields behave.

Lesson Title: How do we strengthen Induction Current **Lesson No. 18**

Benchmark: 8.2.1.4 Discover that an electric current can be obtained by moving coils and magnets?

Key question: How is the strength of induction current increased?

Lesson objective: By the end of the lesson, the students can;

- Identify ways in which induction current is increased.

Knowledge	Skills	Attitudes
Increase number of coils Increase number of batteries Direction of current flow	Identify that increasing the number of coils and battery will increase the strength of induction current	Beware of how magnetic fields behave.

Lesson Title: Difference between Direct Current and Alternating Current **Lesson No. 19**

Benchmark: 8.2.1.5 Compare the difference between direct currents and alternating currents

Key question: How are direct currents different from alternate currents?

Lesson objective: By the end of the lesson, the students can;

- Identify the difference between alternate currents and direct currents.

Knowledge	Skills	Attitudes
- Electricity produces currents - Electric currents can be direct - Electric currents can be alternate	Demonstrate the difference between alternate current and direct currents using sand particles	Electric currents are dangerous.

Lesson Title: How are electromagnets used in motors? **Lesson No. 20**

Benchmarks: 8.2.1.6 Identify the application of electromagnets in daily life

Key question: How are electro magnets used in daily life.

Lesson objective: By the end of the lesson, the students can;

- Identify items in which electromagnets are used.

Knowledge	Skills	Attitudes
Some items in which electromagnets are used. - Washing machine - Fans - Vacuum cleaners	Relate the idea of how electromagnets are used in these items	Electric currents are dangerous

Lesson Title: How do Electromagnets generate Electricity **Lesson No. 21**

Benchmark: 8.2.1.4 Discover that an electric current can be obtained by moving coils and magnets

Key question: How do magnets produce electric currents?

Lesson objective: By the end of the lesson, the students can;

- Restate how electricity is produced by an electromagnet

Knowledge	Skills	Attitudes
Electromagnets produce electricity by using the following; torch batteries, copper coil wire and simple magnet	Demonstrate how electricity is produced by electromagnets using the batteries, coil of copper wire and magnets	Electricity current is dangerous.

STRAND: PHYSICAL SCIENCE	UNIT: ENERGY	TOPIC: Force and Work
CONTENT STANDARD: 8.2.2 Investigate the relationship between force and work		

Lesson Title: What is **work** in Physics? **Lesson No. 34**

Benchmark: 8.2.2.1 Describe the relationship between Force, Work and Distance

Key question: What is work in relation to force and distance

Lesson objective: By the end of the lesson, the students can;

- State with confidence what work is in relation to force and distant.

Knowledge	Skills	Attitudes
Define WORK - Work done - Force applied - Distance covered	Develop the ability to combine work with force and distant.	Appreciate how work is defined.

Lesson Title: What is the relationship between Force, Work and Distance? **Lesson No. 35**

Benchmark: 8.2.2.1 Describe the relationship between Force, Work and Distance

Key question: How does force and distance relate to work.

Lesson objective: By the end of the lesson, the students can;

- Restate with confidence how work and force are combined to define work.

Knowledge	Skills	Attitudes
Force, Work and Distance are all interconnected. -Work done is equal to -Force applied on an object -Distance covered by object	Develop the ability to combine work with force applied and distant covered.	Appreciate how work is defined.

Lesson Title: Units of Force and Work **Lesson No. 36**

Benchmark: 8.2.2.1 Describe the relationship between Force, Work and Distance

Key question: What are the units of measurement for Force and Work?

Lesson objective: By the end of the lesson, the students can;

- Define the units used to measure force and work.

Knowledge	Skills	Attitudes
Force is measured in *newtons* Work is measured by *force* applied multiplied by *distance* object moved	Develop the ability to correctly identify mathematical operations to use when calculating force and work	Appreciate how work is defined.

Lesson Title: Calculating work **Lesson No. 37**

Benchmark: 8.2.2.2 Use the formula to calculate work (work = force x distance)

Key question: How is work calculated?

Lesson objective: By the end of the lesson, the students can;

- Correctly calculate work using the formula W = F X D

Knowledge	Skills	Attitudes
Formula for Calculating Work. Work = Force X Distance Work is measured in units of force X units of distance = Work in units of (J) joule	Identify Force as effort placed on an object to move it in any direction. Identify Distant as the movement of the object from the original place of rest to the new place of rest.	Appreciate how work is calculated using the formula W = F X D

Lesson Title: What is **Power** in Physics? **Lesson No. 38**

Benchmark: 8.2.2.2 Use the formula to calculate work (work = force x distance)

Key question: How is power defined?

Lesson objective: By the end of the lesson, the students can;

- Correctly define power as learnt during the lesson.

Knowledge	Skills	Attitudes
Power is the rate of doing work, the amount of energy transfer per unit time	Develop the ability to define power as part of work and can be seen as the amount of time spent doing work	Appreciate how power is defined and calculated

Lesson Title: Units of Power **Lesson No. 39**

Benchmark: 8.2.2.2 Use the formula to calculate work (work = force x distance)

Key question: What unit is used to measure power?

Lesson objective: By the end of the lesson, the students can;

- Correctly restate the units of measurement for *power*

Knowledge	Skills	Attitudes
The unit of power is the joule per second (J/s) known as the watt. Power = Watt / Time P = W/t	Develop the ability to use the correct information in the formula when calculating power using the formula given	Appreciate how power is defined and calculate

Lesson Title: Calculating Power **Lesson No. 69**

Benchmark: 8.2.2.2 Use the formula to calculate work (work = force x distance)

Key question: How is power calculated?

Lesson objective: By the end of the lesson, the students can;

- Confidently calculate power

Knowledge	Skills	Attitudes
Formula to calculate Power Power = Watt / Time P = W/t	Develop the ability to mathematically calculate power correctly using the formula given	Appreciate how power is defined and calculated

Lesson Title: Hooke's Law **Lesson No. 41**

Benchmark: 8.2.2.4 Apply Hooke's law to demonstrate that the extension of the spring is proportional to
the load applied.

Key question: How can load be measured?

Lesson objective: By the end of the lesson, the students can;

- Explain and restate correctly Hooke's Law by demonstration.

Knowledge	Skills	Attitudes
Hooke's Law "the force needed to extend or compress a spring by some distance is proportional to that distance".	Develop the ability to correctly demonstrate and explain Hooke's Law using a spring and load.	Appreciate and value Hooke's Law

STRAND: PHYSICAL SCIENCE	UNIT: Our Earth	TOPIC: Volcano and Igneous Rocks
CONTENT STANDARD: 8.3.1 Investigate the mechanism of volcano and formation of igneous rock		

Lesson Title: What is Volcano? **Lesson No. 44**

Benchmark: 8.3.1.1. Describe the formation of volcano

Key question: What are some words associated with volcano?

Lesson objective: By the end of the lesson, the students can;

- Define correctly what a volcano is and state its characters.

Knowledge	Skills	Attitudes
- Definition of volcano - Produces magma - Forces it way through channel(weak rocks) - Near surface it escapes through the vent	Develop the ability to follow the flow of magma from within the earth to the surface	Appreciate and value how volcanoes behave

Lesson Title: Types of Volcano **Lesson No. 45**

Benchmark: 8.3.1.2. Identify different types of volcanoes

Key question: Are there different types of volcano?

Lesson objective: By the end of the lesson, the students can;

- Differentiate and correctly name volcanoes from their cone

Knowledge	Skills	Attitudes
- Type of volcano as indicated by the cone (shield, cinder and composite)	Construct models of the different volcano and name them correctly	Appreciate the different types of volcanoes

Lesson Title: Mechanism of Volcano **Lesson No. 46**

Benchmark: 8.3.1.2. Identify different types of volcanoes

Key question: What happens in a volcano?

Lesson objective: By the end of the lesson, the students can;

- Restate how molten rock from within the earth reach the earth surface and become lava

Knowledge	Skills	Attitudes
- Produces magma - Creates a channel in weak rocks - Near surface it escapes through the vent and become lava	Develop the ability to restate the flow of lava from the interior of earth to the surface	Appreciate and value how volcanoes behave

Lesson Title: Types of Igneous Rocks - Volcanic **Lesson No. 47**

Benchmark: 8.3.1.4 Identify the types of Igneous rocks

Key question: What are the characteristics Igneous rocks?

Lesson objective: By the end of the lesson, the students can;

Identify characteristics of Igneous rocks -volcanic

Knowledge	Skills	Atitude
- Plutonic rocks form from the cooling of *lava* - *Lava* is found on the earths surface - Rate of cooling is very fast	Develop the understanding that *lava* is found in the earth's surface	Appreciate and value the formation of igneous rocks

Lesson Title: Types of Igneous Rocks – Plutonic **Lesson No. 48**

Benchmark: 8.3.1.4 Identify the types of igneous rocks

Key question: What are the characteristics plutonic rocks?

Lesson objective: By the end of the lesson, the students can;

- Identify characteristics of igneous rocks -plutonic

Knowledge	Skills	Attitudes
- Plutonic rocks form from the cooling of *magma* - *Magma* is found in the earth's interior - Rate of cooling is very slow	- Develop the understanding that *magma* is found in the earth's interior	Appreciate and value the formation of igneous rocks

Lesson Title: Characteristics of Igneous Rocks **Lesson No. 49**

Benchmark: 8.3.1.4. Identify the types of igneous rocks

Key question: What are the characteristics of Igneous rocks?

Lesson objective: By the end of the lesson, the students can;

- State correctly the characteristics of Igneous rocks

Knowledge	Skills	Attitudes
- Forms from solidification of molten rock - Magma within/lava on (the earth) - Size of crystals/grains - Texture, color and weight of rock	Identify certain factors that are used to classify igneous rocks	Appreciate and value the formation of igneous rocks

Lesson Title: Classification of Igneous Rocks **Lesson No. 50**

Benchmark: 8.3.1.4 Identify the types of igneous rocks

Key question: How is igneous rock classified?

Lesson objective: By the end of the lesson, the students can;

- Restate correctly factors used to classify igneous rock

Knowledge	Skills	Attitudes
- Forms from solidification of molten rock - Magma within/lava on (the earth) - Size of crystals/grains - Texture of rock	Identify certain factors that are used to classify plutonic and volcanic igneous rocks	Appreciate and value the formation of igneous rocks

STRAND: PHYSICAL SCIENCE	UNIT: Our Earth	TOPIC: Volcano and Igneous Rocks
CONTENT STANDARD: 8.3.1 Investigate the mechanism of volcano and formation of igneous rock		

Lesson Title: Types of Rocks **Lesson No. 87**

Benchmark: 8.3.1.5 Distinguish volcanic and plutonic rocks based on their characteristics

Key question: How are volcanic rocks different from plutonic rocks?

Lesson objective: By the end of the lesson, the students can;

- Identify characteristics which differentiate plutonic rocks from volcanic rocks

Knowledge	Skills	Attitudes
Formed from molten *magma* and *lava* - Plutonic rocks (granite) Very slow cooling, large crystals, light weight, grey in color, presence of quartz - Volcanic rocks (basalt) Very fast cooling, small crystals, heavy weight, dark in color	Develop the ability to indicate on a chart when what name is given to solidified molten magma under the earth's surface and above the earth's surface	Appreciate and value the formation of volcanoes

Assessment 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 8 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 8

Strand	Unit	Topic	Content	Benchmark	Assessment Task
Life	**Unit 2:** Plants and Animals	Cells	**8.1.2**	**8.1.2.1.** Investigate the structure of plant and animal cells, and draw appropriate conclusions. **8.1.2.2.** Examine the functions of parts of plant cells and animal cells.	Make a model of a plant and animal cell structure and label the parts and their functions.

Physical Science	**Unit 1:** Energy	Electric current and magnetic field	**8.2.1**	**8.2.1.3.** Examine the direction of magnetic field around the electric current.	Investigate the direction of magnetic field around an electric current.
				8.2.1.5. Compare and contrast the difference between direct currents and alternating currents.	Set up a complete circuit and investigate the difference between Alternate Current (AC) and Direct Current (DC).
				8.2.1.6. Identify and evaluate the applications of electromagnet in daily life.	Research and explain house hold appliances that use electromagnets.
Life	**Unit 1:** Plants	Gas exchange system	**8.1.1**	**8.1.1.2.** Explain the process of respiration using the equation.	Explain the process of photosynthesis using the formula and describe the functions of photosynthesis parts
				8.1.1.1. Investigate the process of respiration in plants.	Describe the process of respiration in plants.
Physical Science	**Unit 2:** Force and Motion	Force and Work	**8.2.2**	**8.2.2.1.** Examine the relationship between Force, Work, and Distance.	Explain the relationship between force, work and distance.
				8.2.2.2. Use this formula to calculate work. (Work= force x distance)	Calculate work done using the correct formula and unit. (Work=force x distance)
				8.2.2.3. Use appropriate instrument to measure force.	Use spring balance to measure force with correct metric unit.
Earth and Space	**Unit 1:** Our Earth	Volcano and Igneous Rocks	**8.3.1**	**8.3.1.1** Investigate the formation of volcano.	Explain the formation of volcano using a flow chart.
				8.3.1.3 Explain the formation of igneous rock.	Describe the different stages of the formation of igneous rocks.
				8.3.1.5 Distinguish volcanic and plutonic rocks based on their characteristics.	Collect sample of volcanic and plutonic rocks and write a brief description of their characteristics.

		Rock Cycle		**8.3.2.2.** Examine the characteristics of the three types of rocks.	Collect samples of the three types of rocks and write short description of their characteristics.
				8.3.2.4. Investigate the process of rock cycle.	Explain the process of rock cycle on a flow chart and indicate to show what causes these rocks to change from one type to another.
Physical Science	**Unit 3:** Matter	Chemical Change	**8.2.3**	**8.2.3.2.** Explain the relationship between chemical change and heat.	What is the relationship between chemical change and heat?
				8.2.3.3. Describe conservation and regularity of mass in chemical changes.	Investigate the conservation and regularity of mass in chemical change.
				8.2.3.4. Use word equations to represent chemical change.	Write the correct word equations for the different chemical changes.
		State change	**8.2.4**	**8.2.4.2.** Analyse the effect of heat on volume and the motion of particles in solid, liquid, and gas.	Investigate the effect of heat on volume and the motion of particles in solid, liquid and gas.
				8.2.4.5. Examine the difference in the arrangement of the particles (atoms and molecules) using particles model.	Make a model of particles using the arrangement of particles in solid, liquid and gas.

Earth and Space	**Unit 2:** Weather and Climate	Weather and Climate	**8.3.3**	**8.3.3.1.** Investigate the factors that determine climate and draw appropriate conclusions.	Research on the factors that determine climate and explain why Papua New Guinea's climate is different from Japan.
				8.3.3.3. Examine the characteristics of climate in Papua New Guinea.	Research on the characteristics of climate in Papua New Guinea and write a report based on the findings.
				8.3.3.4. Analyse the causes and the effects of the different types of climate change.	Research on the causes and effects on the different types of climate change and write a report based on the findings.
				8.3.3.5. Evaluate the strategies for mitigating climate change and propose ways of improving them.	Propose of ways with justifications to protect climate change.
Life	**Unit 4:** Interaction and relationship in the environment	Changes in the environment	**8.1.3**	**8.1.3.1.** Use basic research skills to investigate the environmental changes caused by human activity and natural events, and draw appropriate conclusions.	Research on a natural event that can cause changes to the environment such as tsunami and the prevention measure to avoid major dangers to the natural environment.
				8.1.3.3. Probe the different types of pollution and evaluate their effects on the ecosystem. **8.1.3.4.** Analyse ways of managing and conserving the natural environment, and propose strategies for improvement.	Describe the impacts of the different types of pollution and ways to manage these pollutions.

Earth and Space	**Unit 3:** Space	Exploring Space	**8.3.4**	**8.3.4.3.** Use basic research skills to investigate and report on the history of space exploration.	Research of the history on space exploration and draw timeline on chart to show events associated with space exploration with brief descriptions.
				8.3.4.4. Explain the solar system and analyse its components.	Draw the structure of the solar system on the chart and label the different components with brief descriptions.
				8.3.4.1. Examine the universe. **8.3.4.6.** Examine the galaxy.	Distinguish between universe, solar system and galaxy.

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.

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

STRAND: Life **UNIT: Plants and Animals** **TOPIC: Cells**
CONTENT STANDARD: 8.1.2 Students will be able to investigate the structure of plant and animal cells.
BENCHMARK: 8.1.2.3. Compare and contrast similarities and the differences between plant cells and animal cells.

Assessment task sample 1:					
Assessment method:					
Performance Criteria (quality)	**Level of Mastery (Scale)**				Rating (score)
	1. Limited Proficiency	2. Some proficiency	3. Proficiency	4. Higher Proficiency	
Model a plant and animal cells structure	Could not be able to model a plant cell structure 0-6	Can model a plant cell structure with assistance from the teacher 7-9	Model a plant cell structure without teacher's supervision 10-12	Independently modeling a plant cell structure. 13-15	
Model an animal cell structure	Could not be able to model an animal cell structure	Can model an animal cell structure with assistance from the teacher	Model an animal cell structure without teacher's supervision	Independently modeling an animal cell structure.	
Infer the difference between the plant and animal cell structure	Could not be able to explain the difference between plant and animal cell structure	Can partly explain the difference between plant and animal cell structure with assistance from the teacher	Explain clearly the difference between plant and animal cell structure	Explain descriptively the difference between plant and animal cell structure	
Other details	1	2	3	4	
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:					
Teacher's comment:					

Recording and reporting

The reporting and recording 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 learn from the students work the impact of their teaching.
These enable teachers to keep almost accurate records of how well knowledge and skills in the standard statements were achieved by individual students.

During the students' progress in the school year the achievements are reported to the guardians, parents and students themselves regarding:
- areas of weaknesses
- Strengths
- Parent and guardian support and
- Evaluation of content of learning.

Strategies for recording

The types of strategies teachers may want to use in recording student achievements must be easily interpreted to the expected audience. Some of the strategies include:
- Checklist
- Student portfolio
- Work sample

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
1.	Grade 6 Science TV Resource Books
2.	Grade 7 Science TV Resource Books
3.	Grade 8 Science TV Resource Books
4.	Fundamental Science for Melanesia, Book 1
5.	Fundamental Science for Melanesia, Book 2
6.	Outcomes Edition for Papua New Guinea, Science Grade 6 Teacher Resource Book
7.	Outcomes Edition for Papua New Guinea, Science Grade 7 Teacher Resource Book
8.	Outcomes Edition for Papua New guinea, Science Grade 8 Teacher Resource Book

Glossary

Science subject has words specific to teaching and learning science. The words provided here come from the content of learning for Science in grade 8. The words have definitions which teachers can use if there is difficulty in accessing a dictionary.

Words	Definitions
boiling point	the temperature at which bubbles of vapour escape from a liquid.
cells	The building blocks of all living things. Cells are usually microscopic.
change of state	A change of state from one state of matter to another, eg from solid to liquid.
chemical change	a change of substance of a substance to form a new substance.
chemical equations	chemical formulas and symbols showing the substances that react and form in a chemical reaction
chemical reaction	the formation of one or more new compounds with properties and chemical compositions that differ from the original substances.
chlorophyll	green pigment that captures energy from sunlight.
chloroplast	an organelle that makes food from sunlight, water, and carbon dioxide.
climate	the average weather conditions in an area over a long period of time.
cytoplasm	the gel-like material that surrounds the internal parts of the cell.
electric generator	a device that transforms mechanical energy into electric energy.
electric motor	a device that converts electric energy into mechanical energy.
galaxy	an array of old and new stars, gases, and dust held together by gravity. a large group of million stars.
galaxy	An enormous number of stars grouped together and having one of the three basic shapes – spiral, elliptical or irregular.
greenhouse gas	A gas such as methane or carbon dioxide that contributes to global warming.
heat	an amount of thermal energy transferred from a warmer object to cooler object.
igneous rock	a type of rock that is formed when molten rock within earth cools and harden.
melting point	the temperature at which a solid changes to a liquid.
metamorphic rock	a type of rock formed when heat and pressure alter existing rock.
oxidation	A chemical reaction in which a substance gains oxygen, loses hydrogen, or lose electrons.
photosynthesis	the process in which plants use energy from the sun to carbon dioxide and water into sugar and oxygen.
pollution	Harmful or poisonous substances released into the environment
recycling	To reuse resources such as glass and plastics.
reduction	A chemical reaction in which a substance loses oxygen, gains hydrogen, or gains electrons.
respiration	the process in which oxygen and sugar combine to produce carbon dioxide and water, while releasing store energy.
rock cycle	the process in which one type of rock is changed to a new type of rock.
satellite	Something that orbits or travels around the Sun
sedimentary rock	a type of rock formed when fragments of worn-away rocks or seashells are deposited and buried.
solar system	The sun and the family eight planets, moon and asteroids.
volcano	An area of the Earth's crust where magma gets through the surface
work	The result of a force moving an object a certain distance, energy is needed to do work.

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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.

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 will be able to;
Teaching period:	40 minutes
Preparations:	
Key word(s):	
Learning content	

Teacher's Notes:

1. _____
2. _____
3. _____

1. _____
2. _____
3. _____

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 life cycle of plants to link to today's lesson.
Body **35 mins**	**Predictions** **Activity:** **Discussion questions on findings** **Introduce the key words for the lesson.**	**Predictions** **Activity:** **Discussion questions on findings** **Key words**	**Concepts and Misconceptions** **Strategy:**
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	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?)

……
……
……
……
……

Student Work Sheet

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.

TIME	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
8:00 – 8:15	Assembly	Assembly	Assembly	Assembly	Assembly
8:15 -8:40					
9:20 – 10:00	English	Assembly	Assembly	Assembly	Assembly
10:00 – 10:30	**RECESS BREAK**				
10:30 – 11:10	Mathematics	Mathematics	Mathematics	Mathematics	Mathematics
11:10 – 11:50					Science
11:50 – 12:30	Science	Science	Christian Religious Education	Science	Arts
12:30 1:00	**LUNCH BREAK**				
1:00 – 1:40	Health / Physical Education	Health/ Physical Education	Health /Physical Education	Health /Physical Education	Social Science
1:40 – 2:20	Social Science	Social Science	Social Science	Making a Living (80min)	
2:20 – 3:00	Mathematics	Making a Living (40min)	Making a Living (40min)		
3:00 – 4:06	**Teachers Planning and Preparation**				

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 4: TYPES OF KNOWLEDGE, SKILLS, ATTITUDES AND VALUES

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)	**Sustaining Values**
Core Values • Sanctity of life • Truth • Aesthetics • Honesty • Human • Dignity • Rationality • Creativity • Courage • Liberty • Affectivity • Individuality	• 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.

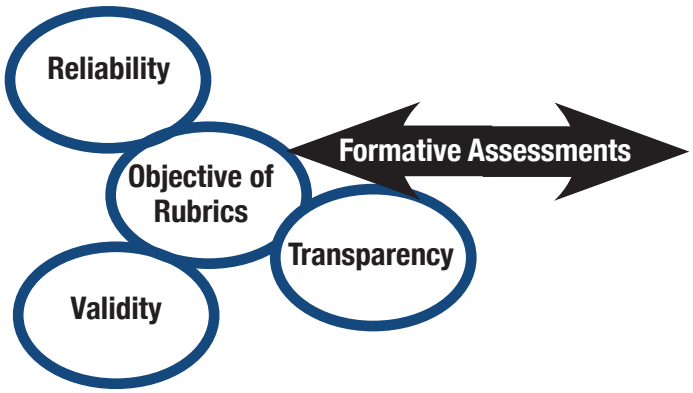
Types of rubrics

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)