Science

Teacher Guide

Grade 7

Standards Based

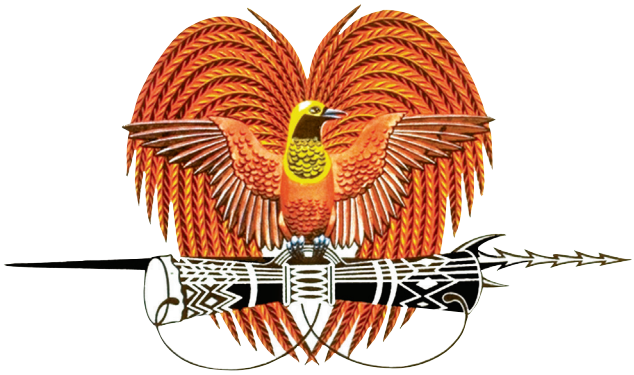
Papua New Guinea
Department of Education

Science

Teacher Guide

Grade 7

Standards Based



Papua New Guinea

Department of Education

Issued free to schools by the Department of Education

Published in 2019 by the Department of Education, Papua New Guinea

First Edition

Graphic Design & Layout by Vitus Witnes Kanua
Illustrations by Michael John

ISBN: 978-9980-905-36-9

Acknowledgements

The Grade 7 Teacher Guide was developed by the Curriculum Development Division of the Department of Education. The development of this Science Teacher's Guide was coordinated by Emmanuel Ragu with the assistance from Moses Koran Hatagen and the Subject Curriculum Group (SCG) members and the writing team.

The Department of Education acknowledges contributions from Teachers College Lecturers, Teachers, Standard Officers, resource persons from Non-Government Organizations (NGOs) and other stake holders.

Syllabus Advisory Committee (SAC) and Basic Education Board of Studies (BEBoS) Committee members are also acknowledged for their recommendation and endorsement of this Teacher Guide.

Contents

Secretary's Message

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

The Grade 7 Teacher Guide has been realigned, repositioned and replaced with standards based statements to improve knowledge, skills and competency in all domains of science including Life Science, Physical Science and Earth and Space.

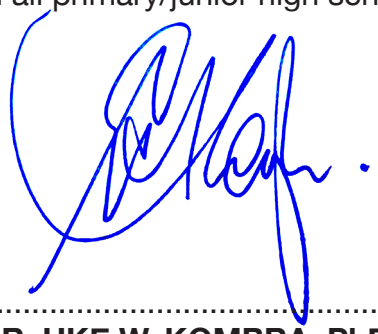
It has been designed with a view of making the students understand the basic scientific knowledge and skills in accordance with daily experience and prior knowledge about the environment and understanding of what is around them in a simple way thus will become the foundation of learning science at Grade 7.

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

I commend and approve this Grade 7 Science Teacher Guide to be used in all primary/junior high schools throughout Papua New Guinea.



.....

DR. UKE W. KOMBRA, PhD
Secretary for Education

Introduction

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

The content of this guide features the following sections:

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

Purpose

The main purpose is to implement the Grade 7 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 7 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 7 contents as prescribed in the Grades 6, 7 and 8 Primary Science Syllabus.

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

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

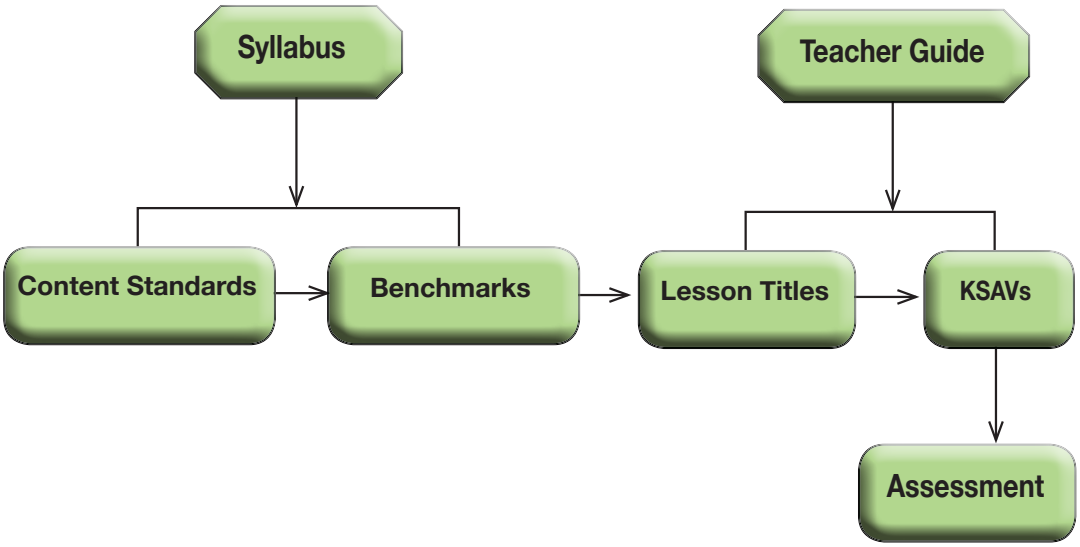


Figure 1.1: The organization chart above illustrates the link between the science syllabus and the teacher guide.

Key Features

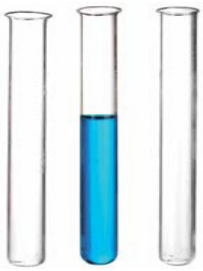
The key features outlined in this section are identified as unique to Science are important in the planning and teaching of Science. The key features of Grades 6, 7 and 8 Science Curriculum emphasizes recommended knowledge and skills and processes and provide ideas on how to teach practical science and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

1. Working in a laboratory

1.1 Laboratory equipment

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

COMMON LABORATORY APPARATUS AND EQUIPPMENT



Test Tubes

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

Test tube stand or rack

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

Test tube holder

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

Beaker

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

Round-bottom Flask

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

Conical Flask

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

Glass Tubing/Tube

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

Glass Rod

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

Funnel

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

China dish

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

Pipette

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

Measuring Cylinder

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

Retort Stand

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

Tripod Stand

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

Asbestos Wire Gauze

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

Pestle and Mortar

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

Spirit Lamp

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

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

Bunsen Burner

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

Spatula

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

Dropper

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

Watch Glass

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

Reagent Bottle

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

Gas Jar

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

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

Test tube brush

Beehive shelf

Cork borer

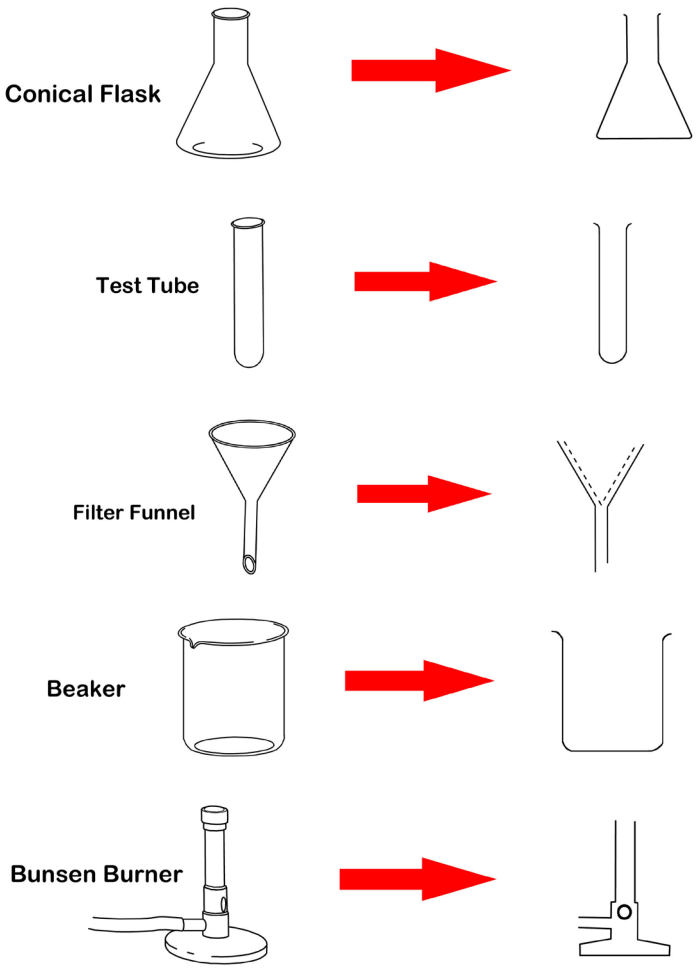
1.2 Drawing science equipment

It is best to keep drawings of science equipments 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.
- Not use shading or coloring.

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



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

1.3 Safety in the laboratory

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

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

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

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

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

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

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

Cuts are caused mainly by broken glass. Students should:

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

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

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

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

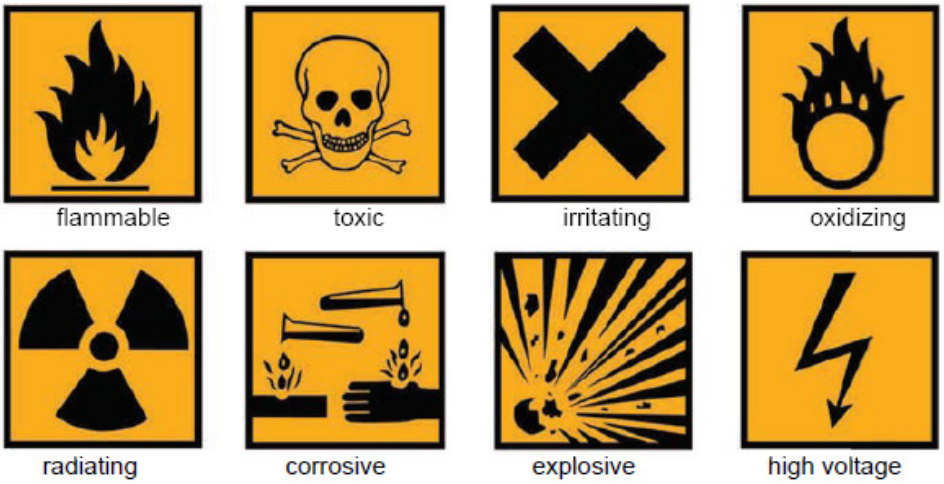
- Don’t use paper to light a burner, and never place burning things in rubbish bins.
- If they have long hair, it is essential you tie it back whenever you are using a burner.

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

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

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

SAFETY SIGNS AND SYMBOLS IN THE LABORATORY



1.4 Science is investigating

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

Writing reports

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

A report is organized using the seven headings.

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

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

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

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

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

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

Conclusion – students answer the questioned posed on the aim.

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

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

2. Science process skills

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

These skills are:

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

2.1 Inferring and Predicting

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

Making inference:

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

Making predictions

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

2.2 Measuring

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

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

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

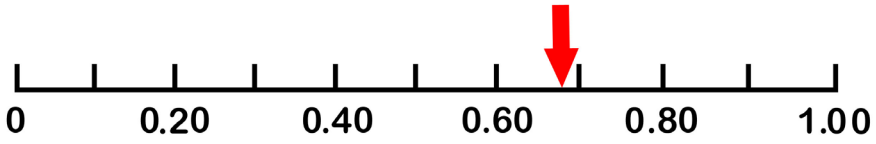
How to read a scale

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

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

Estimating readings

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



Accuracy

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

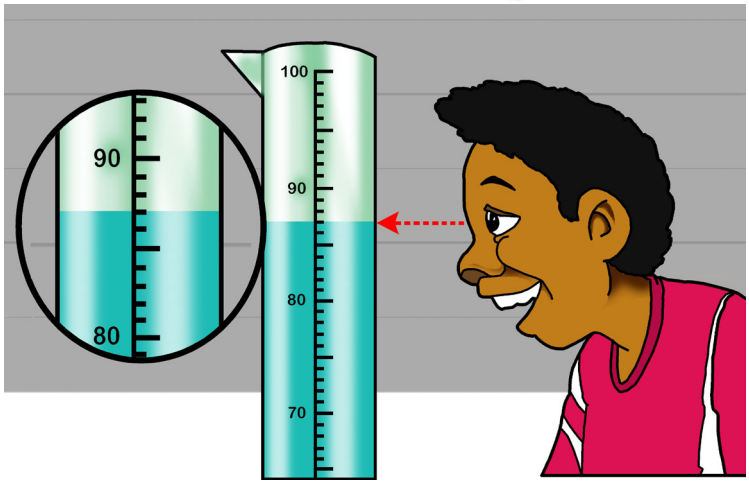
Errors

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

Parallax error

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

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



Reading the bottom of the meniscus

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

2.3 Displaying data

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

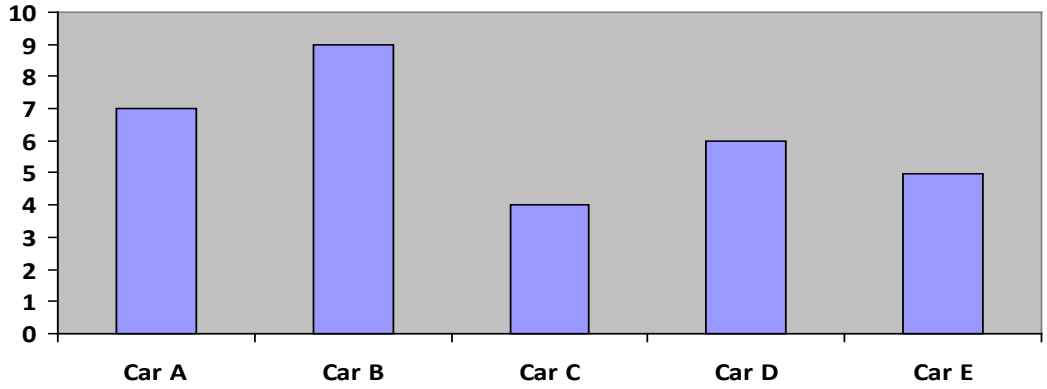
Bar graphs

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

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

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

Time taken for cars to travel down ramp



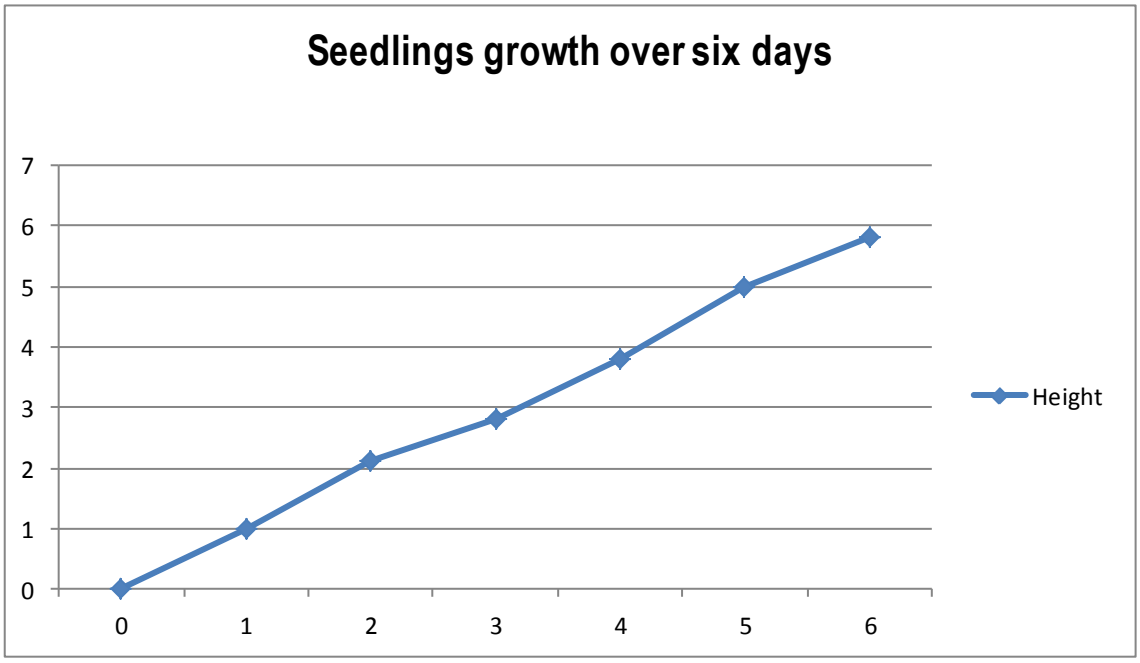
Line graphs

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

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

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

Seedlings growth over six days



2.4 Experimenting

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

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

Designing experiments

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

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

Students with Special Needs

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

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

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

1. Maintain an organized classroom and limit distractions.

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

2. Use music and voice inflection.

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

3. Break down instructions into smaller, manageable tasks.

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

4. Use multi-sensory strategies.

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

5. Give students with special needs opportunities for success.

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

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

Teaching and Learning Strategies

Learning Strategies For Science

Metacognitive strategies:

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

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

Cognitive strategies:

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

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

Social/Affective strategies:

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

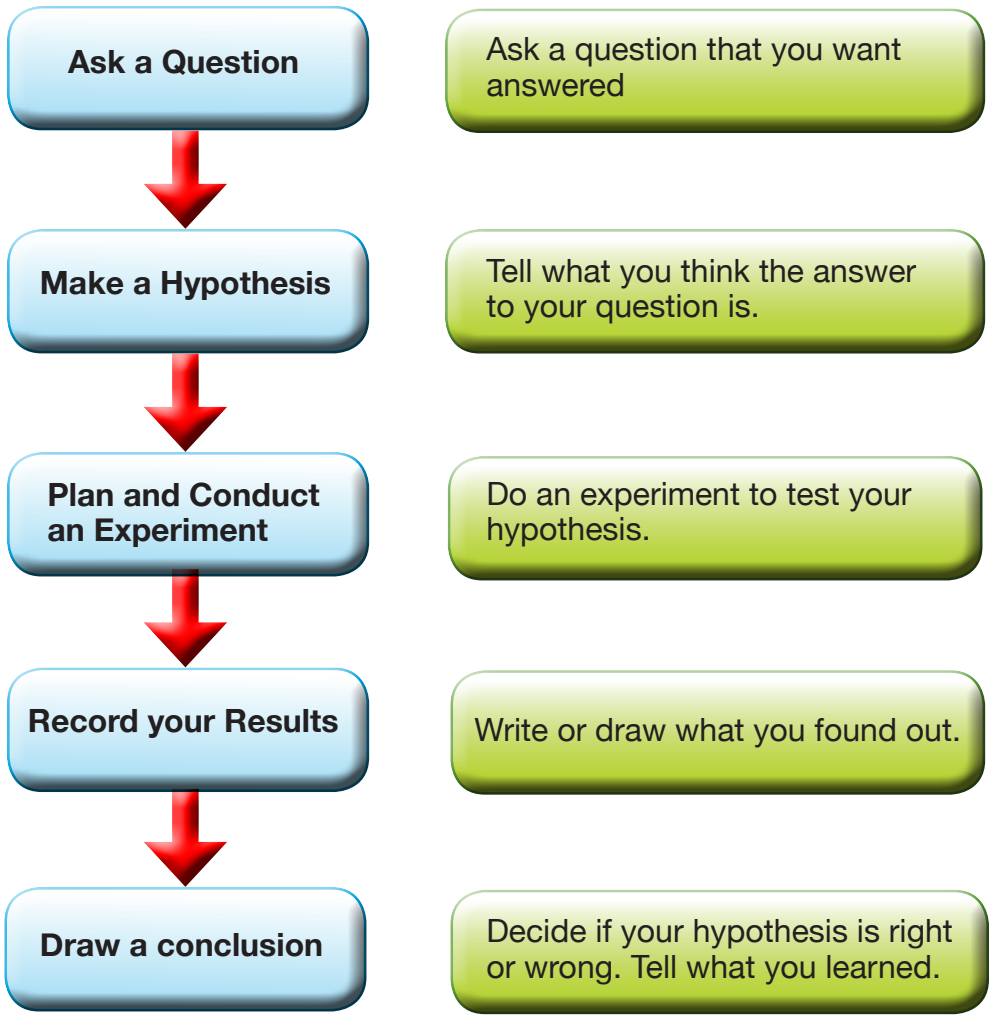
Questioning for	What help do students need? Who can they ask? Who should they ask?
Cooperating	How can students work with others to answer the question or solve the problem?
Self-talk	Yes, students can do this task – what strategies do they need?

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

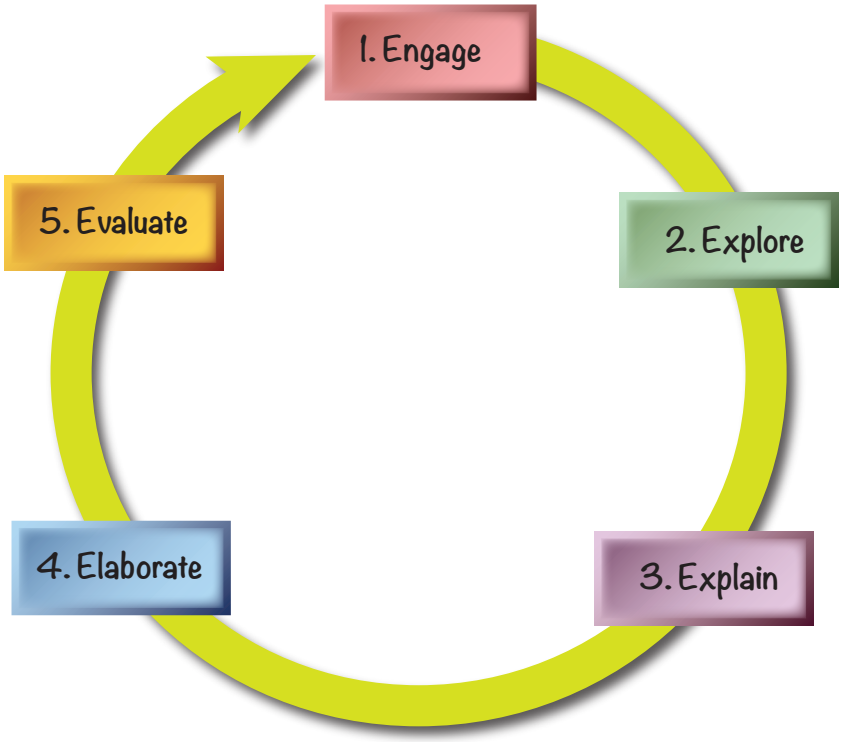
Applying learning strategies to Science

The Scientific Method

Science Problem-solving steps



5 Learning Cycle



1. Engage

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

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

Student asks questions such as:

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

2. Explore

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

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

3. Explain

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

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

4. Elaborate

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

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

5. Evaluate

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

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

Methods teachers use to support the learning cycle should:

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

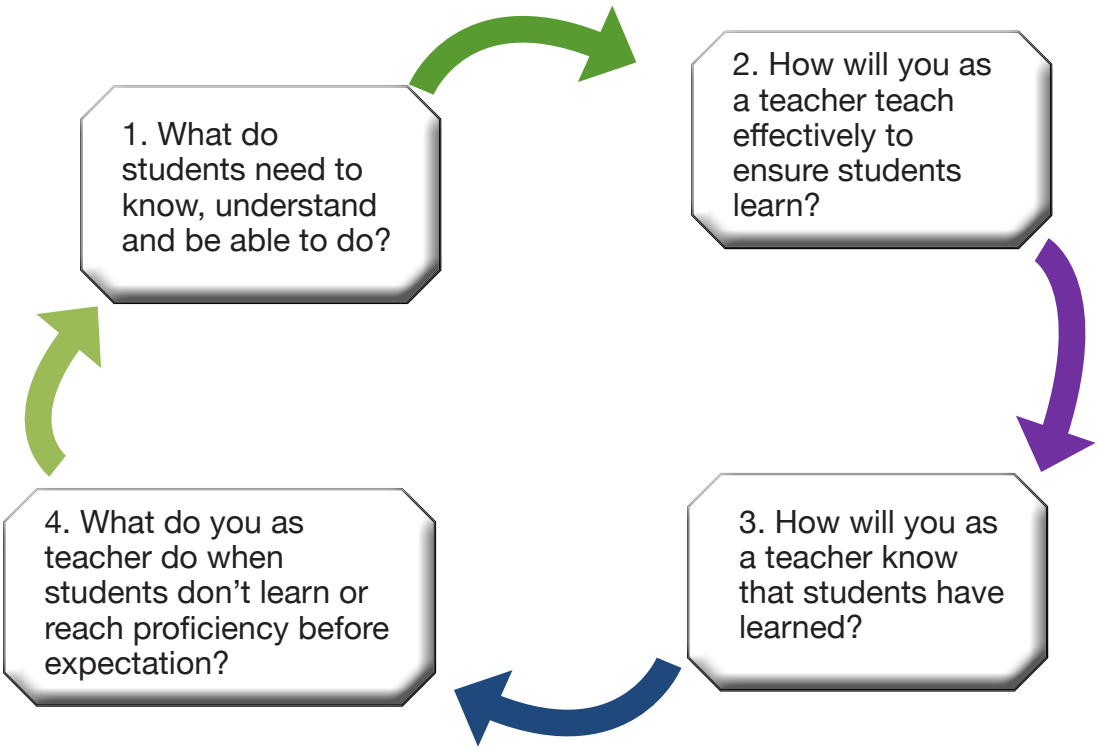
Teaching Methods should allow students to:

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

Standards Based Teaching and Learning

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

Continuous Cycle of Students Learning



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

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

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

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

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

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

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

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

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

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

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

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

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

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

Characteristics of standards-based teaching and learning

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

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

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

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

Examples of practice

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

B. Instructional Design and Delivery

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

Examples of practice

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

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

Examples of practice

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

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

Examples of practice

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

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

Examples of practice

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

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

Examples of practice

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

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

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

Examples of practice

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

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

Examples of practice

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

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

Examples of practice

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

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

C. Student ownership of learning

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

Planning and Programming

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

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

Yearly Plan

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

- strands
- units
- content standards.

Weekly Plan

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

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

- units
- content standards
- benchmarks
- lesson titles.

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

Content Overview

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

- Life
- Physical Science
- Earth and Space respectively.

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

Content scope of learning for Grade 7

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

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

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

Yearly Overview

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

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

Unit 1: Plants

Groups of plants</td><td rowspan="2">Life

Unit 3: Human Body

Digestive System</td><td>Earth and Space

Unit 1: Our Earth

Natural Resources</td><td rowspan="2">Life

Unit 4: Interaction and relationship in the environment

Living together</td></tr>
<tr><td>3</td><td rowspan="4">Physical Science

Unit 3: Matter

Properties of Solutions</td></tr>
<tr><td>4</td><td>Life

Unit 2: Animals

Groups of animals</td><td rowspan="2">Physical Science

Unit 1: Energy

Light and Lens</td></tr>
<tr><td>5</td><td>Physical Science</td><td>Physical Science</td></tr>
<tr><td>6</td><td>Unit 1: Energy

Electricity</td><td>Unit 3: Matter

Atoms, Molecules and Compounds</td></tr>
<tr><td>7</td><td rowspan="3">Earth and Space

Unit 2: Our Earth

Earth’s structure</td><td rowspan="2">Pressure</td><td rowspan="3">Earth and Space

Unit 2: Weather and Climate

Weather Change</td><td>Earth and Space

Unit 3: Space

Earth’s motion</td></tr>
<tr><td>8</td><td>Physical Science

Unit 2: Force and Motion</td></tr>
<tr><td>9</td><td></td><td></td><td>Assessment & Report Writing</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 (40mins)	
Week 1 - Orientation and Revision Work						
2	Strand 1: **Life**	Unit 1: Plants	Groups of Plants	Characteristics of plants	1	
				Types of flowering and non-flowering plants	1	
				Groups of plants	1	
				Classification of Plants	1	
				Reproduction process in Flowering plants	1	
3				Reproduction process in non-flowering plants	1	
				Topic Review	2	
				Unit Review	2	
4		Unit 2: Animals	Groups of Animals	Vertebrates and Invertebrates	1	
				Characteristics of Vertebrates	1	
				Classification of vertebrates	1	
				Characteristics of Invertebrates	1	
5				Classification of Invertebrates	1	
				Topic Review	2	
				Unit Review	2	
6	Strand 2: **Physical Science**	Unit 1: Energy	Electricity	Electric current	1	
				Measuring electric current in circuits	1	
				Measuring voltage in circuits	1	
				Electric current, Voltage and Resistance	1	
7				Calculating Voltage	1	
				Properties of Static Electricity	1	
				Static Electricity at work	1	
				Topic Review		
8	Strand 3: **Earth and Space**	Unit 1: Our Earth	Earth's structure	Composition of the Earth	1	
				Structure of the Earth	1	
				Movement of tectonic plates	1	
				Tectonic boundaries	1	
				Effects of moving tectonic plates 1: Earthquake	1	
				Effects of moving tectonic plates 2: Volcanoes	1	
				Effects of moving tectonic plates 3: Mountains	1	
				Topic Review	2	
9				Composition of the Earth	1	
				Structure of the Earth	1	
				Movement of tectonic plates	1	
				Tectonic boundaries	1	
				Effects of moving tectonic plates 1: Earthquake	1	
				Effects of moving tectonic plates 2: Volcanoes	1	
				Effects of moving tectonic plates 3: Mountains	1	
				Topic Review	2	
10	**Testing and Compiling of Assessment**					

Term 2: Overview

Week	Strand	Unit	Topic	Lesson Title	Periods (40mins)
Week 1: Orientation And Revision Work					
2	Strand 1: **Life**	Unit 3: Human Body	Digestive System	Types of nutrients	1
				Functions of nutrients	1
				Digestive organs	1
				Functions of digestive organs	1
				Mechanism of digestion	1
3				Role of enzymes	1
				Topic Review	2
				Unit Review	2
4	Strand 2: **Physical Science**	Unit 1: Energy	Light and Lens	Speed of light	1
				Properties of light	1
				Reflection of light	1
				Refraction of light	1
				Properties of convex lens	1
5				Function of convex lens	1
				Pinhole Camera	2
				Application of convex lens	1
				Topic Review	2
				Unit Review	2
6	Strand 2: **Physical Science**	Unit 2: Force and Motion	Pressure	Properties of pressure	1
				Pressure in solids	1
				Pressure in liquids	1
				Pressure in gas	1
7				Calculating pressure	1
				Uses of pressure in daily life	1
				Topic Review	2
8	Strand 2: **Physical Science**	Unit 2: Force and Motion	Density	Characteristics of density	1
				Comparing density of matter	1
				Calculate density of matter	1
9				Uses of density	1
				Topic Review	2
10	**Testing and compiling of assessment**				

Term 3: Overview

Week	Strand	Unit	Topic	Lesson Title	Periods (40mins)
Week 1 - Orientation and revision work					
2	Strand 3: **Earth and Space**	Unit 1: Our Earth	Natural Resources	Types of natural resources	1
				Importance and uses of natural resources	1
				Conservation of natural resources	1
3	Strand 2: **Physical Science**	Unit 3: Matter	Properties of Solutions	Solute, solvent and solution	1
				Types of solutions	1
				Solute in a solution – Carbon dioxide	2
4				Functions of solution – hydrochloric acid	2
				Acid Solutions	2
				Alkaline Solution	2
				Neutral Solution	2
5				Indicators	2
				Solubility	2
				Concentration of solutions	2
6				Separating solutions	2
				Topic Review	2
7	Strand 3: **Earth and Space**	Unit 2: Weather and Climate	Weather Change	Layers of the atmosphere	1
				Types of air pressure 1: Low pressure	1
				Types of air pressure 2: High pressure	1
				Atmospheric movements	1
8				Greenhouse effects	1
				Types of clouds	1
				Weather and clouds	1
				Water Cycle on Earth	1
9				Characteristics of weather in Papua New Guinea	1
				Weather patterns in Papua New Guinea	1
				Topic Review	2
				Unit Review	2
10	**Testing and compiling of assessment**				

Term 4: Overview

Week	Strand	Unit	Topic	Lesson Title	Periods (40mins)
Week 1 - Orientation and revision work					
2	Strand 1: **Life**	Unit 4: Interaction and relationship in the Environment	Living Together	Components of an ecosystem	1
				Living and non-living in the ecosystem	1
3				Roles of organisms in the ecosystem	1
				Causes of population change	1
				Effects of population change	1
4				Types of communities in the ecosystem	1
				Topic Review	2
				Unit Review	2
5	Strand 2: **Physical Science**	Unit 3: Matter	Atoms, Molecules and Compounds	Characteristic of molecules in matter	1
				Molecules and their symbols	2
				Common compounds and their elements	1
6				Examples of compounds in everyday life	1
				Topic Review	2
				Unit Review	2
7	Strand 3: **Earth and Space**	Unit 3: Space	Earth's Motion	Earth's orbit	1
				Earth's rotation	1
				Difference between Earth's orbit and rotation	1
8				Causes of day and night	2
				Seasons	1
				Topic Review	
				Unit Review	
9	**Week 9 - Assessment and report writing**				
10	**Speech day preparation**				

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 7 classrooms in the schools.

Strand	Unit	Topic	Sub-topic	Lesson No.	Lesson Title)
Strand 1: **Life**	Unit 1: Plants	Groups of plants	Flowering and Non-flowering Plants	1	Characteristics of flowering plants
				2	Characteristics of non-flowering plants
				3	Classification of flowering plants
				4	Classification non-flowering plants
				5	Fruiting life cycle - tomato
				6	Conifer life cycle
				7	**Topic Review**
				8	**Unit Review**
	Unit 2: Animals	Groups of animals	Vertebrates and invertebrates	9	Vertebrates and Invertebrates
				10	Types of vertebrates and invertebrates
				11	Classification of Vertebrates
				12	**Topic Review**
				13	**Unit Review**
Strand 2: **Physical Science**	Unit 1: Energy	Electricity	Circuits, electric current, voltage	14	Regularity of electric current in circuits
				15	Measuring electric current in circuits
				16	Measuring voltage in circuits
			Electric current, voltage, resistance	17	Resistance in wires
				18	Electric current, Voltage and Resistance
				19	Calculating Voltage
			Static electricity	20	Properties of Static Electricity
				21	Static Electricity at work
				22	**Topic Review**
Strand 3: **Earth and Space**	Unit 1: Our Earth	Earth's structure	Composition and structure of the Earth	23	Composition of the Earth
				24	Structure of the Earth
			Plates and earthquake	25	Movement of tectonic plates
				26	Tectonic boundaries
				27	Effects of moving tectonic plates 1: Earthquake
				28	Effects of moving tectonic plates 2: Volcanoes
				29	Effects of moving tectonic plates 3: Mountains
				30	**Topic Review**

Strand	Unit	Topic	Sub-topic	Lesson No.	Lesson Title)
Strand 1: **Life**	Unit 3: Human Body	Digestive System	Nutrients	31	Types of nutrients
				32	Functions of nutrients
			Digestion	33	Digestive organs
				34	Functions of digestive organs
				35	Mechanism of digestion
				36	Role of enzymes
				37	**Topic Review**
				38	**Unit Review**
Strand 2: **Physical Science**	Unit 1: Energy	Light and Lens	Light	39	Speed of light
				40	Properties of light
				41	Reflection of light
				42	Refraction of light
			Lens	43	Properties of convex lens
				44	Function of convex lens
				45	Pinhole Camera
				46	Application of convex lens
				47	**Topic Review**
				48	**Unit Review**
	Unit 2: Force and Motion	Pressure	Pressure	49	Properties of pressure
				50	Pressure in solids
				51	Pressure in liquids
				52	Pressure in gas
				53	Calculating pressure
				54	Uses of pressure in daily life
				55	**Topic Review**
		Density	Properties of density	56	Characteristics of density
				57	Comparing density of matter
				58	Calculate density of matter
				59	Uses of density
				60	**Topic Review**
				61	**Unit Review**
Strand 3: **Earth and Space**	Unit 1: Our Earth	Natural Resources	Natural Resources	62	Types of natural resources
				63	Importance and uses of natural resources
				64	Conservation of natural resources
				65	**Topic Review**
				66	**Unit Review**

Strand	Unit	Topic	Sub-topic	Lesson No.	Lesson Title)
Strand 2: **Physical Science**	Unit 3: Matter	Properties of solutions	Properties of solutions	67	Elements
				68	Characteristics of Elements
				69	Chemical symbol of Elements
				70	Atoms
			Acid, alkaline and neutral solutions	71	Characteristics of atoms
				72	Molecules
				73	Characteristics of molecules
				74	The Periodic Table
			Solubility	75	Compounds
				76	Types of Compounds
				77	Examples of compounds
				78	**Revision**
Strand 3: **Earth and Space**	Unit 2: Weather and Climate	Weather Changes	Atmosphere	79	Compositions of atmosphere
				80	Layers of the atmosphere
				81	Types of air pressure 1: Low pressure
				82	Types of air pressure 2: High pressure
				83	Atmospheric movements
				84	Greenhouse effects
			Cloud and Fog	85	Types of clouds
				86	Weather and clouds
				87	Water cycle on Earth
			Weather in PNG	88	Characteristics of weather in Papua New Guinea
				89	Weather patterns in Papua New Guinea
				90	**Topic Review**
				91	**Unit Review**
Strand 1: **Life**	Unit 2: Interaction and relationship in the environment	Living together	Ecosystem	92	Components of ecosystem
				93	Living and non-living in the ecosystem
				94	Roles of organisms in the ecosystem
			Population	95	Causes of population change
				96	Effects of population change
			Communities	97	Types of communities in the ecosystem
				98	**Topic Review**
				99	**Unit Review**

Strand	Unit	Topic	Sub-topic	Lesson No.	Lesson Title)
Strand 2: **Physical Science**	Unit 2: Matter	Atoms, molecules and compounds	Atoms	100	Characteristics of atoms
				101	Characteristics of elements
				102	Atoms and elements (difference)
				103	Classifying elements
			Molecules	104	Characteristic of molecules in matter
				105	Molecules and their symbols
			Compounds	106	Common compounds and their elements
				107	Examples of compounds in everyday life
				108	**Topic Review**
				109	**Unit Review**
Strand 3: **Earth and Space**	Unit 3: Space	Earth's motion	Motion of the Earth	110	Earth's orbit
				111	Earth's rotation
				112	Difference between Earth's orbit and Earth's rotation
			Day and night	113	Causes of day and night
			Seasons	114	Seasons
				115	**Topic Review**
				116	**Unit Review**

Content Background Information

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

Strand 1: Life

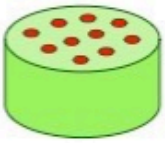
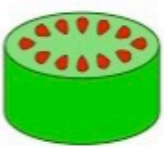
Unit 1: Plants

Topic: Groups of Plants

Flowering and non-flowering plants

Angiosperms are plants that have flowers and their reproduction is done by flowers. All flowering plants produce seeds. And it is covered by a fruit. Angiosperms have complicated flowers with complicated structure. These are the most developed plants in the world. There are 2 types of Angiosperms namely Dicotyledonous Plants and Monocotyledonous plants.

Monocotyledons have one cotyledon (seed leaf), which is the food store of a seed. They also have leaves with parallel veins, and flower parts in multiples of three. Dicotyledons have two cotyledons, leaves with branching, netlike veins, and flower parts in groups of four or five.

	Seed	Root	Vascular	Leaf	Flower
Monocot					
	One cotyledon	Fibrous roots	Scattered	Parallel veins	Multiples of 3
Dicot					
	Two cotyledon	Tap roots	Ringed	Net-like veins	4 or 5

https://www.google.com/bioninja.com.au

Most of the plants people normally grow in their homes and gardens are seed plants. These plants have five characteristics in common.

1. Leaves

Seed plants all possess leaves in some pattern and configuration. Leaves vary widely in appearance and can be very small or large. Leaves are part of the shoot system of the plant that is located above ground. It is where the photosynthesis, the conversion of light into sugars, take place. Food is also stored in leaves and released as it is needed by the plant's cell. Plant hormone reproduction also takes place in this upper shoot system of the plant.

2. Stems

Seed plants all have stems to help them support the plant and hold the cells for photosynthesis, food and water transport, as well as cells for reproduction. Stems are where the flowers are located, which then turn into seeds that create more plants. Not all plants have visible flowers. Some flowers are very inconspicuous, but serve the same function for seed dispersal as more lush flowers.

3. Roots

All seed plants have a root system that helps to anchor the plant in place. Roots are generally underground structures that absorb water and nutrients from the soil and store it for later as it is needed. Roots can spread broadly within the soil to absorb as much water and nutrition as possible. Generally, the larger the plant, the wider the root system will spread.

4. Seed-Producing Capability

All seed plants produce seeds as a method of reproduction. Not all plants reproduce this way, however. Some plants, like mosses, use spores to grow into new environments. Though different types of seeds may look very different from one another, they all contain the same basic structures. Seeds all have an embryo, a food storage organ and a seed coat. Seeding is a very efficient way of creating more plants, which is why there are so many seed-type plants.

5. Vascular System

Plants require a vascular system to carry moisture and nutrients to all parts of the plant and to maintain its upright structure. Phloem is a vascular tissue that carries food throughout the plant. Xylem is a vascular tissue that carries water and nutrients to the plant cells. The vascular system is so important to the plant that damage to these tissues can cause its death.

Reproduction in Flowering Plants

Flowering plants are unable to move around. Thus there must be a way of bringing in the egg and pollen together. This process is called pollination. The male gamete is carried to another flower. This is usually achieved by natural process, although gardeners may do this artificially to produce new plant. Wind, water or animals can carry the male gamete. The pollen grain then grows down to the ovary and fuses with the egg cell.

Reproduction in Non-flowering plants – Ferns

All ferns have true roots, stems and leaves with highly specialised transport systems. Ferns make their own food in the fronds. The food is then carried by the transport system to other parts of the plant where it is used for new growth or stored. Ferns vary in size from plants less than 2 centimetres across to tree ferns which are up to 10 metres tall.

Ferns have no flowers and reproduce by spores. The spores from the back of the leaves grow to form a very small heart-shaped plant. Sexual reproduction takes place on this small heart-shaped plant, resulting in the formation of the large fern seen in many bushes.

Spores

Ferns are only one step in a bi-generational life cycle and are flowerless. They do not bear seeds; instead they produce spores typically on the back of their leaves called fronds. Staghorn ferns are examples of ferns that produce spores on the tip of their frons. When the spores mature, they are ejected from the cases and dispersed by the wind

Tomato plants belong to the plant group known as flowering plants or angiosperms. The tomato plant reproduces sexually, meaning that it requires both female and male organs to produce seeds. Every tomato seed has a tiny tomato plant inside. When the conditions are just right, tomato seeds will germinate.

As the seed germinates, the radicle or young root first appears and grows down into the ground. The cotyledons or seed leaves then appear and grow up towards the Sun and the young plant develops true leaves. As the plant matures, more leaves develop and flower buds form (see Figure 1). On mature tomato plants, flowers develop and this is where sexual reproduction occurs.

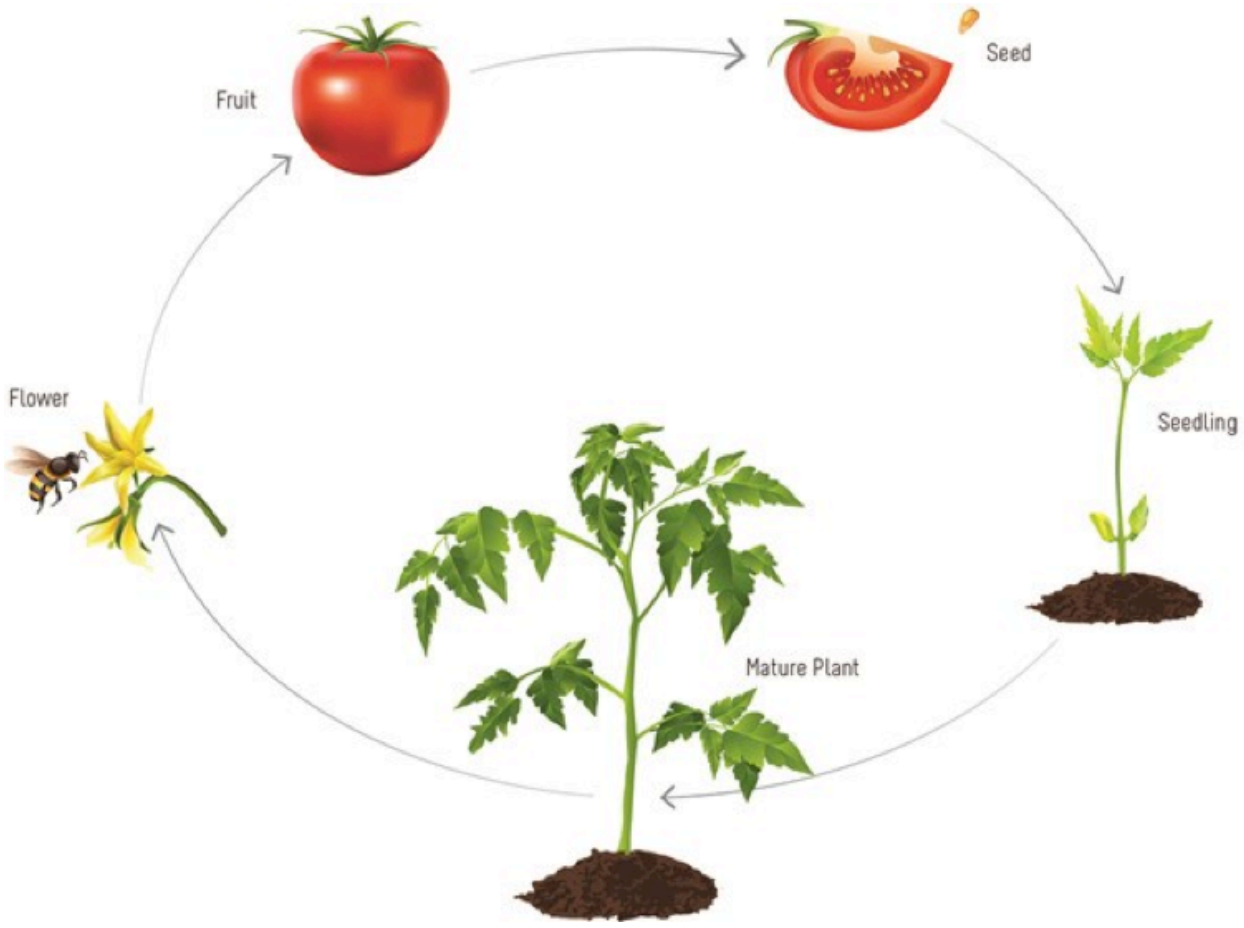


Figure 1: Diagram of the tomato life cycle. The life cycle starts from seeds and as the plant grows and matures, flowers develop. After pollination and fertilization, fruits develop which contain seeds, allowing for the life cycle to start again.

https://www.google.com/tomatosphere.letstalkscience

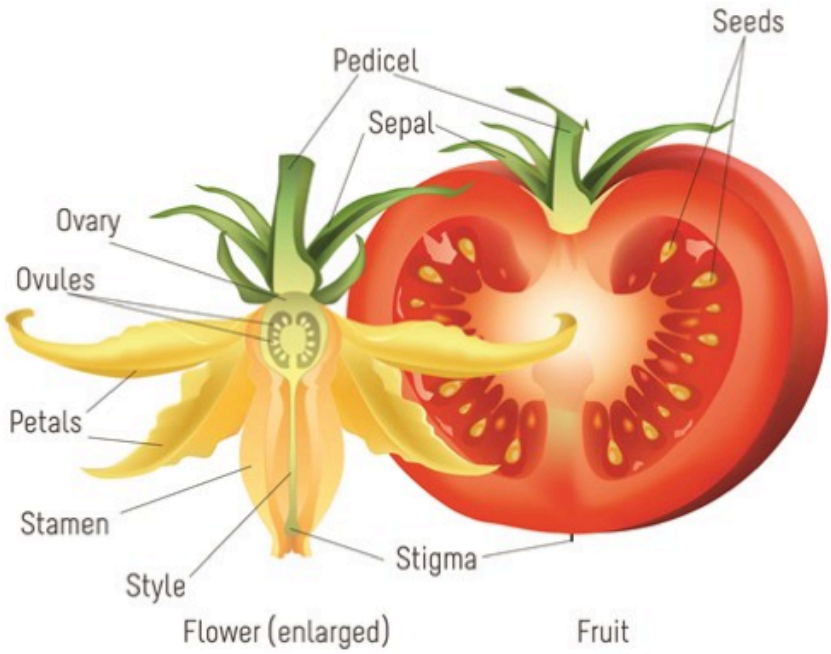


Figure 2: Diagram of tomato flower and its fruit.

The ovary within the flower develops into a tomato fruit that we eat.

https://www.google.com/ixl.com/science/conifer-life-cycles

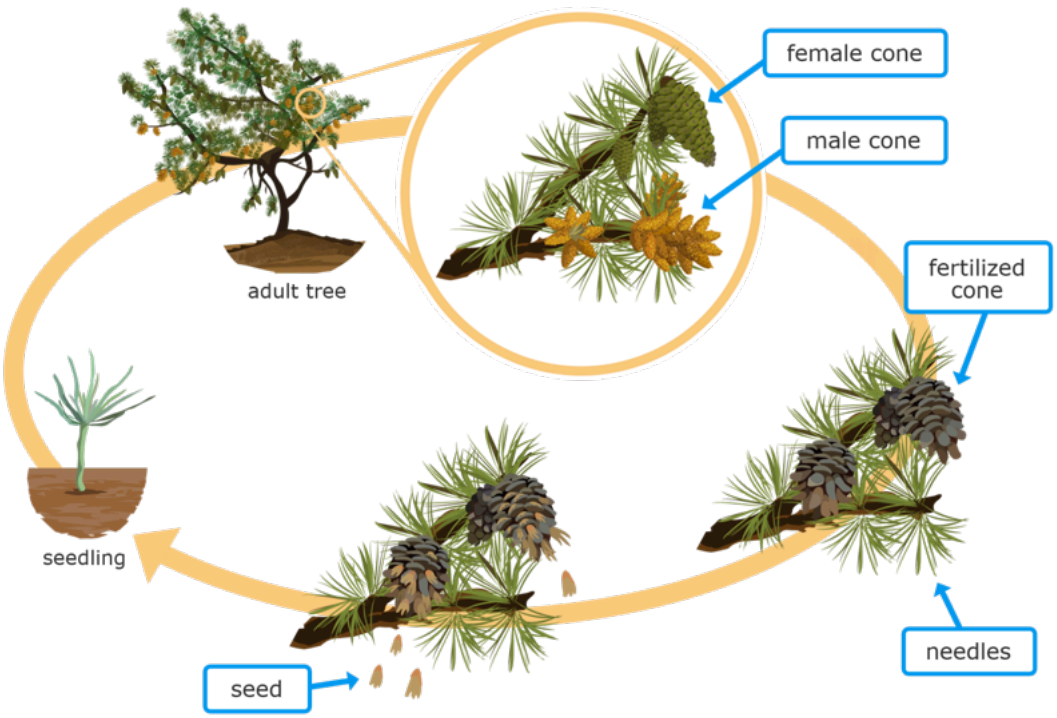


Figure 3: Conifer Life Cycle

https://www.google.com/ixl.com/science/conifer-life-cycles

Unit 2: Animals

Topic: Groups of Animals

Vertebrates and Invertebrates

Vertebrates are animals that have a back bone or spinal column. Animals that belong to the vertebrates group have chain of bony elements from the head to the tail of the body. The vertebral that is present in the animals helps them in the locomotion.

Invertebrates are animals without a backbone. They do not have internal skeleton made of bone. Of the planet's estimated 15-30 million animal species, 90% or more are invertebrates. They occupy almost all habitats; they can be found crawling, flying, swimming or floating.

The most common vertebrates include sponges, annelids, echinoderms, mollusks and arthropods. Arthropods include insects, crustaceans and arachnids.

Some examples of antropods

Butterfly

Spider

Bee

Beetle

Classification of Vertebrates

Vertebrates are highly cephalized and have well developed organs. They have endoskeleton and a closed circulatory system. And they have the ability to regulate their body temperature. Of the five classes of vertebrates birds and animals are endothermic in nature and others like fish, amphibians, and reptiles are ectothermic in nature.

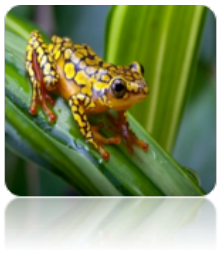
They have bony endoskeleton which consists of cranium, limb girdles, visceral arches and two pairs of appendages. Muscles attached to the endoskeleton helps in locomotion and they have ventral hearts with 2 to 4 chambers. Have a large digestive system with liver, digestive glands and pancreas. Also have well developed body cavity.

The bloods of the vertebrates contain red blood and white blood corpuscles. They paired kidneys. The general body plan of the vertebrates consists of head, trunk, appendages and post anal tail.

Classification of vertebrates

Vertebrates are classified into the following five classes.

1. Fish
2. Amphibians
3. Reptiles
4. Birds
5. Mammals
    - Animals
        - Marsupials
        - Primates
        - Rodents
        - Cetaceans
        - Seals

Vertebrates				
Mammals	**Birds**	**Amphibians**	**Fish**	**Reptiles**
				
• Give birth to live babies and feed them milk • Hair or fur on body	• Have feathers • Lay eggs	• Have moist skin • Can live on land and in water	• Have scales and fins • Breath under water through gills	• Have dry scaly skin • Lay eggs

Characteristics of Invertebrates

General characteristics of invertebrates are as follows:

- The main characteristic that separates invertebrates from other organisms is the absence of the spinal cord and the backbone.
- They are multicellular organisms, they completely lack cell walls.
- They are devoid hard body endoskeleton.
- Due to the lack of complex skeleton systems, some invertebrates tend to be slow and small in nature.
- Due to the lack of the backbone and complex nervous system the invertebrates cannot occupy multiple environments, though they are found in the harshest of the environments.
- Body is divided into three parts – head, thorax and the abdomen.
- They do not have large lungs for respiration.
- Respiration is through skin.
- Some invertebrates groups possess a hard, exoskeleton.

Examples of invertebrates:

Crustaceans, Centipedes, Ants, Wasps, Spiders, Locusts, Honey bees, Termites, Cockroach, Grasshoppers, Crickets, Stick insects, Mantis, Crabs, Star fish, Leeches, Earthworms, etc.

Nutrients

We need food for three reasons:

1. **For energy**
   Food is needed to supply the energy for many body functions such as muscle movement and keeping a constant body temperature.

2. **For growth and repair**
   Food is needed to supply the raw materials for cell growth and the replacement of old cells.

3. **To keep our body healthy and functioning correctly**
   Food is needed to keep the cells and organs in your body functioning correctly.

Food provides nutrients to help the body perform properly. It is important to enjoy a well-balanced, healthy diet by consuming a variety of foods to provide all the nutrients our bodies need.
Some nutrients are water soluble, meaning that they dissolve in aqueous solutions. Other nutrients are fat soluble, meaning that they dissolve in fatty tissues and oils.

There are six main nutrients that the body needs;
1. Protein
2. Carbohydrate
3. Vitamins
4. Fat
5. Minerals
6. Water

Protein

Protein is needed for growth and development. Requirements are higher for babies and children than for adults.

- Protein is made up of amino acids.
- Some amino acids cannot be made by the body and must be supplied by the diet, known as essential amino acids.
- Protein foods can be provided from both animal and plant origin.
- Animal sources of protein tend to provide all the essential amino acids, known as a 'complete' protein.
- Plant sources of protein tend to provide different essential amino acids, so by eating a wide variety of these foods, you can get all the amino acids you need to make up a 'complete' protein from a vegetarian diet.

Carbohydrates

Most of the energy (calories) we need should come from carbohydrates. Carbs, along with fat and protein, provide energy so we can perform our daily activities. Carbs are split into two types:

Simple Carbohydrates	Complex Carbohydrates
Made of one or two sugar molecules	Many sugar molecules chemically bound together
Fast burning	Slow burning
Digested quickly; provide immediate burst of energy For example, table sugar, honey, soft drinks	Digested slowly; provide long lasting, stable energy For example, oatmeal, whole grain bread

Fibre

Dietary fibre is a term that is used for plant-based carbohydrates that, unlike other carbohydrates (such as sugars and starch), are not digested in the small intestine, so fibre reaches the large intestine (helps with the digestion).

There are two main groups of fibre: soluble and insoluble. Soluble fibre reduces cholesterol in the blood and controls blood sugar levels. Insoluble fibre helps keep your digestive tract in good working order. They work in different ways so it is important to include both types in your diet. What is important to remember is that fibre-rich foods typically contain both types of fibre.

Vitamins

Vitamins are essential for our health (the name comes from "vital"). Many different vitamins are present in food. However, they are required in small amounts to maintain good health. Most of us should meet our vitamin requirements by eating a healthy, well balanced diet. Certain groups, however, for example the sick, elderly, post-menopausal women, pregnant women or individuals following restrictive diets, may need to take an additional vitamin supplement.
Hypervitaminosis is a condition of abnormally high storage levels of vitamins, which can lead to toxic symptoms. Toxic levels of vitamins are generally a result of high supplement intake or a large intake of highly fortified foods and not from natural food.

Vitamins have diverse functions in the body:

- Hormone-like functions as regulators of mineral metabolism (vitamin D)
- Regulators of cell and tissue growth and development (vitamin A)
- Antioxidants (vitamin E, C)
- Help to enzymes (B complex)

Fat

It provides energy, absorbs certain nutrients and maintains your core body temperature. You need to consume fat every day to support these functions, but some types of fat are better for you than others. While carbohydrates are the main source of energy in your body, your system turns to fat as a backup energy source when carbohydrates are not available.

Fatty acids are the building blocks of fat and there are three different types: saturated fatty acids, monounsaturated fatty acids and polyunsaturated fatty acids.

While monounsaturated and polyunsaturated fats can lower blood cholesterol and help reduce the risk of heart disease, saturated fats can raise blood cholesterol and increase the risk of heart disease.

There is a special sub group of polyunsaturated fatty acids known as Essential Fatty Acids (EFAs). They are called 'essential' as they are not easily manufactured by the body and must be provided by food. They are split into two groups: Omega 3 and Omega 6.

Trans fatty acids are a form of fat that the body does not actually need and only have adverse effects.

Minerals

Along with vitamins, minerals are vital nutrients found in food, which help the body to convert food into energy, control body fluids and build strong bones and teeth.

Minerals are found in a wide variety of foods including fruit, vegetables, cereals, milk and dairy products, meat and fish. There are two types of minerals your body needs to stay healthy: major and trace minerals. As their names suggest, these kinds of minerals are divided by need. Your body needs large amounts of major minerals and only very small amounts of trace minerals for normal function.

- Calcium
- Magnesium
- Potassium
- Sodium
- Phosphorous
- Iron (trace mineral)

Digestion

When we take a bite out of a kaukau, you chew the mouthful of food a few times, and then swallow it. That is the last you see of the hamburger. How is the hamburger digested? The diagram of the digestive system or gut will help answer this question.

The function of the digestive system is to break down the food you eat into smaller molecules, which are then able to pass from the small intestine into your blood. Digestion is both physical break down of large lumps of food into smaller one, and the chemical break down of food. The chemical breakdown occurs with the help of substances called enzymes, which are made in special cells in the body. These substances speed up chemical reactions, which break down insoluble food molecules into small soluble ones.

1. Mouth - Digestion begins here. Food is chewed and broken into smaller pieces. In addition an enzyme called amylase begins the chemical breakdown of starch.

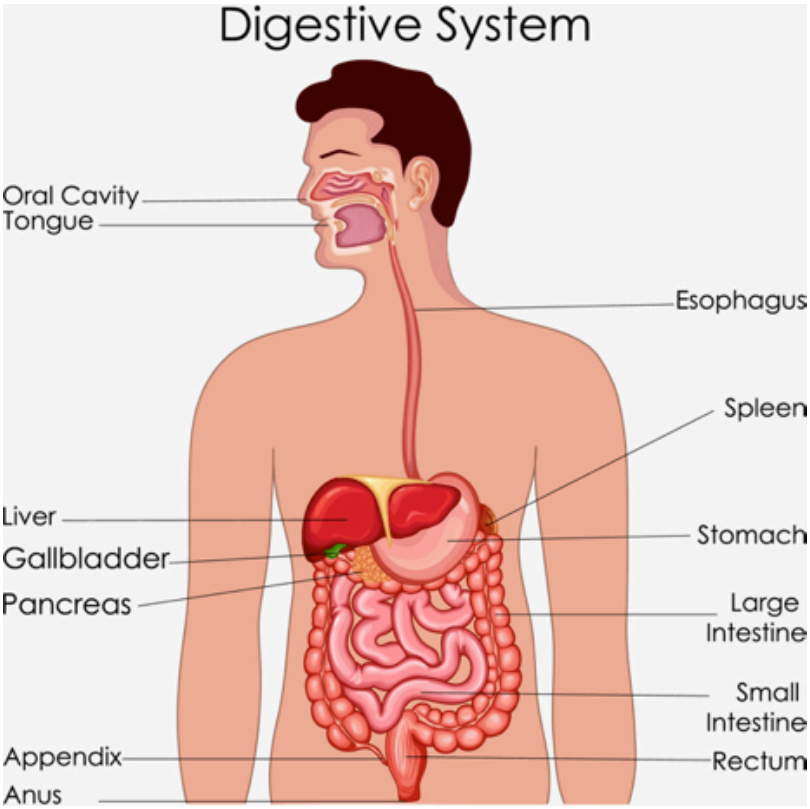
2. The gullet contains muscles that food in a tube from mouth to the stomach.

3. The stomach is the place in which mechanical digestion occurs by muscles churning food around to break it into small pieces. Chemical digestion by gastric juice also occurs in the stomach. The juice contains an enzyme called protease, which breaks down complex protein to simple protein.

4. In the small intestine there is a little mechanical digestion and a lot of chemical digestion. Bile, a fluid produced by the liver and stored in the gall bladder, enters the intestines by a tube. Bile helps in preparing fats and oils for digestion.

5. The large intestines is the place where water is absorbed into the blood stream. No mechanical or chemical digestion occurs here.

6. The anus is the end of the digestive tube. Undigested food passes out of this opening . this is called elimination.



https://www.google.com/digestive-system-anatomy-vector-material

Enzymes that break down carbohydrates into sugars such as glucose are called amylases. Amylases are made in the salivary glands in the mouth and in other glands in the digestive system. Enzymes called proteases break down proteins into amino acids. These molecules are essential for your body to build structures such as cell membranes. Proteases are made in glands in the stomach and the small intestine. The enzymes that break down fats (lipids) are called lipases. Fats are broken down to fatty acids.

Unit 4: Interaction and Relationship In the Environment

Topic: Living Together

Ecosystem

Ecosystems are made up of living and non-living things that interact with each other. Interactions between organisms can be described in terms of the feeding relationships. Various types of human activity can affect these interactions.

An ecosystem includes all of the living things (plants, animals and organisms) in a given area, interacting with each other, and also with their non-living environments (weather, earth, sun, soil, climate, and atmosphere). Ecosystems are the foundations of the Biosphere and they determine the health of the entire earth system. In an ecosystem, each organism has its own role to play.

An ecosystem is the sum of both the living (biotic) and nonliving (abiotic) components of a natural community. The process of energy flows and nutrient cycles make it possible for both the biotic and abiotic elements to work together. In short, an ecosystem is an interaction and sometimes a symbiosis that permits organisms to exist in limited spaces. Energy, air, water, soil, soil minerals, and nitrogen are all important components of an ecosystem.

Ecosystems come in three types:

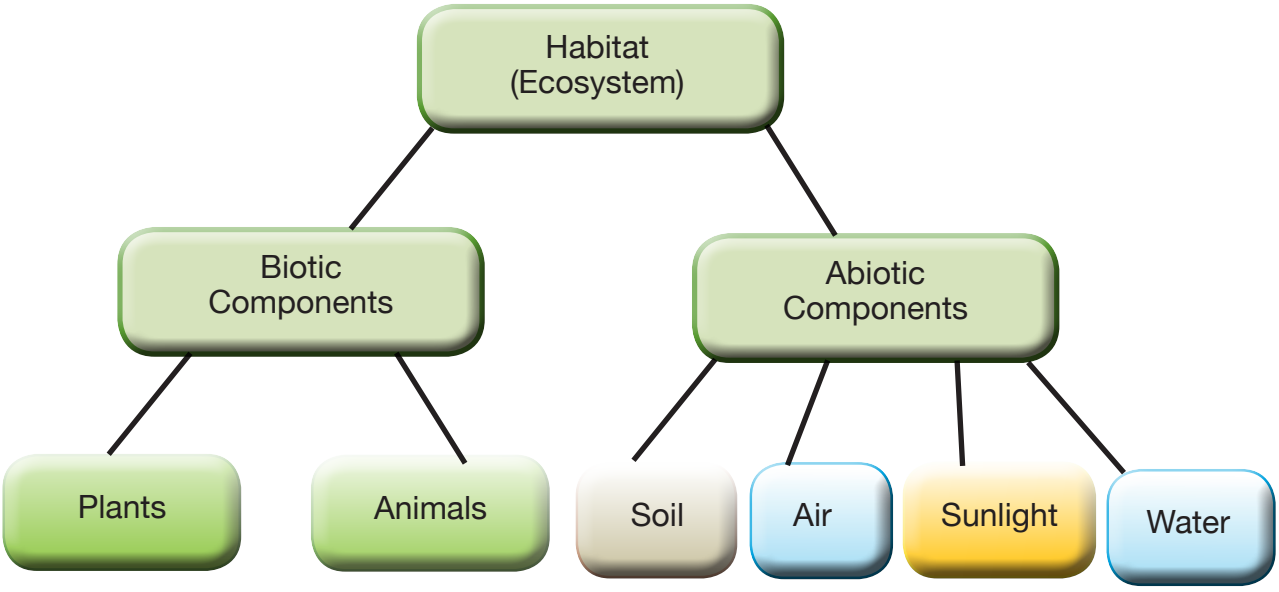
1. **Freshwater ecosystems**
   A freshwater ecosystem can be defined as a small area equal to just about 1.8% of the earth's surface. This ecosystem has a variety of life such as flora and fauna. Freshwater plankton is also available.

2. **Terrestrial ecosystem**
   The terrestrial ecosystem encompasses seven major ecosystems such as the tropical rainforest, savannas, deserts, temperate grasslands, deciduous forests, coniferous forest, and tundra. Location of a place and climate patterns affect terrestrial ecosystems in a major way.

3. **Ocean ecosystem**
   Ocean ecosystem covers about 75% of the planet. About 40% of all photosynthesis happens in oceans.

https://www.google.com/twitter.com/1547177570090174

Living and non-living elements of an ecosystem have a complex inter-relationship that enables all the participants within its bounds to flourish. As the biotic organisms and abiotic elements come together, they play their distinct roles to produce a viable environment for an ecosystem to exist. Biotic organisms are defined as the living elements such as micro-organisms, animals, and plants. Abiotic factors are the rocks, soil, air, and water that allow these biotic elements to flourish.



Population

A population consists of all the members of the same type of organism that live in an ecosystem. Population numbers depend on resources, prey-predator relationships, diseases, and competition. In any population, growth is limited by factors such as competition, predation, water and disease.
If the population in the areas exceeds that number, many animals won't get enough to drink. To survive, they must find water elsewhere.

The water available to animals at this watering hole is a limiting factor in the ecosystem. A limiting factor is something that restricts the growth and distribution of a population. Limiting factors include resources such as food, water and space. They can also involve competition, predation, disease, invasive species, and human activities.

Competition is the struggle among living things to use the same resources in an ecosystem. Some competition occurs between individuals of the same species. For example, birds of the same species might compete for the best places to nest. Plants might compete for growing space soil. Two lions might compete for the same prey.

There is also completion between different species. Owls and hawks hunt the same type of food. Their completion is limited because they hunt at different times of the day.

Predation occurs when one organism-the predator-catches and feeds on another organism-the prey. Predation is an important limiting factor in an ecosystem. When prey population grows, predators have plenty to eat. As a result, the predator population grows.

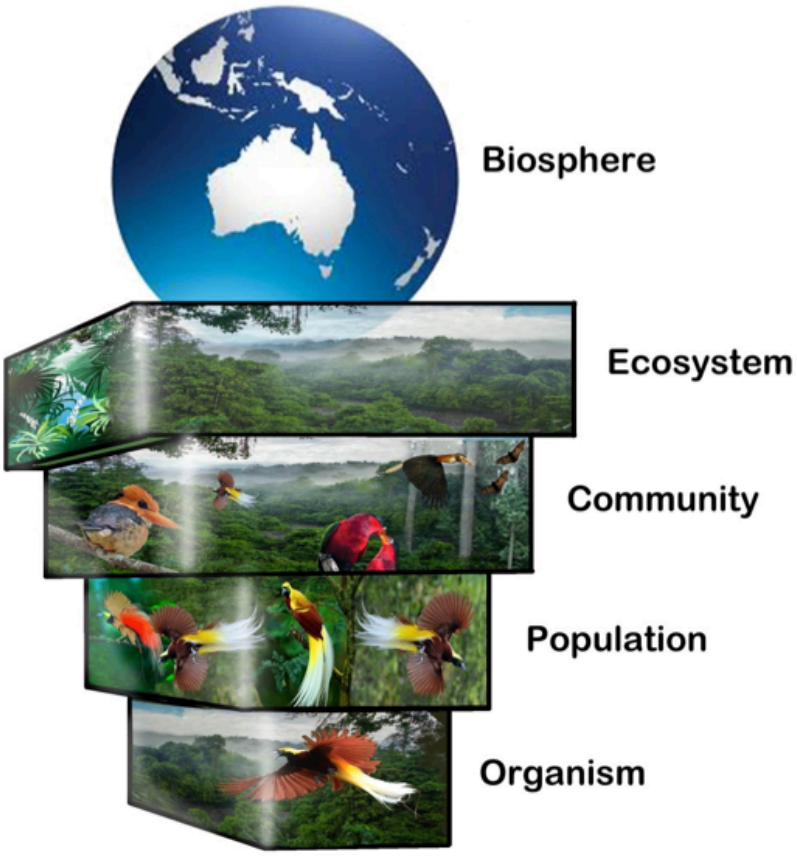
A disease is a condition that prevents an organism from functioning properly. It is an important limiting factor because it can stop population growth. Diseases often appear in animal populations weakened by overcrowding and lack of food and water. Disease can also affect plant populations.

The natural balance of ecosystems can be destroyed when an organism arrives from elsewhere. Invasive species are plants or animals that are not native to an ecosystem. Invasive species harm ecosystems because they often have no natural enemies. In such cases, their populations can increase quickly. They crowd out native species and consume resources. They can also destroy habitats and disrupt food chains.

Community

A community is the group of living things found in an ecosystem. These living things depend upon one another for food, shelter and other needs. They also depend upon the nonliving things in the ecosystem. Organisms that live well in one ecosystem might not survive in another. Alligators for example, find food and shelter only in warm, wet places. They must also drink lots of water to flush wastes from their blood.

The structure of the biosphere begins with the organism, population, community and ecosystem.



Strand 2: Physical Science

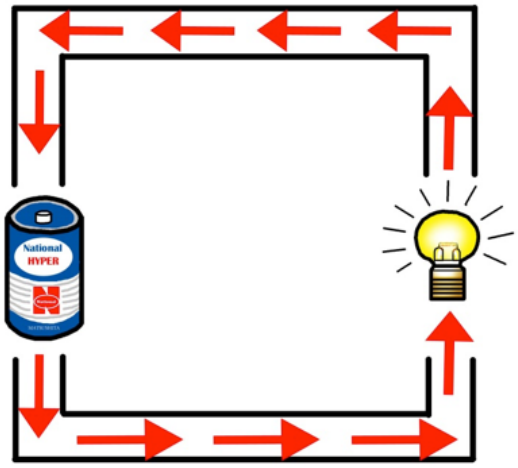
Unit 1: Energy

Topic: Electricity

Circuits and Electric Current/Voltage

Electricity is the continuous net flow of electric charges from one place to another. The electric charges are always electrons. For the current to flow through, the electrons must follow a circuit. Cooper wires are used in circuits because copper carries electricity very well.

A circuit also includes a source of energy and some resistors. A resistor is a device that resists electricity flowing through it. Examples of resistors are light bulbs and many devices. They change the electrical energy into light, heat or sound. Most circuits have a switch. A switch is a device that allows the current to be turned on or off. When the switch is open, the circuit is broken and therefore the current stops.



Volts and Amperes

Voltage is the electric potential energy per unit charge. The greater a battery's voltage, the greater the current it can supply when it is wired into a circuit. The amount of voltage is measured in units called volts (V). You can think of volts as a measure of "electric push" that a battery can provide.

The unit of measure of electric current is ampere (A). One ampere of current is the net flow of about 6 billion billion electrons every second through a point in the circuit.

Measuring electric current

The brightness of a lamp can be used to indicate the size of the current flowing in a circuit. The brighter the lamp, the larger the current flowing. However the brightness of a lamp does not measure electric current exactly and a lamp will not glow when the current is small. In order to measure the current exactly, an instrument called an ammeter is used. An ammeter is always connected in series with circuit. The units of electric current are amperes or amps (A) and the symbol for current (I)

Measuring Voltage

An electric current is produced by a source of electricity. The forces that pushes the electricity along a wire is called the voltage. If the voltage is increased, the force pushing the electricity through the circuit is increased, and so the current will also be increased. Voltage is measured in volts (V) using a special instrument called a voltmeter. A voltmeter is connected in parallel across any electrical device.

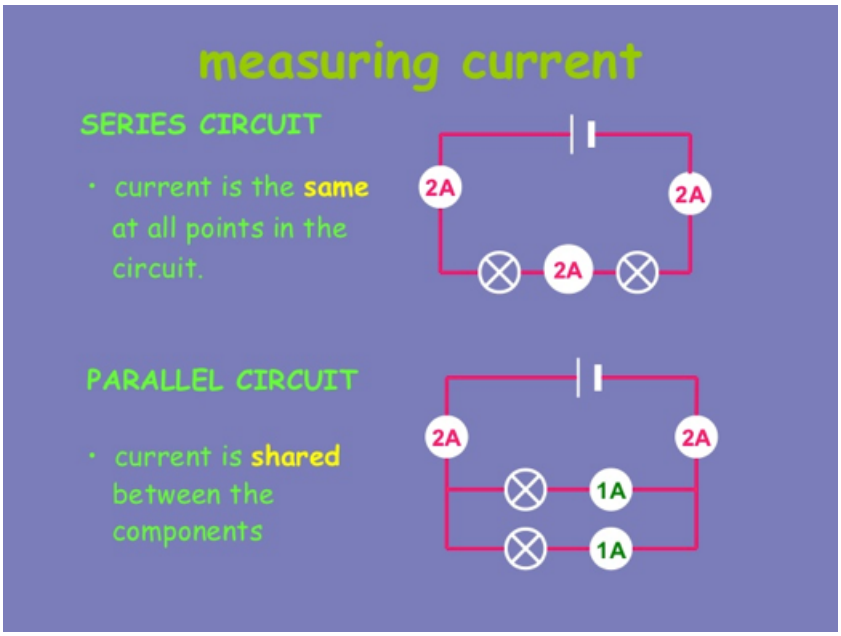
Types of Circuits

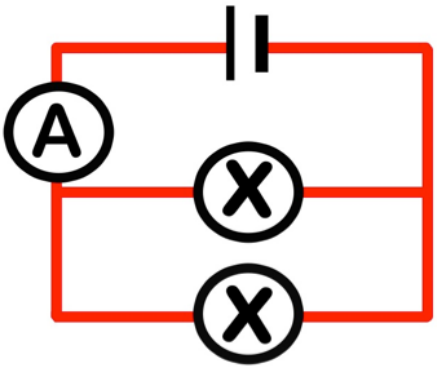
The parts of an electric circuit can be connected in different ways. In a series circuit, current flows in a single path. Along the way it may pass through two or more resistors, such as light bulbs. In a series circuit the current is the same throughout the circuit.

Note that the a switch is used to open and close a circuit. If a switch is open, the pathway is broken and no charges can flow. Similarly if one of the resistors breaks, it acts alike an open circuit and stops the current. When a bulb burns out in a series circuit, the electricity stops flowing.

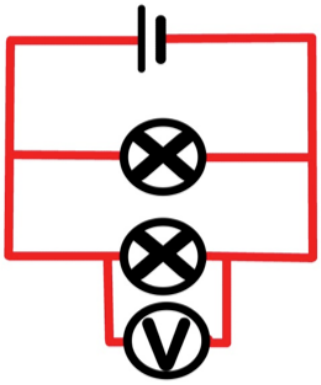
In a parallel circuit, electric current can flow through more than one path to complete the circuit. If all of the pathways are complete, some of the along each path. When a resistor in one of the pathways breaks, current can still flow along other paths.

In a parallel circuit, the resistors in each pathway receive the full voltage of the circuit. So bulbs wired in parallel are quite bright-as bright as if only one were in the circuit. In a series circuit, the voltage is divided among various resistors. The more bulbs added into a series circuit, the more dimer they are lit.

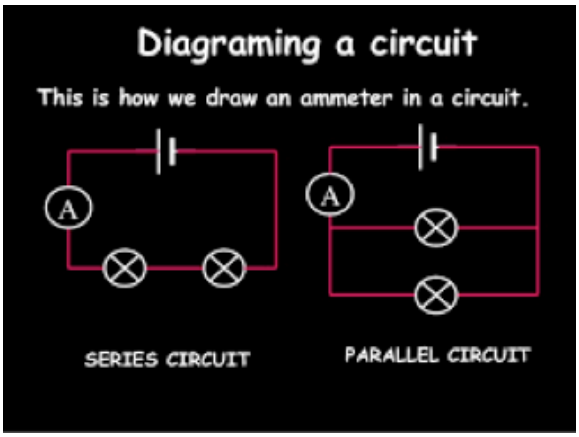


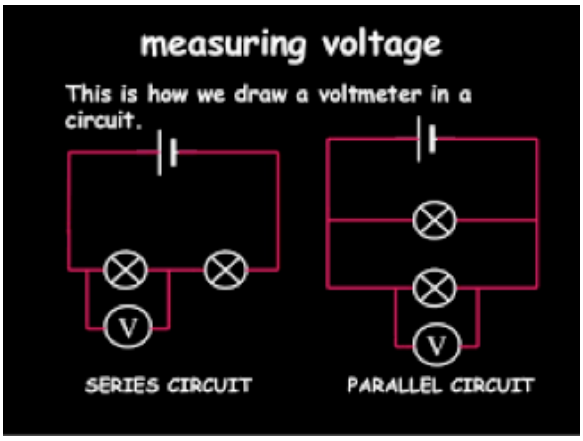


Ammeter in paralell circuit



Voltmeter in parallel circuit





Electric Current/Voltage and Resistance

Definition:
Voltage (A)

- Electric potential, measured in volts (V)

Electric Current (I)

- a measure of the rate at which electric charges flow, measured in Amperes (A)

Resistance (R)

- the ability to impede the flow of electrons in conductors, measured in Ohms (Ω)

When an electric current moves through a conductor, there is always some *electrical resistance* to the current. This is because of the attraction of the electrons to the positive nuclei of the atoms in the conductor. This attraction is greater in some conductors than in others, giving them a greater electrical resistance. As the electrons are pushed through a conductor they lose some of their energy as heat. This waste heat can be a nuisance; for example, computers get hot when used. However the waste heat is sometimes useful. For example, because nichrome wire has a fairly high resistance, it is used to make the heating elements in many electrical appliances used around the home. It is usually coiled to take up less space. The filament of a light bulb is made from a very thin tungsten wire. When a current is passed through it, the wire becomes so hot that it gives off a brilliant white light.

Ohm's Law

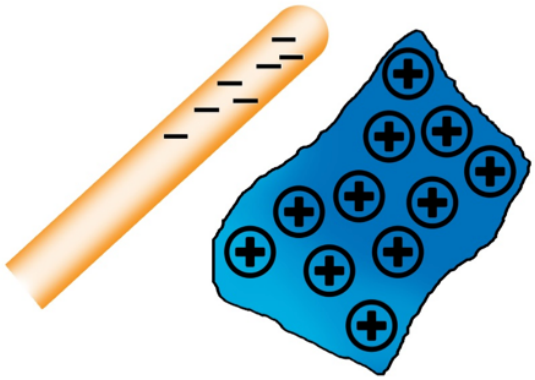
- Relationship between voltage, current, and resistance
- States that the current in a circuit varies in direct proportion to the potential difference, or voltage, and inversely with the resistance.
- Used to make calculations in all circuit problems
- V = potential difference (voltage) in volts
- I = electric current in amperes (amps, A)
- R = resistance in ohms Ω

Static Electricity

Have you ever felt a plastic comb pulling your hair when you hold the comb above your head? Have you heard the crackling sound as you take off your nylon shirt or blouse? This is caused by static electricity. If the static or stationary electricity is made to move, it can make a spark.

The word 'electricity' came from the Greek word 'electros', which means amber. Amber is old tree gum, which becomes charged very easily when it is rubbed with a cloth.

Normally objects have no charge on them because the number of negative charges balances the number of positive charges. However, when some substances are rubbed together charges can be moved from one substance to another. This is how static electricity is formed. For example, plastic rod is rubbed with a piece of cotton cloth; negative charges are rubbed off the plastic rod on to the cloth. In this way the cotton cloth becomes negatively charged, because it now has more negative charges. The plastic rod becomes positively charged, as it is now has more positive charges because of the negative charges lost to the cloth.



Topic: Light and Lens

Light

Like all waves, light waves can be transmitted, absorbed, reflected, or refracted. The interation of light and matter is the basis of vision and of the optical technology.

Electromagnetic waves all travel at the same speed – about 300,000 km (186,000 mil) per second. This rate of travel is known as the speed of light.

To get an idea if how fast is this, consider that the circumference of Earth is about 40,000 km (25,000 mi). At that speed, light and other electromagnetic waves could travel this distance seven times in one second! Light cannot travel around the world, however. Another property of light waves is that they usually travel in a straight line.

Here is a simple way to demonstrate both that light is moving, and it travels in a straight line. Hold your hand between a light source and wall. What happens? Your hand creates a shadow by blocking the light and keeping it from traveling to the wall. The shadow is shaped like your hand, because the light rays move in a straight line as they go past your hand or are absorbed.

If you ever sit at the edge of a swimming pool with your legs in the water, you may notice something odd. Your legs may appear to bend sharply just below the surface of the water. This optical illusion results from refraction of the lights coming from your legs.

Refraction is the bending, or changing of direction, of light rays when they pass from one material into another. If the rays pass through the surface of the material at an angle other than 90 degrees to the surface, they will refract.

Light moves at different speeds through different materials. When light crosses the surface between two materials at an angle, it changes direction.

The bouncing of light off a surface is called reflection. The flatness and smoothness of the mirror ensure that light rays are reflected in an orderly way.

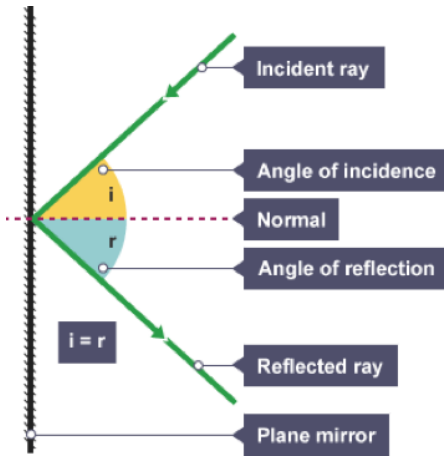
Whenever light reflects off a mirror, it obeys the law of *reflection.* According to this law, light rays leave the mirror at the same angle at which they strike the mirror.

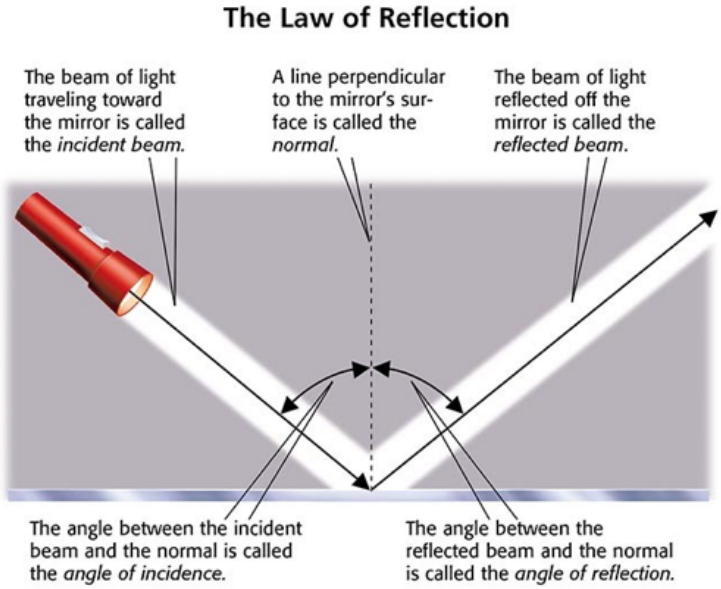
As the law of reflection predicts, all of the light rays that strike a plane mirror will reflect off the surface in a specific direction. So, the light rays leaving the mirror will have the same arrangements that they had when they struck the mirror. That is why the image of your face has left and right reversed.

Most objects, even if they are highly reflective, are not as smooth as a mirror. Their surfaces have tiny bumps and pits. These irregularities cause different rays to hit different parts of the surface at different angles. Each ray reflects off the surface at a different angle and no clear image is formed. The type of reflection produced by such a surface is called a diffuse reflection.

Reflection:

- Light is reflected when light falls on a smooth polished surface or shinny surface
- The ray of light is reflected in another direction after striking the mirror.
- Light rays that strike the surface (plane mirror) is called the incident ray and the ray that comes back from the surface (plane mirror) after reflections is known as the reflected ray.
- Angle of incidence (Đi) is the angle between the normal and the incident ray and the angle of reflection is between the reflected ray and the normal.
- The angle of incidence is always equal to the angle of reflection. This is known as the *Law of reflection.*





https://www.google.com/ineedmorespace.wave_diagram_reflection_mirror.

Refraction:

The phenomenon of bending away of light from the normal is known as Refraction. The bending of the light depends on the two medium that the light is traversing. If the light travels from a denser medium to a lighter medium, the ray tends to bend away from the normal, whereas if the light is travelling from a lighter medium to a denser medium, then the ray tends to bend towards the normal.

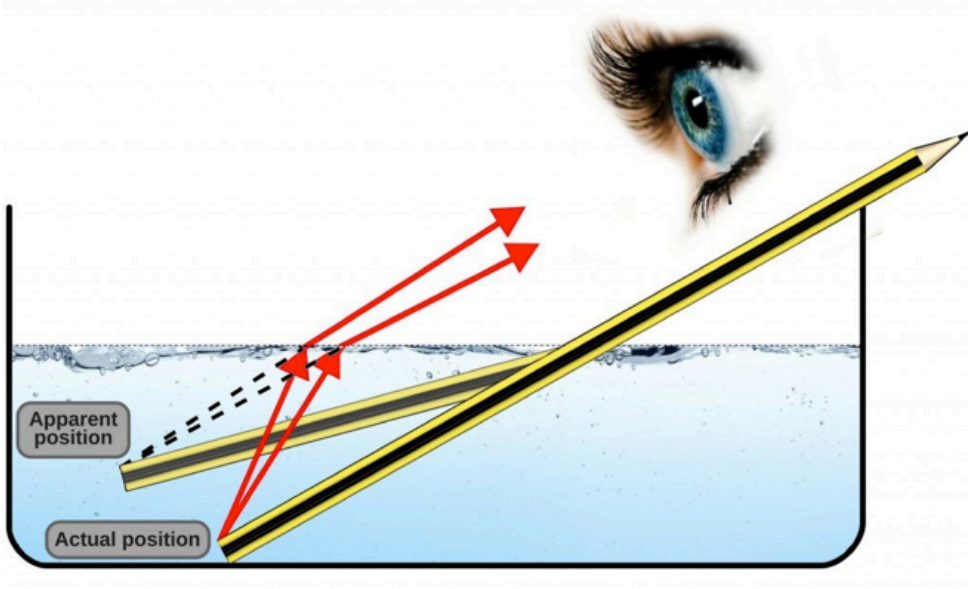
Laws of refraction

- All the three rays that is, incident ray, normal and the refracted ray, lies in the same plane
- The relation between the angle of incidence and angle of refraction is constant and can be defined as the ratio of sine of both the angles that is, angle of incidence to angle of refraction. The constant value is also known as Refractive Index (μ).

Light is indeed the fastest entity in the universe, but only in a vacuum. In other words, nothing can travel faster than light in a vacuum; in other mediums, however, like water, glass etc., it's quite possible for other entities to be as fast as – or even faster than – light.

The speed of light depends entirely on the medium through which it's traveling, and as you can imagine, every medium has a different set of properties, which means that light's speed in one medium can be assumed to be at least slightly different from another. For instance, the properties of a medium such as air are different from those of another medium, like water. Similarly, water as a medium is quite different from glass as a medium.

Therefore, the speed of light changes when it travels from one medium to another. The moment that a light ray leaves a certain medium and enters a new one, it refracts, i.e., it bends away from its original path. You can actually observe this phenomenon in action in many ways in your everyday life. For example, try putting a pencil in a jar full of water (as shown in the image below).



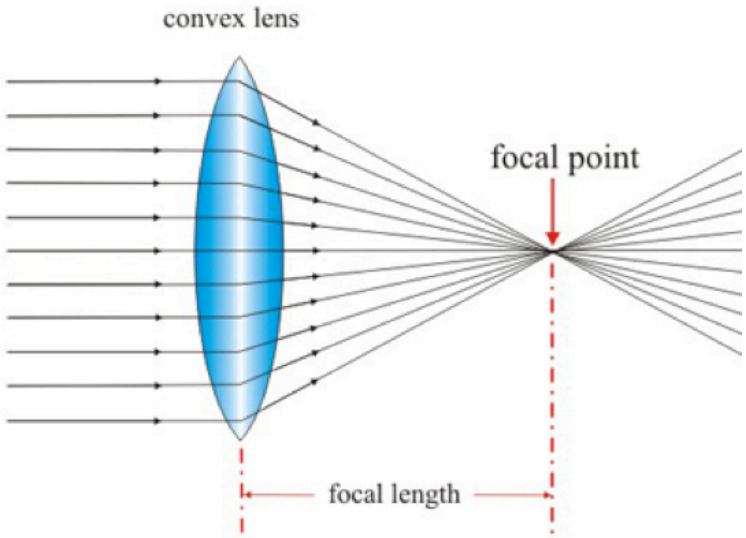
www.scienceabc.compure-sciences/what-index-of-refraction-defintion-examples-water-air-glass

Lens

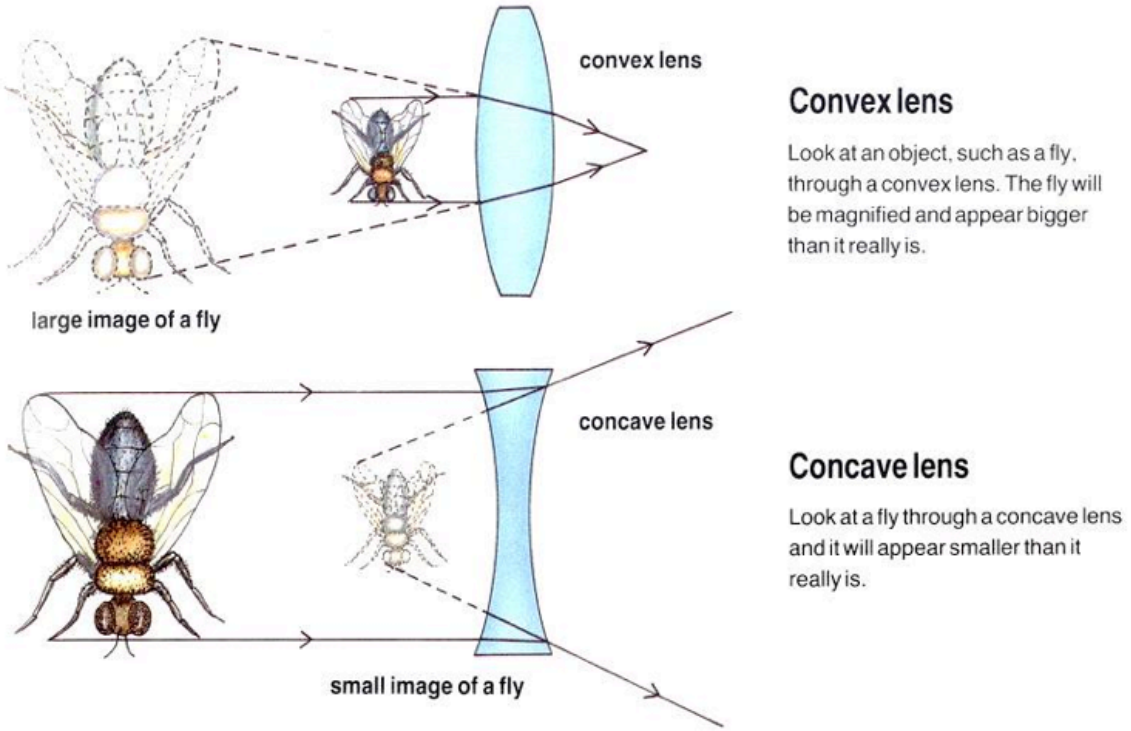
A lens is a transparent material that refracts light in such a way as to form an image. Like mirrors, lenses may be convex or concave. Unlike mirrors, both sides of a lens may be curved.

A convex lens is thicker at the centre than at the edges. Convex lenses are thicker at the middle. Rays of light that pass through the lens are brought closer together (they converge). A convex lens is a converging lens.

When parallel rays of light pass through a convex lens the refracted rays converge at one point called the principal focus. The distance between the principal focus and the centre of the lens is called the focal length.



A convex lens causes light rays to converge at a focal point. The distance of the focal point from the center of the lens is the focal point of the lens. The type of image formed by a convex lens depends on the distance of the object from the lens. If the distance is less than one focal length, the image will be right-side up and enlarged. A hand lens produces this type of image.



https://www.google.com/.physics.illinois.edu/-rays-though-lenses

If the distance between the object and the lens is between one and two focal lengths, the image formed will be up-side down and enlarged. If the distance is more than two focal lengths, the image will be up-side down and reduced in size. This is the type of image that a camera focuses on film.

Unit 2: Force and Motion

Topic: Force and Pressure

Pressure

Pressure is an effect on which occurs when force is applied on a surface. Pressure is the amount of force acting on a unit area. Pressure is the action of one force against another over, a surface. The pressure P of a force distributed over an area A is defined as:

$P = F/A$

Properties of Air
Because air has mass, it has pressure. It also has other properties, including density and pressure.

Air pressure is the pressing down of the weight of air on an area. Denser air has more air pressure than less dense air.

Pressure of a solid

- The pressure exerted by a solid is down. Think of it this way: When you put a book on a desk, the pressure exerted by the book is on the desk.

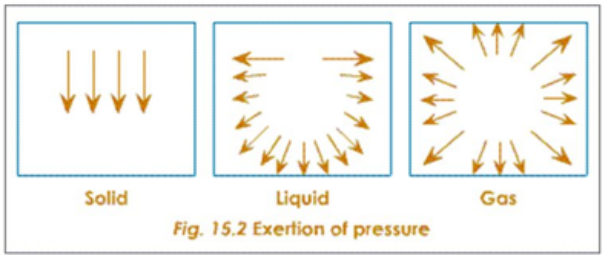
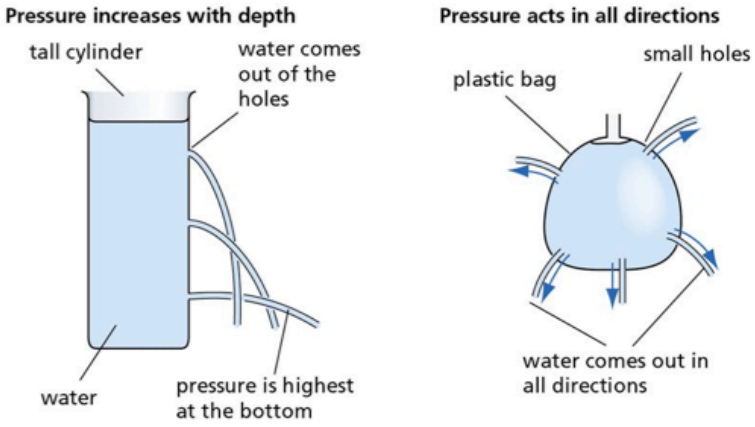


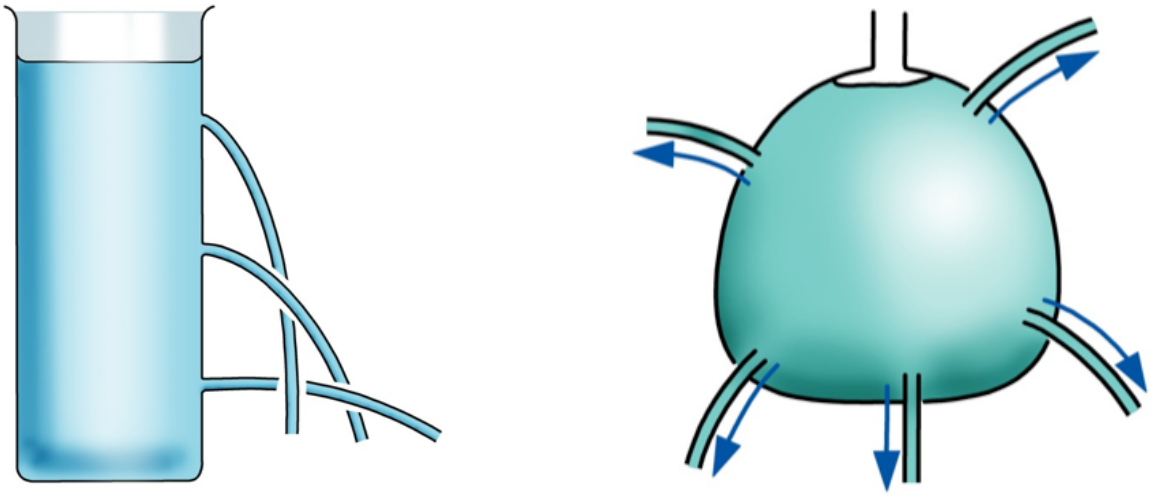
Fig. 15.2 Exertion of pressure

https://www.google.com/slide/1547251761215806

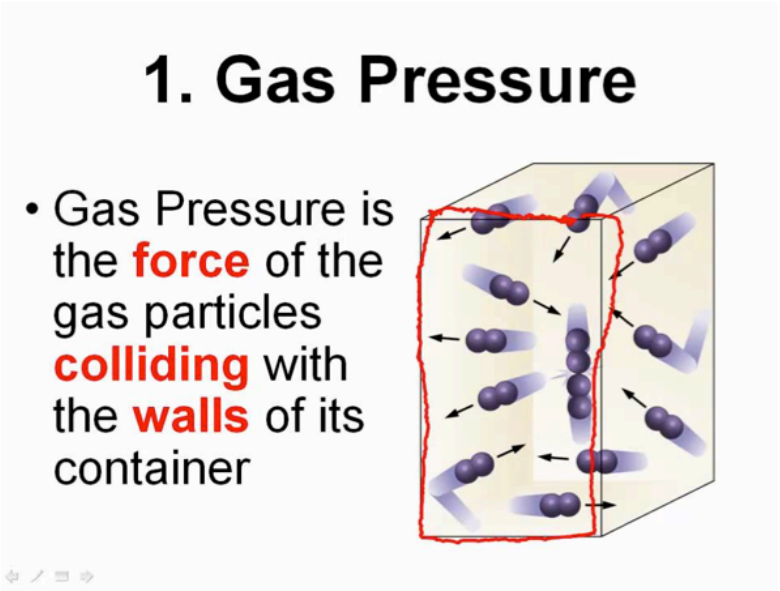
If a force is applied over a smaller surface area, you get a larger pressure

Pressure in liquids





A liquid in a container exerts pressure because of its weight. Pressure in lquids acts in all directions. The weight of the liquid causes pressure in the container. It also causes pressure in any object in the liquid.



Density

Density can be best explained using the following example. Which would you like to carry up a hill- a 10kg bag of rice or the same bag filled with feathers? The rice and the feathers take up the same space in the bag, but the bag of rice is much more heavier than the bag of feathers. This is because rice is denser than feathers

Density is how much mass is packed into a measured volume. It is usually measured in grams per cubic centimetre (g/cm3). To find the density of something simply us the following formulae:

$$\text{Density (g/cm}^3\text{)} = \frac{\text{Mass (g)}}{\text{Volume (cm}^3\text{)}}$$

To find the volume of regular objects use volume = length x width x height. To find the volume of irregular shaped objects, use a displacement can to find the volume. Simply drop the object into the can and measure the volume of water it displaces (pushes out of the way).

All samples of pure substances kept under the same conditions have the same density. A drop of pure water and a tub-load of pure water both have density of 1g/mL. this is the density of pure water in liquid state. Liquids with other densities are not pure water.

Remember that density is not the same as mass. For example, lead is much denser than aluminium if a block of lead and a block of aluminium each have a mass of 10g, what can you conclude about them?

Table of densities (g/cm3)

Air	0.0013		Ice	0.9
Styrofoam	0.1		water	1.0
Cork	0.2		Sea water	1.03
Pine wood	0.4		Aluminium	2.7
Petrol	0.7		Iron	7.8
Polythene plastic	0.9		Lead	11.3

** *Adopted from Science Essentials 8, pg. 28)*

Unit 3: Matter

Topic: Properties of Solutions

Properties of Solutions

Solutions are mixtures that are evenly mixed at the molecular level. You cannot see the particles that make up the solution. A solution has two parts, a solute and a solvent. The solute is the substance that is present and lesser amount. The solvent is the substance that is present in the greater amount. For example, in a sugar solution, the sugar is the solute and the water is the solvent.

Because solution is a mixture, the substance that make up the mixture keep their properties. This means that sugar can be separated from the solution by evaporation. Many solutions are made of a liquid solvent and a solid solute such as sugar and water. Other solutions form from other combinations of gases, liquids and solids.

Acid, Alkaline and Neutral Solutions

Acids and Bases

Acids

Scientist use many definitions of acids. One simple definition is that an acid tastes sour when dissolved in water. Lemon, oranges, lemons, pamellos, limes, apples and vinegar contain weak acids. Lemons, oranges, pamellos and lime contain citric acid. Apples contain malic acid, sour milk contains lactic acid and vinegar contains acetic acid. All these food contain weak acids and are harmless. The stomach also uses acids to digest food.

There are other acids that are strong and are mostly found in the laboratories. The common ones are the hydrochloric acid, sulphuric acid and nitric acid. Strong acids are corrosive and can cause serious burns to the skin and damage clothes. If you get any acid on your skin or clothes, wash it immediately with plenty of water.

An acid solution that does not contain very much water in it is said to be concentrated and a watered-down acid solution is said to be dilute.

When mixing concentrated acids with water to dilute them, be careful and add water to the acid. Because so much heat is given out as acid dissolves, the mixture bubbles and could splash out causing burns.

To identify compounds as acids, scientist use a special kind of test paper called a *litmus paper.* Litmus paper comes in blue and red strips. Acids turn blue litmus to red.

With an ACID
Litmus indicator is RED

Bases

A base feels slippery, tastes bitter and turns red litmus paper blue when dissolved in water. Soap, detergents and ammonia contain compounds called base. Bases are chemical compound that can be thought to be chemical opposite to acids. Three common bases that are used in the laboratory are sodium hydroxide, ammonium hydroxide and calcium hydroxide. Litmus indicator is blue in base. A good way to remember that the litmus is blue in bases is that “blue” and “base” start with same letter “b”.

With a BASE
Litmus indicator is BLUE

Why can acids and bases be powerful? One reason is that both react strongly with water. As a general rule, acids add hydrogen ions (H+) when they dissolve in water. Bases add hydroxide ions (OH-) in water. Both hydrogen ions and hydroxide ions are very unstable. They combine with other substances very quickly.

When an acid and a base react with each other, H+ ions in the acid and OH- ions in the base combine to form a neutral water. A compound called a salt is also formed. The reaction is called neutralisation.

Indicators

Chemical dyes that are one colour in and acidic solution but change to a different colour in a basic solution are called indicators. The indicators that commonly used in laboratory and the colours they give when added to an acid or base are shown in the table below.

Indicator	Colour in Acid	Colour in Base
Litmus	Red	Blue
Phenolphthalein	Colourless	Pink
Methyl orange	Red	Yellow
Bromothymol blue	Yellow	Blue

Coloured dyes in plants, vegetables and flowers are also good indicators. The red colouring in hibiscus flowers can be extracted by boiling the petals in water in a few minutes. The red solution can then be used as an indicator. Hibiscus flower indicator is red in acids and green in bases.

Neutralisation

Acids and bases react together and neutralise each other. When acids and bases react together they combine to form a salt and water. This is known as neutralisation reaction. Energy in the form of heat is always released during a neutralisation reaction.

Neutralisation reactions
Base + Acid ⟶ Salt + Water + Heat
Sodium Hydroxide + Hydrochloric acid ⟶ Sodium chloride + water + heat
Ammonium hydroxide + sulphuric acid ⟶ Ammonium sulphate +water + heat
Calcium + Nitric acid ⟶ Calcium nitrate + water + heat

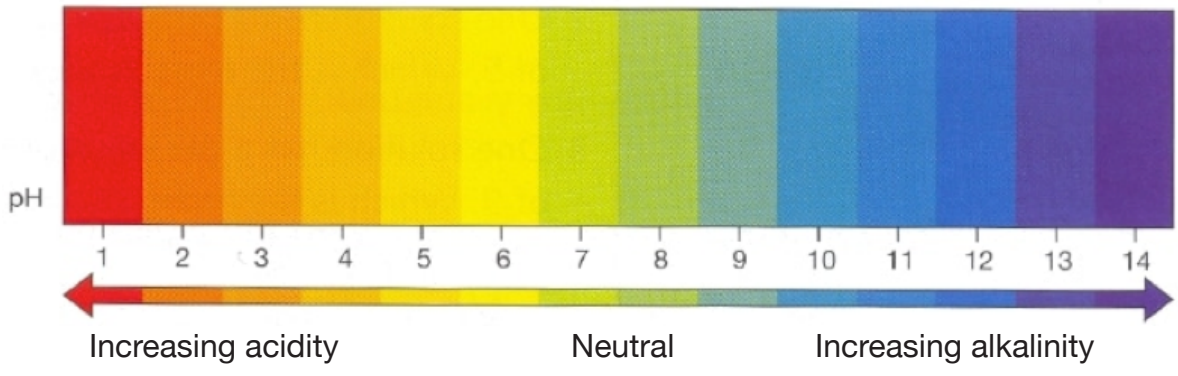
Range of pH	Colour of universal indicator	Strong/weak/acid/base
0	Red	
1	Red	Strong acids, from example,
2	Red	hydrochloric acid
3	Pink	
4	Pink	Weak acids, for example citric acids
5	Orange	
6	Yellow	
		Neutral solutions, for example,
7	Green	pure water, salt solution
8	Blue-green	Weak bases, for example lime
9	Blue	water
10	Blue	
11	Purple	Strong bases for example ,
12	Purple	sodium hydroxide
13	Purple	
14	Purple	

Measuring pH

To compare strengths of two acids using a litmus paper won't work it will turn red in both acids. Scientists use a scale called the pH scale to measure the strength of an acid or base dissolved in water. The range of the pH scale is from 0 to 14. Low pH reading means a high concentration of hydrogen ions. Acids have a pH between 0 and 6. A high pH means a low concentration of hydrogen ions. Bases have a pH between 8 and 14. Water has a pH of 7. It is neutral and has equal concentration of hydrogen ions and hydroxide ions.

Scientists use special chemicals called indicators to determine the pH of a solution. An indicator is a chemical that changes colour when mixed with an acid or base. The chemical in the litmus is an indicator that changes colour in any solution that is not neutral (pH7). Other indicators change colour over a different range of pH.

Several indicators can be combined into a universal indicator.it turns a range of colours over a broad range of pH values. By placing a small drop of an acid or base solution on the paper and comparing the colour to a key, you can determine the pH of the solution.



Concentration of Solution

Different substances dissolve in water in different amounts. The amount of a solute that can dissolve in water is known as the *solubility* of a substance. The solubility depends on the temperature of the water and is measured by how many grams of the substance will dissolve in 100 cubic centimeters of water at that temperature. For example, the solubility of copper sulphate at 20^0C is 22grams in 100 cubic centimeter of water. The solubility of potassium nitrate at 20^0C is 29 grams in 100 cubic centimeters of water.

The solubility of most substances increases with temperature. Sugar, salt, coffee and copper sulphate becomes more soluble as the temperature of the water increases.

Separating a Solution

To separate a solution, you must make use of the different properties of the mixed materials. You usually cannot use the size of the particles to separate them, because only very special filters are fine enough to trap a molecule. There are other properties you can use, however. For example, some liquids evaporate at fairly low temperatures. You can often allow solvent to evaporate, leaving the solute behind.

Another way to separate most solutions is to use the different boiling points or melting points of the substances. Sugar is collected in this way. Growers cut down the sugar cane stems and crush them. Then the sugar cane juice is collected and heated. The water boils off at 100 degrees, while solid sugar remains behind.

Topic: Atoms, Molecules and Compounds

Unit of Matter: Atom

Atoms are the basic building blocks of all matter-both living and non-living. They are incredibly small. To give some idea of their size, there would be 10 000 000 000 000 000 atoms in the dot at the end of this sentence. This means that there are about 2500 times more atoms in the dot than there are people in the world.

Atoms are not usually found on their own. Two or more atoms joined together are called a molecule.

Pure substances like iron and copper, whose atoms are all the same, are called elements. An element is a substance that cannot be broken down into other substances. An atom is the smallest unit of an element. All atoms of an element contain the same number of protons.

The first elements discovered were the metals gold, tin, copper and iron. Over the years more and more elements were discovered. In total, 90 elements have been found in the Earth's rocks, soil, air and water. Another 20 or so elements, which do not occur naturally, have been made by nuclear scientists, and more will almost certainly be made in future.

Some common elements are listed in the table below:

They are classified into two main groups – metals and non-metals. (Metals conduct electricity, and most non-metals do not.) The elements can also be classified according to whether they are solids, liquids or gases at room temperature (200C).

Each element is represented by a symbol. This is a shorthand way of writing the name of the element. Sometimes the symbol is the first letter of the English name of the element: for example, carbon **C**. However, some elements have the same first letter: for example, carbon and calcium. In these cases a second letter is used: calcium **Ca**. Note that the first letter is a capital, but the second letter is not. In some cases the symbol comes from a Greek or Latin name. For example, the symbol for gold is **Au**. This comes from the Latin word aurum, which means 'shining dawn'. Some elements are named after famous people or places: for example, einsteinium and francium.

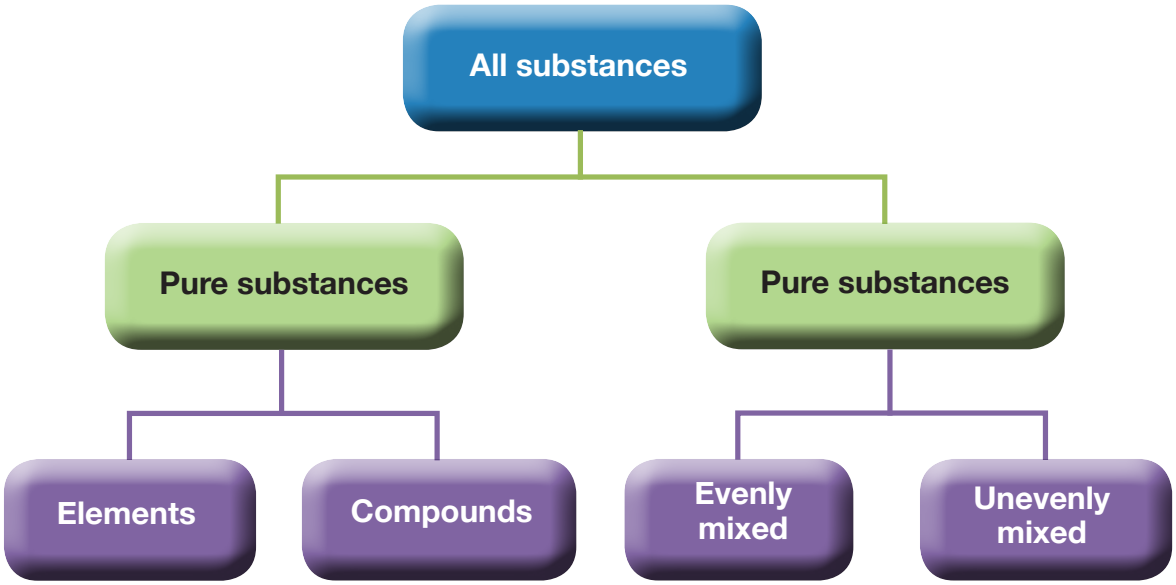
Element	Symbol	Metal or non-metal
Aluminum	Al	Metal
Argon	Ar	Non-metal
Bromine	Br	Non-metal
Calcium	Ca	Metal
Carbon	C	Non-metal
Chlorine	Cl	Non-metal
Copper	Cu	Metal
Gold	Au	Metal
Hydrogen	H	Non-metal
Iodine	I	Non-metal
Iron	Fe	Metal
Lead	Pb	Metal
Magnesium	Mg	Metal
Mercury	Hg	Metal
Nitrogen	N	Non-metal
Oxygen	O	Non-metal
Phosphorus	P	Non-metal
Plutonium	Pu	Metal
Silver	Ag	Metal
Sodium	Na	Metal
Sulfur	S	Non-metal
Zinc	Zn	Metal

Molecules

Atoms are usually found on their own. Two or more atoms joined together is called a molecule. For example, an oxygen molecule consists of two oxygen atoms held together by a chemical bond. A water molecule is made of two hydrogen atoms bonded to one oxygen atom. This means water contains two different atoms. Molecules vary in size from tiny hydrogen molecules up to huge protein molecules in our body. Each of these protein molecules contains about half a million atoms. Only in recent years have scientists been able to use special microscopes to 'see' atoms and molecules.

Compounds

All materials can be classified into two groups – pure substances and mixtures. Pure substances contain atoms or molecules that are exactly the same. Mixtures contain different types of atoms or molecules. The pure substances can be divided into elements and compounds. Compounds can be broken down into simpler substances but elements cannot.



Oxygen and hydrogen are both elements. They are gases at ordinary temperatures. Water is made up of oxygen and hydrogen but when we examine water carefully we cannot observe either oxygen or hydrogen. This is because the oxygen and hydrogen have been joined together.

When elements joined together a new substance is formed. This new substance has properties that are different from the properties of the original elements. Oxygen and hydrogen are both gases but when they are joined together the liquid water is formed.

Substances that are made by joining two or more different elements together are called compounds. Water is a compound. Water can be made from its elements in the laboratory. When hydrogen burns in oxygen, the liquid water is produced.

Properties of Compounds

All matter can be classified as either a pure substance or a mixture. A substance has a definite composition and the same composition and properties regardless of where it comes from. A substance also has uniform composition throughout. A mixture on the other hand has a variable makeup.

The properties of a compound are usually different from the properties of element s that make it up. For example, a shiny silver spoon will turn black when exposed to sulphur compounds in the air. The black coating is silver sulphide, a compound made of silver and sulphur. It is neither shiny like silver nor yellow like sulphur.

Strand 3: Earth and Space

Unit: Our Earth

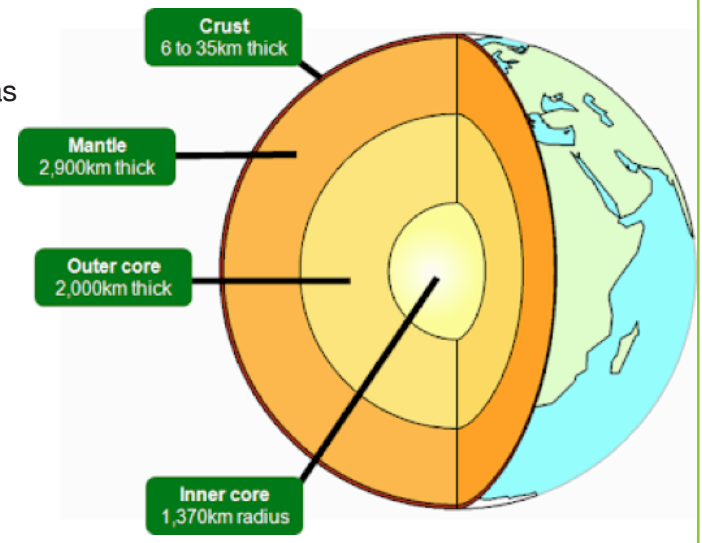
Topic: Earth's Structure

Compositions and Structures of the Earth

Earth has a layered structure. Most of these layers are made up of solid or partly melted rock. The innermost layers are mostly a mixture of metals. Earth's layers vary in thickness. The crust, the uppermost layer, is much thinner than the other layers. The crust is nearly all solid rock. Under the continents, the crust is mostly granite and other light rocks. Below the oceans, the crust is mostly made of basalt-a dark, dense rock. The crust is by far the thinnest of Earth's layers. Under the continents, the average thickness of the crust is about 40km (24mi), but it may be as much as 70km (42mi) in mountainous regions. The crust is even thinner under the oceans. The ocean-floor crust has a thickness of about 7km (4mi).

The temperature increases as you go deeper that rocks are located, the hotter they are. The layer just below Earth's crust is the *mantle.* The mantle is about 2, 900km (1,800mi) thick and makes up more than two-thirds of Earth's mass. At the boundary where the upper mantle meets the crust, the mantle rock is solid. This solid upper mantle and crust combine to form a rigid shell called the *lithosphere.*

Below the lithosphere, much of the rock material in the mantle is partially melted. This material can flower very slowly, like plastic that has been heated almost to its melting point. The solid lithosphere can be thought as "floating" on this thick lower mantle.



The inner most of Earth's layers is the *core,* which extends to the center of the Earth. The core is divided into two regions, or layers - the outer core is about 2, 200km (1,400mi) thick, and is the only layer that is in a liquid state. It is made up of mostly of molten iron and nickel, with some sulfur and oxygen also present. The inner core, about 1,200km (720mi) thick, is even hotter than the outer core. It is probably made up of iron and nickel as well. However, the extremely high pressure so deep inside Earth keeps this metal from melting.

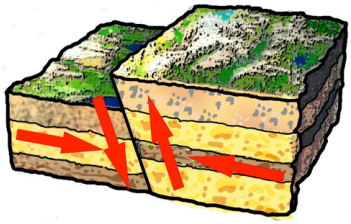
Many scientists believe that the presence of molten iron and nickel in Earth's core explains why Earth is surrounded by a magnetic field. According to one theory, convection currents move slowly throughout the liquid outer core. Electric currents are produced as Earth rotates, setting up Earth's magnetic field.

Plates and Earthquake

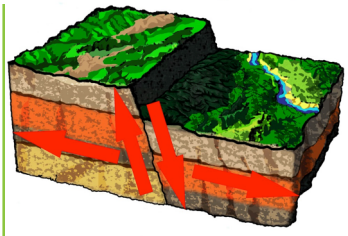
In the 1950s, scientists discovered that molten rock from the mantle was rising to Earth's surface in the ocean basins. As this rock is cooled and hardened, it was being added to Earth's crust. This discovery led scientists to suggest that the lithosphere is no one solid shell rock. In fact, they now believe that the lithosphere is broken up into giant slabs of rock called plates. These plates seem to "float" on top of the mantle, much like giant ships floating on a sea of thick molten rock.

The idea of giant plates of rock moving slowly across Earth's surface is called *plate tectonics.* As you might expect, the plates move very slowly. Their average speed is about 10cm (4 in.) a year. However, over millions of years, plates can move thousands of kilometers. There are two kinds of plates. Oceanic plates consist of almost entirely dense ocean-floor material. Continental plates are made up of lighter continental rock "riding" on top of denser rock.

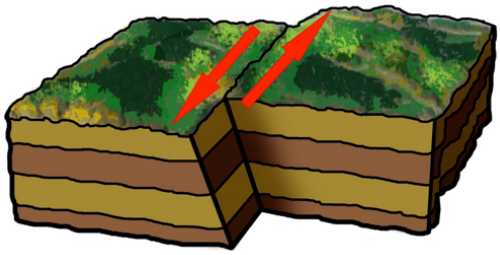
Plates interact at their edges, or plate boundaries. There are three ways in which Earth's plates interact at their boundaries.



Converging Boundaries
Two plates move toward each other. One plate may move under the other in a process called subduction.



Diverging Boundaries
Two plates move away from each other. Molten rock rises to fill the gap. Creating new crust.



Sliding boundaries
Two plates slide past each other, moving in opposite directions.

Earth's crust moves very slowly. Typically, this motion can hardly be felt. But at times, it can cause sudden and unexpected changes to Earth's surface.

An earthquake is a violent shaking of Earth's crust. The release of built-up energy along a fault is what makes Earth shake, or quake. That energy released depends on how much rock breaks and how far the blocks of rock shift.

Mountains form where tectonic plates collide. There are three main types of mountains: fold mountains, fault-block mountains, and volcanic mountains.

Fold mountains form from colliding plates. Layers of sedimentary rock buckle upward as they are squeezed.

Fault-block mountains form from movement along large faults. Large blocks of rock drop down, leaving other areas high.

Volcanic mountains form when magma below Earth's surface pushes rock layers upward, forming domes. Volcanic mountains can also result when immense magma bodies cool into huge igneous bodies called batholiths.

Earthquakes and volcanic eruptions are examples of geological activities that usually occur at plate boundaries.

Topic: Natural Resources

Topic: Natural Resources

Natural resources are the resources available in a nature like air, water, sunlight, soil, minerals, forest, wild life etc. Natural resources are of two main types. They are renewable and non-renewable natural resources.

Sources of natural resources

Types of natural resources

Natural resources that can be replaced and reused by natures are termed renewable.

Natural resources that can not be replaced are termed non-renewable.

Renewable resources are replaced through natural processed at a rate that is equal to or greater that the rate at which they are used, and depletion is usually not a worry.

Non-renewable resources are exhaustable and are extracted faster than the rate at which they formed. For example, Fossil Fuels (coal, oil, natural gas).

Non renewable resources take millions of years to form. Because of the time it takes to reform them, they are considered non-renewable.

Examples of renewable resources:

- Fresh water
- Air
- Trees
- Sun energy
- Bio fuel
- Hydroelectricity
- Solar energy
- Wave power
- Wind power

Unit 2: Weather and Climate

Topic: Weather Change

Atmosphere

The formation of atmosphere

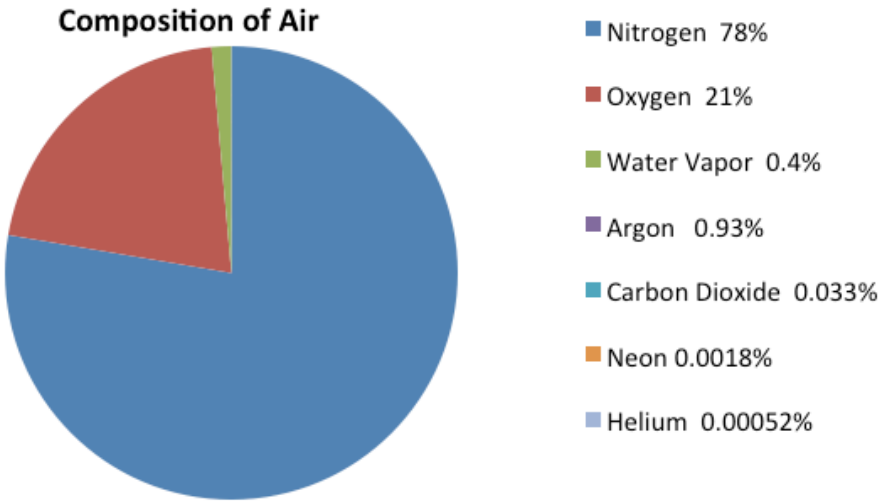
The atmosphere of a planet is an envelope of gas that surrounds the planet, and is held to it by the force of gravity. The planets have different atmospheres or no atmosphere. The difference in these atmospheres can be explained by:

1. The distance the planet is from the Sun
2. The composition of the planet
3. The size of the planet, which determines the gravity that holds the atmosphere around the planet.

Earth's atmosphere is a mixture of gases, liquids, and solids that surrounds the planet. The atmosphere supports all life on Earth. Weather takes place in the lower atmosphere.

The air we breathe is part of the atmosphere. The atmosphere is the mixture of gases, liquids, and solids that surrounds Earth. The atmosphere not only provides the air, but it also helps protect us from the Sun's harmful radiation. Planets other than Earth have atmosphere, too, but their mixtures of gases are different.

Earth's atmosphere is about 78 per cent nitrogen, 21 per cent oxygen. Oxygen is the gas that our body needs, and you take it in with every breath. The remaining 1 per cent of the atmosphere includes carbon dioxide makes up about 0.03 per cent of dry air. Neon and helium each make up a tiny percentage of our atmosphere. The amount of any one gas in the atmosphere can vary. In dry air, for example, there is little or no water vapour. In the moist air over an ocean, water vapour can make up four per cent of the air. Carbon dioxide is another gas that is present in the atmosphere in varying amounts. The amount of carbon increases when fossil fuels are burned.



Composition of Planetary Atmospheres

Planet	Composition of Atmosphere
Mercury	No atmosphere
Venus	Carbon dioxide, nitrogen and smaller amounts of oxygen and water vapor
Earth	Nitrogen, Oxygen and smaller amounts of carbon dioxide and water vapor
Mars	Mostly carbon dioxide
Jupiter	Hydrogen, helium, methane and ammonia
Saturn	
Uranus	Mostly methane and hydrogen
Neptune	
Pluto	*Yet to confirm. Search internet*
Moon	No atmosphere

Structure of the Atmosphere

Earth's atmosphere can be divided into four distinct layers as shown in the illustration on the right.

The layer closest to the Earth, where almost weather occurs, is the troposphere. About 90 percent of the atmosphere's mass is in the troposphere, the lowest layer. Although it is the thinnest layer, the troposphere contains about 75 percent of the gases that make up the atmosphere.

Temperature and air pressure decrease with distance from the surface. Air pressure, which is an important element of weather, is caused by the weight of gases in the atmosphere. Air pressure affects the water cycle which in turn applies to them.

The *stratosphere* lies above the troposphere. Air in this layer is much colder and drier than air in the troposphere. It contains the ozone layer. It is a special form of oxygen which absorbs ultra-violet rays emitted by the sun. The absorption of this radiation causes temperature to increase with altitude in the stratosphere.

The *mesosphere* lies above the stratosphere. The top of the mesosphere is the coldest part of Earth's atmosphere. Almost all the atmosphere's mass is below the mesosphere, so air pressure in this region is extremely low-about 1,000 times less than at the Earth's surface. The temperature of the mesosphere decrease with altitude.

The *thermosphere* contains a very low density of gas molecules. Therefore, the absorption of a small amount of energy causes a large increase in temperature. The thermosphere extends to an altitude of about 600km. The very thin air of the thermosphere is the first part of the atmosphere struck by sunlight. Temperatures in the thermosphere can reach 1700˚C.

Although the molecules of gases are too small to see, they have mass. If air had no mass, we would not be able to feel the wind. Air also exerts pressure. Earth's gravity pulls gas molecules toward it. Air pressure is greatest near the surface because air density is higher and the total weight of the air column above an area is greater. Pressure quickly decreases with height above Earth's surface.

> As altitude increases, the density of gas molecules decreases. Some mountain climbers climb so high that they need to carry oxygen with them.

Earth's surface is warmer during the day and colder at night. The atmosphere keeps these temperatures in a moderate range. Earth's atmosphere is heated by the Earth's warm surface, not directly by the Sun. Much of this energy is transferred by convection, which is the transfer of heat by circulation in a gas or liquid.

Air rises or sinks because if its density. Warm air is less dense than cold air, so it rises. Cold air is denser than warm air, so it sinks. This can create a loop of moving air. Such a loop is called convection current. This kind of current forms in both air and water.

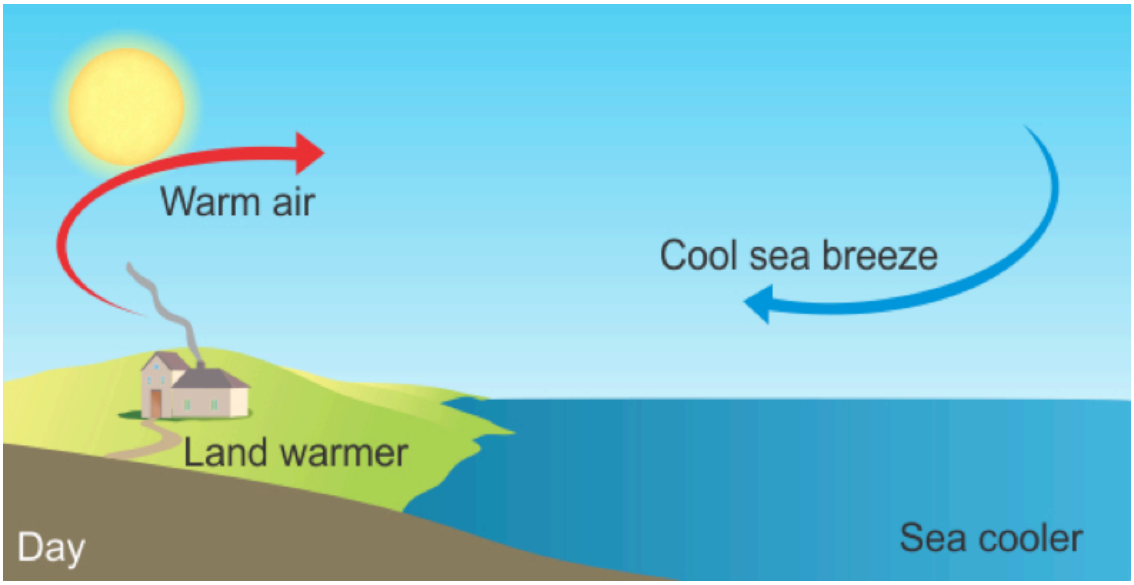
Warm and cold air also creates differences in air pressure. Rising warm air lowers the air pressure below it. Sinking cold air increases the air pressure. As in land and sea breezes, air moves from areas of high pressure to areas of low pressure. Winds always blow this way.

Convection currents and differences in air pressure are caused by the Sun heating Earth's surface unevenly. The areas near the equator receive the most energy from the Sun. The poles receive the least.

The uneven heating results in low air pressure at the equator and high air pressure at the poles. Therefore, air tends to move from the poles toward the equator. This tendency, in combination with Earth's rotation, creates the planet's global wind patterns. Regional wind patterns are influenced by such features as mountains, plateaus, and large lakes.

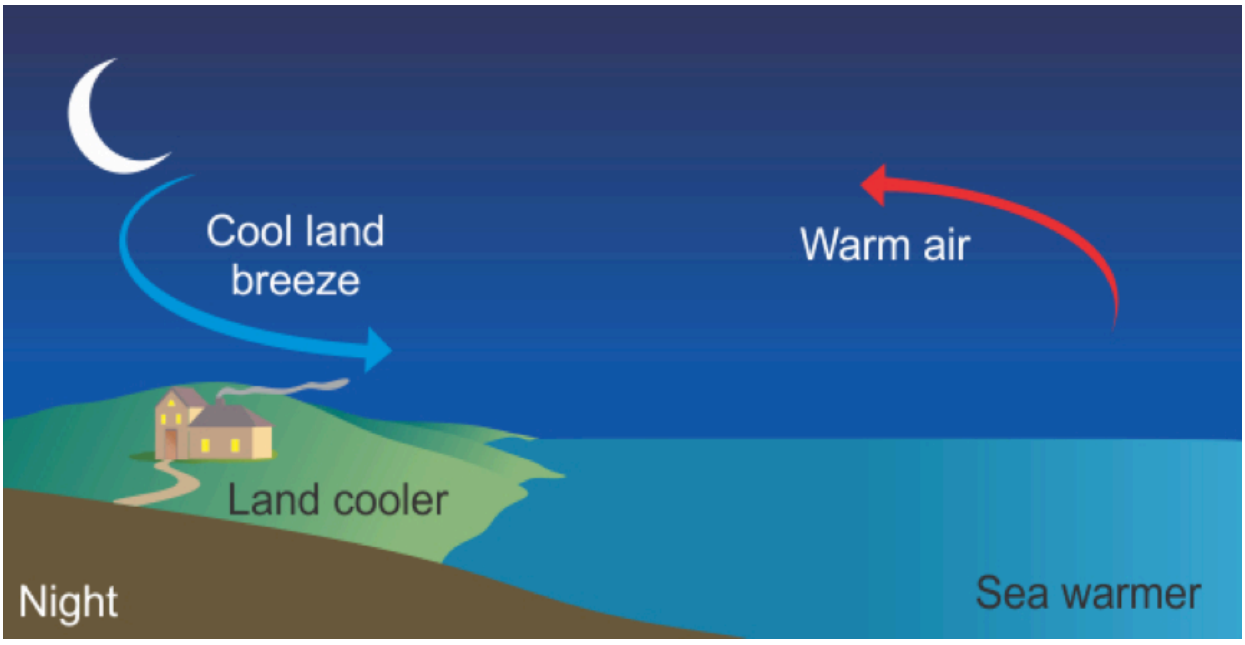
Sea Breeze

At day time, warm air expands and rises on land at high temperature (low pressure). Cool air sink along sea low temperature (high pressure). Wind blows an area of high pressure to low pressure. Wind blows from the sea towards the land.



Land Breeze

Over the ocean at night, cool air sinks on land at low temperature (high pressure). Warm air expands and rises on sea at high temperature (low pressure). Wind blows an area of low pressure to high pressure. Wind blows from the land towards the sea.



https://www.google.com/.topperlearning.com/please-explain-what-is-land-breeze-and-sea-breeze-with-a-diagram

Cloud and Fog

As well as creating winds, the Sun's energy powers the water cycle. The Sun's energy causes liquid water to evaporate, meaning to change into water vapor, an invisible gas. Water vapor is part of air, and it moves through the atmosphere. Water vapor condenses into liquid water or into solid ice. It usually condenses around tiny particles, such as dust or grains of salt. Millions of water droplets or ice crystals form clouds. Rain, snow, hail, sleet, or mist that falls to Earth's surface from clouds is called *precipitation.*

A cloud is classified by its appearance and altitude. Three of the main groups of clouds are high,middle, and low clouds. The fourth group contains clouds that develop vertically. They may be puffy and quiet tall.

Cloud names can be taken apart and put together in various ways. For example, the prefix *nimbo-* refers to rain, stratus indicates layers, and *cumulo-* or *cumulus* indicates a cloud that forms vertically. The most common high clouds are cirrus clouds. Other high clouds are given the prefix *cirro-*, as in cirrocumulus. Middle clouds are given the prefix *alto-*. Low clouds are often stratus or nimbostratus clouds.

Fog forms when clouds touch the ground.

Cloud Types

			
Cirrus • Thin, wispy clouds at high attitudes • Made of ice crystals • Indicate pleasant weather	**Stratus** • Form in layers • May cover large parts of the sky	**Cumulus** • Puffy, white clouds with flat bottoms • Form in rising currents of warm air • Generally mean fair weather	**Cumulonimbus** • Bring heavy rain or thunderstorm • May extend up through the troposphere

Unit 3: Space

Topic: Earth's Motion

Motion of the Earth

The axis of the Earth is an imaginary line through the centre of the Earth from pole to pole. This axis is tilted at an angle of 231/2 degrees. The Earth rotates or spins on this axis, rotating once every 24 hours. This means that people on the equator are moving at 1700km per hour! We do not feel or see movement because everything else around you moves at the same speed.

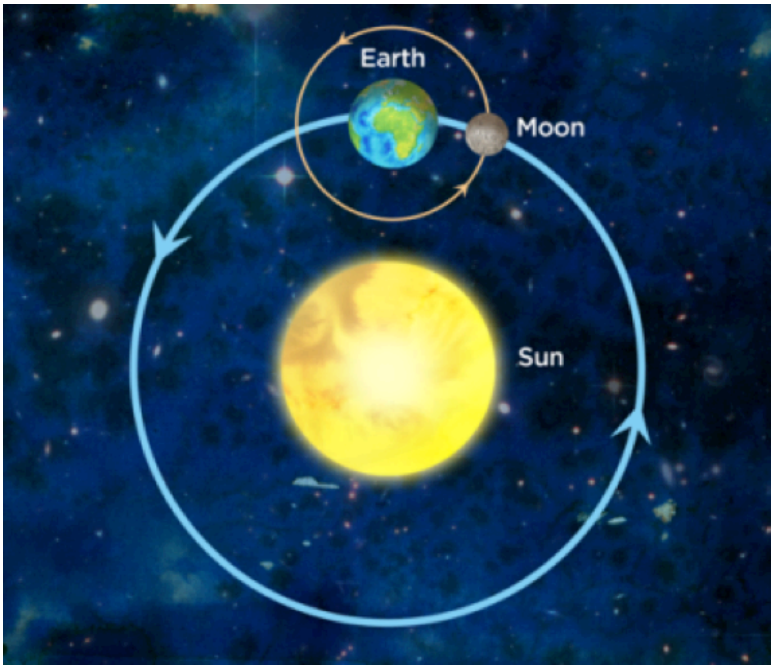
Earth's rotation and its revolution causes day and night as well as seasons.

As the Earth rotates from west to east, the sun, moon, stars and planets all seem to move the other way – from east to west. This is why we the circular star trails in the photo. It is because the Earth rotates on its axis that we get night and day. As the Earth rotates, only one half of it faces the sun at one time. While this half is in sunlight, the other half is in darkness.

As well as rotating on its axis, the Earth travels through space around the sun. This is why the stars appear to change position in the sky throughout the year. For example, Orion (the Saucepan) appears in the north-east in summer and disappears in the north-west in autumn. We say the Earth revolves around the sun. The path it follows is called its *orbit.* This orbit is almost circular, but slightly oval.

The time taken for one complete *revolution* of the sun is one year. During this time the Earth rotates 3651/4 times. This means there are 3651/4 days in a year. This is very difficult to divide into equal parts for our days and weeks. So we consider each year as having just 365 days every fourth year, or leap year, has 366 days.

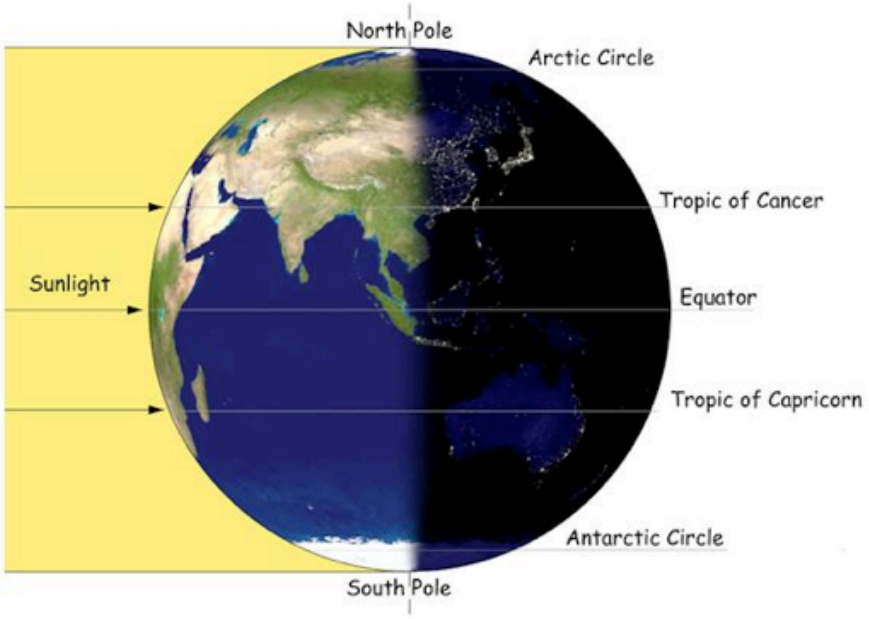
The Earth stays in its orbit because of the gravitational force of attraction between it and the sun.



Motion of the Earth

Day and Night

It takes 23 hours and 56 minutes – one day – for the Earth to make one full rotation on its axis. As Earth rotates, different parts face the Sun. it is daytime on the side of Earth facing the Sun. It is night time on the side facing away from the Sun.



Seasons

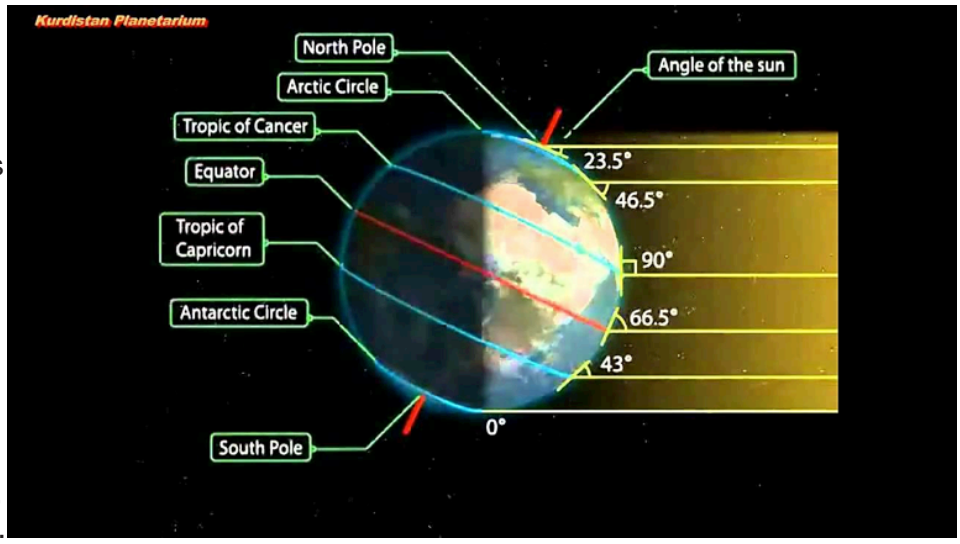
In everyday life, seasons are period of a particular kind of weather. Earth scientists, however, define season by the position of Earth in its orbit. By this definition, all places on Earth have four seasons: spring, summer, autumn (fall), and winter. Yet the effect of these seasons is extreme in some places, while they hardly exist in others.

Near the equator, the Sun's rays arrive at almost right angles. This causes the Sun's energy to be more concentrated. Near the poles, the rays arrive at much sharper angles. This causes the same amount of sunlight to be spread out. This difference affects average temperatures.

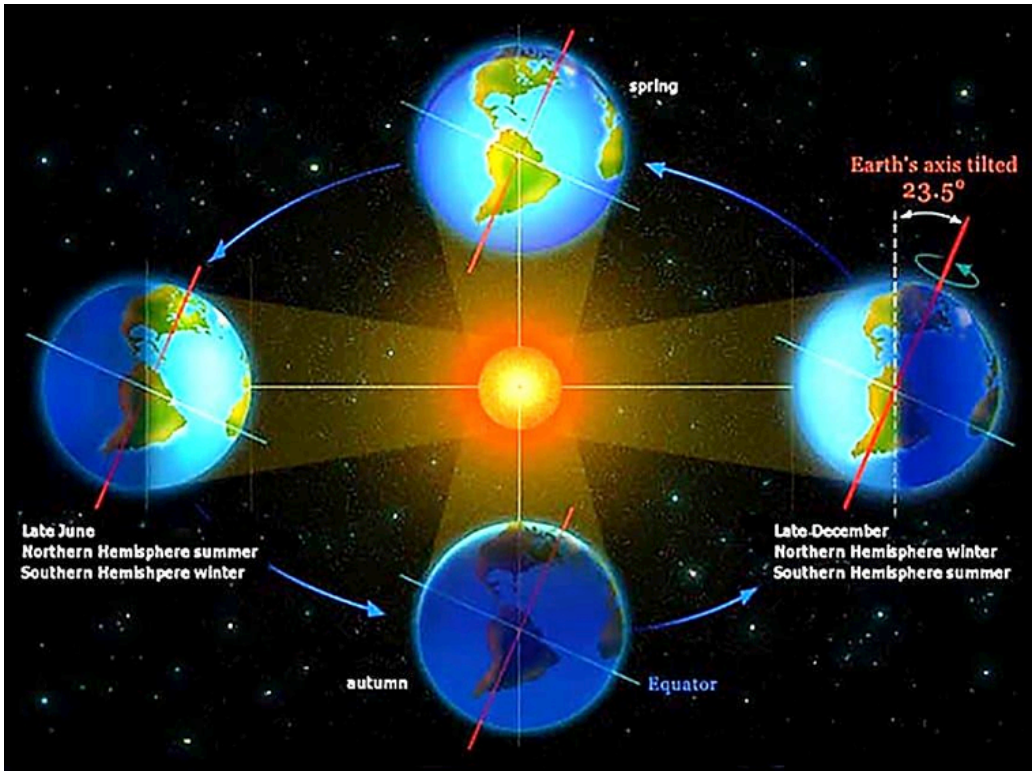
Places closes to the poles, such as McMurdo in Antarctica, have cold weather all year long. Compare its temperature to those of Papua New Guinea, which is near the equator. Other places have wide variations in temperature throughout the year.

A place's position on Earth is the most important factor affecting its temperature and seasonal changes.

The sun's ray strike Earth unevenly-at different angles at different times of the year. Near the equator, the sun's rays hit directly. At the poles, the sun's rays hit at an angle.



https://www.youtube.com/watch?v=WLRA87TKXLM


spring
Earth's axis tilted
23.5°
Late June
Northern Hemisphere summer
Southern Hemishpere winter
Late December
Northern Hemisphere winter
Southern Hemisphere summer
autumn
Equator

Guided Lesson Samples

Guided lesson section descriptions and icons

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

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

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

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

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

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

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

Guided lesson sample 1

Lesson Title: Classification of vertebrates	Lesson No: 11
Strand 1: Life	**Unit 3:** Human Body
Topic: Digestive System	**Sub-topic:** Digestion
Content standard:	**7.1.2.** Students will be able to investigate groups of animals that are vertebrates and invertebrates, and their characteristics.
Benchmark:	**7.1.2.3.** Classify and profile groups of vertebrates according to their characteristics.
Key question:	How can we classify vertebrates?
Lesson objective:	By the end of the lesson the should be able to; • classify vertebrates into different types of vertebrates such as mammals, birds, amphibians, fish and reptiles on the basis of their characteristics.
Teaching period:	40 minutes (1 period)
Preparations:	Pictures of fish, frog, parrot, snake and dog.
Key word(s):	vertebrates, characteristics, mammals, reptiles

Learning content

Knowledge	Skills	Attitudes and Values
• Vertebrates are animals that have • backbones. • Vertebrates can be further classified into five major groups of vertebrates based on their characteristics. • Vertebrates are divided into five major groups according to their characteristics: 1. Mammals 2. Birds 3. Amphibians 4. Fish 5. Reptiles	Making predictions on the classification of vertebrates. Classify vertebrates into fish, amphibians, reptiles, birds, mammals using their characteristics. Communicate ideas and findings on vertebrates using verbal, written and pictorial.	Develop curiosity to know about types of vertebrates. Show open-mindedness when learning about types of vertebrates. Be responsible by taking care of vertebrates. Respect views of others.

Teacher's Notes:

Vertebrates are divided into five major groups according to their characteristics. That is the fishes, amphibians, retiles, birds and mammals.

Type of Vertebrate	Characteristics
Mammals	Give birth to live babies and feed milk, have hair or fur on body
Birds	Have feathers, lay eggs
Amphibians	Have moist skin, can live on land and in water
Fish	Have scales and fins, breath under water through gills
Reptiles	Have dry scaly skin, lay eggs

1. Name the five major groups of vertebrates?
2. What are the characteristics used to classify vertebrates?

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
Recall the previous lesson on vertebrates and invertebrates by asking the following questions.
1. What is a vertebrate?
2. What is an invertebrate?

Introduce lesson title and the key question of the lesson.</td>
<td>Key Question
How can we classify vertebrates?</td>
<td>Students will use their prior knowledge about classification of vertebrates to link to today's lesson.</td>
</tr>
<tr>
<td>Body
35 mins</td>
<td>Making predictions
Allow time for students to discuss in groups and give answers to the key question.

Activity:
Show the picture of fish, frog, parrot, snake and dog to students.

Complete the table by filling in the missing information.
<table><tr><th>Vertebrate</th><th>Types of vertebrate</th><th>Characteristics</th></tr><tr><td>Dog</td><td></td><td></td></tr><tr><td>Parrot</td><td></td><td></td></tr><tr><td>Frog</td><td></td><td></td></tr><tr><td>Snake</td><td></td><td></td></tr></table>
Introduce the five major groups of vertebrates. That is fish, amphibians, reptiles, birds and mammals.

Discussion questions on findings
Lead students through the discussion and pose a question based on their findings for the activity.

Question:
What are the common characteristic that these five groups have that other groups of living things do not have?

Introduce the key words for the lesson; "vertebrates, characteristics, mammals, reptiles"</td>
<td>Making predictions
Discuss in groups and share their assumptions with the teacher.

Activity:
Observe the pictures closely and point out major distinguishing features.
Complete the table by filling in the missing information.
<table><tr><th>Vertebrate</th><th>Types of vertebrate</th><th>Characteristics</th></tr><tr><td>Dog</td><td></td><td></td></tr><tr><td>Parrot</td><td></td><td></td></tr><tr><td>Frog</td><td></td><td></td></tr><tr><td>Snake</td><td></td><td></td></tr></table>
Listen attentively to the teacher introducing five major groups of vertebrates.

Fish, amphibians, reptiles, birds and mammals.

Discussion questions on findings
Students to go through discussions based on the question and give their feedbacks.

Key words
1. Vertebrates
2. Characteristics
3. Mammals
4. Reptiles</td>
<td>Write the key words on the blackboard.</td>
</tr>
</table>

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 can we classify vertebrates?" Guide students by having them to summarize what they have learnt about 'Classification of vertebrates'.	**Summary:** • Vertebrates are divided into five major groups according to their characteristics: 1. Mammals 2. Birds 3. Amphibians 4. Fish 5. Reptiles	The students' conclusion should reflect the key concepts in the lesson.

Black Board Plan

Title: Classification of vertebrates

Key question:
What are the different types of vertebrates?

Activity:
Complete the table.

Vertebrate	Types of vertebrate	Characteristics
Dog		
Parrot		
Frog		
Snake		

Discussion

Q: What is the common characteristic that these five groups have that other groups do not have?

Key words:
1. Vertebrates
2. Characteristics
3. Mammals
4. Reptiles

Summary

• Vertebrates are divided into five major groups according to their characteristics:
1. Mammals
2. Birds
3. Amphibians
4. Fish
5. Reptiles

Challenge for students:

Use the characteristics that were used to classify vertebrates to differentiate between vertebrates and invertebrates.

Guided lesson sample 2

Lesson Title: Calculating voltage	Lesson No: 19
Strand: Physical Science	**Unit:** Energy
Topic: Electricity 3	**Sub-topic:** Electric current, voltage and resistance
Content standard:	**7.2.1.** Students will be able to investigate the function of electricity and the relationship between electrical currents and voltage.
Benchmark:	**7.2.1.5.** Use the formula to calculate the voltage. (Voltage = Current x Resistance).
Key question:	How do we find the unknown voltage?
Lesson objective:	**By the end of the lesson the students should be able to;** • calculate the unknown voltage using the given formulae.
Teaching period:	40 minutes (1 period)
Preparations:	Flash cards with the formulae of calculating the voltage. (V= I x R)
Key word(s):	Voltage, Current, Resistance

Learning content

Knowledge	Skills	Attitudes and Values
Volt is the unit difference in the electric potential between two points. Example; resistance of a bulb or other device. To find the voltage (V) which is the difference between two points, the current (I) flowing is taken in amperes is multiplied by resistance (R) taken in ohms in a conductor between two points. V= I x R	Make predictions on how to find the unknown voltage. Infer on how to calculate the voltage when there is no voltage taken or given. Calculating the voltage of two different points using the given formulae, V= I x R. Communicate ideas and findings on how to calculate voltage using verbal and written.	Develop curiosity to learn more about calculating voltage. Show open-mindedness when learning about calculating voltage. Respect views of others.

Teacher's Notes:

To find the voltage (V) which is the difference between two points, the current (I) flowing is taken in amperes is multiplied by resistance (R) taken in ohms in a conductor between two points. This can be represented by;
Example: if there is 10 amps (A) of current flowing through the circuit and a resistance (R) or (Ω) of 11 ohms the voltage (V) is 110;
V= IR = 10A x 11 Ω = 110v

1. Find the voltage of the using the formulae. (V=I x R)
2. What measurements should be taken to find the voltage in a circuit?

Lesson procedure

<table>
<tr><th>Time section</th><th>Teacher activity</th><th>Student activity</th><th>Points to notice</th></tr>
<tr>
<td>Intro
5 mins</td>
<td>Access prior knowledge
Ask students questions to elicit their ideas about the lesson title.

What is a voltage?

Introduce the lesson title and the key question.</td>
<td>Key Question
How can we classify vertebrates?</td>
<td>Students will use their prior knowledge about voltage to link to today's lesson.</td>
</tr>
<tr>
<td>Body
35 mins</td>
<td>Making predictions
Allow students to discuss in pair and give answers on how to find the voltage.

Explain how to use the formula using the example.

Suppose a 6 volt battery is connected to a 10 ohm resistor. What current will flow through the resistor?
(Voltage = Current x Resistance)
V = I x R

Note that the formulae can also be used to calculate Current (I = V/R), Resistance (R= V/I)

So, I = V/R
I = 6/10 = 0.6 ampere

What does this current value mean in terms of the amount of charge passing through the resistor?
0.6 coulomb of charge passes through the resistor each second.

Activity: Find the voltage
<table>
<tr><th>Voltage</th><th>Current</th><th>Resistance</th></tr>
<tr><td></td><td>0.5</td><td>12 ohms</td></tr>
<tr><td></td><td>2.4</td><td>5 ohms</td></tr>
<tr><td></td><td>3.6</td><td>15 ohms</td></tr>
<tr><td></td><td>0.9</td><td>20 ohms</td></tr>
<tr><td></td><td>15</td><td>10 ohms</td></tr>
</table>
</td>
<td>Making predictions
Discuss in pair and give their answers and ideas on how to find the voltage.

Students listen attentively and respond where appropriate on the explanation on how to use the formula to calculate the voltage.

(Voltage= Current x Resistance)
V = I x R

Note that the formulae can also be used to calculate Current (I = V/R), Resistance (R= V/I)

Write the formulae down into the exercise books.

Copy the table and complete it in the exercise book.

Activity: Find the voltage
<table>
<tr><th>Voltage</th><th>Current</th><th>Resistance</th></tr>
<tr><td></td><td>0.5</td><td>12 ohms</td></tr>
<tr><td></td><td>2.4</td><td>5 ohms</td></tr>
<tr><td></td><td>3.6</td><td>15 ohms</td></tr>
<tr><td></td><td>0.9</td><td>20 ohms</td></tr>
<tr><td></td><td>15</td><td>10 ohms</td></tr>
</table>
</td>
<td>Concepts and Misconception
The measurements of current and resistance should be taken to find the voltage.

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

Body **35 mins**	**Discussion questions on findings** Lead students through the discussion and pose a question based on their findings for the activity. **Question:** What measurements should be taken to find the voltage in a circuit? Introduce the key words for the lesson; "voltage, current and resistance"	**Discussion questions on findings** Students to go through discussions based on the question and give their feedbacks. **Response:** The measurements of current and resistance should be taken to find the voltage. **Key words** 1. Voltage 2. Current 3. Resistance	Write the key words on the black board.
Conclusion **5 mins**	• In our today's lesson, what did you discover or learn from this lesson? Refer students to their predictions for the key question: How do you calculate the voltage? Guide students by having them to summarize what they have learnt about the calculating the voltage.	**Summary:** • To find the voltage (V) which is the difference between two points, the current (I) flowing is taken in amperes is multiplied by resistance (R) taken in ohms in a conductor between two points. V= I x R	The students' conclusion should reflect the key concepts in the lesson.

Black Board Plan

Title: Calculating current, voltage and resistance

Key question:
How do you calculate the voltage?

Activity:
Find the voltage using the formulae.
(V= I x R)

Voltage	Current	Resistance
	0.5	12 ohms
	2.4	5 ohms
	3.6	15 ohms
	0.9	20 ohms
	15	10 ohms

Discussion
Question:
What measurements should be taken to find the voltage in a circuit?

Response:
The measurements of current and resistance should be taken to find the voltage.

Key words:
1. Voltage
2. Current
3. Resistance

Summary
• To find the voltage (V) which is the difference between two points, the current (I) flowing is taken in amperes is multiplied by resistance (R) taken in ohms in a conductor between two points.
V= I x R

Challenge for students:

1. Explain the difference between current, voltage and resistance.
2. How can you calculate the resistance in a parallel circuit?

Guided lesson sample 3

Lesson Title: Structure of the Earth	Lesson No: 24
Strand: Earth and Space	Unit: Our Earth
Topic: Earth's Structure	Sub-topic: Composition and Structure of the Earth
Content standard:	7.3.1. Students will be able to explore the composition and the structure of the Earth.
Benchmark:	7.3.1.1. Examine the composition and the structure of the Earth.
Key question:	What is the Earth made up of?
Lesson objective:	**By the end of the lesson the students should be able to:** • describe the different layers that form the Earth.
Teaching period:	40 minutes (1 period)
Preparation	Chart with diagrams of the Earth's structure and a globe.
Key words:	crust, mantle, outer core, inner core

Knowledge	Skills	Attitudes and Values
The Earth is made up of different layers. Each layer is physically and chemically different. • The crust is the outer layer of the Earth. It has a very thin layer measuring between 0-60km thick. • The mantle is the widest section of the Earth. It has a thickness of approximately 2,900 km. • The outer core is the layer surrounding the inner core. It is a liquid layer, also made up of iron and nickel. • The inner core is in the centre and is the hottest part of the Earth. It is solid and made up of iron and nickel with temperatures of up to 5,500°C.	Making predictions on what is the Earth made of. Infer on the four main layers of the Earth. Draw the structure of the Earth. Communicated findings on the structure including layers using verbal, written and pictorial.	Develop curiosity to learn more about the Earth' structure. Show open-mindedness when learning about the Earth's structure. Handle and communicate data with integrity. Respect views of others.

Teacher's Notes:

It is important that the students learn the structure of the earth well to link to other lesson that will follow after this lesson.

The *crust* is mainly made of rock. There are two types of crust- *continental* and *oceanic*. The continental crust carries the land and the oceanic crust carries water.

- **The *mantle*** is made up of semi-molten rock called *magma*. In the upper parts of the mantle the rock is hard, but lower down the rock is soft and beginning to melt.
- **The *outer core*** is the layer surrounding the inner core. It is a liquid layer, also made up of iron and nickel. It is still extremely hot, with temperatures similar to the inner core
- **The *inner core*** is in the centre and is the hottest part of the Earth. It is solid and made up of iron and nickel with temperatures of up to 5,500°C. With its immense heat energy, the inner core is like the engine room of the Earth.

1. Draw the structure of the Earth with the four main layers.
2. The hottest part of the Earth is found in which layer?
3. In which part of the Earth can you find the molten rock?

Lesson procedure

Time segments	Teacher activity	Student activity	Points to notice
Introduction **5 mins**	Access prior knowledge Ask students questions to elicit their ideas about the lesson title. Q: What is the Earth's atmosphere made up of? Introduce the lesson title and the key question.	**Key Question** How can we classify vertebrates? 	Students will use their prior knowledge on the structure of the Earth.
Body **35 mins**	*Making predictions* *Ask students to give their ideas and answers on what the earth is made of and the shape of the earth* *Show them the picture of "Earth's Structure" and ask the students to observe very carefully.* *Activity* *Draw the structure of the Earth and label the four main layers with its descriptions.* *Discussion questions on findings* *Lead students through the discussion and pose questions based on their findings for the activity.* *Questions:* *1. The hottest part of the Earth is found in which layer?* *2. In which layer of the Earth can you find the molten rock called magma?* *Introduce the key words for the lesson; "crust, mantle, outer core and inner core"*	Making predictions Provide answers to what the earth is made up of. Observe carefully the picture of the Earth's structure and answer the questions. Activity Draw the structure of the Earth and label the four main layers with its descriptions. Discussion questions on findings Students to go through discussions based on the question and give their feedbacks. Responses: 1. The hottest part of the Earth is found in the inner core layer, which is the center of the Earth. 2. I can find the molten rock called magma in the mantle which is also the wider section of the Earth. Key words: 1. Crust, 2. Mantle 3. Outer core 4. Inner Core	Concepts and Misconceptions The Earth is made up of four main layers: 1. Crust 2. Mantle 3. Outer core 4. Inner core Strategy: Work in groups Write the keywords on the blackboard.

Conclusion **5 mins**	In our today's lesson, what did you discover or learn from this lesson? Refer students to their hypothesis for the key question: What is the Earth made of? Guide students by having them to summarize what they have learnt about structure of the Earth.	Summary: • The earth is made up of four main layers. • The crust is the outer layer of the Earth. • The mantle is the widest section of the Earth. The mantle is made up of semi-molten rock called magma. • The outer core is the layer surrounding the inner core. It is a liquid layer. • The inner core is in the centre and is the hottest part of the Earth.	The students' conclusion should reflect the key concepts in the lesson.

BLACK BOARD PLAN

Title: Structure of the Earth Key question: What is the Earth made up of? Activity: Draw the structure of the Earth and label the four main layers with its descriptions.	Discussion Questions: 1. The hottest part of the Earth is found in which layer? 2. In which layer of the Earth can you find the molten rock called magma? Responses: 1. The hottest part of the Earth is found in the inner core layer, which is the center of the Earth. 2. I can find the molten rock called magma in the mantle which is also the wider section of the Earth. Key words: 1. Crust, 2. Mantle 3. Outer core 4. Inner Core	Summary • The earth is made up of four main layer • The crust is the outer layer of the Earth. • The mantle is the widest section of the Earth. The mantle is made up of semi-molten rock called magma.. • The outer core is the layer surrounding the inner core. It is a liquid layer. • The inner core is in the centre and is the hottest part of the Earth.

Challenge for students

1. Construct a model of the structure of the Earth using actual descriptions of the four main layers. vertebrates and invertebrates.

Guided lesson sample 4

Lesson Title: Functions of digestive organs	Lesson No: 34
Strand 1: Life	Unit 3: Human Body
Topic: Digestive System	**Sub-topic: Digestion**
Content Standard:	7.1.3. Students will be able to investigate the functions of nutrients and the digestive system.
Benchmark:	7.1.3.2. Examine the various organs of digestive system and their functions.
Key Question:	What happens to food from the time it enters the mouth?
Lesson objective:	By the end of the lesson the students should be able to; • identify the different digestive organs and state their function.
Teaching period:	40 minutes (1 period)
Preparations:	Picture or chart of the digestive system.
Key word(s):	alimentary canal, oesophagus, pancreas, rectum

Learning content

Knowledge	Skills	Attitudes and Values
• Digestion works by moving food through the alimentary canal. It begins in the mouth with chewing and ends in the small intestine. • The digestive tract is the long tube that opens at both ends. Food goes in your mouth and waste is pushed out the opening at the other end, called the anus.	• Making predictions on the functions of the digestive organs. • Infer on the functions of the digestive organs. • Analyse the process of digestion. • Communicate ideas and findings on functions of digestive organs using verbal, written and pictorial.	Develop curiosity to learn more about the functions of the digestive organs. Show open-mindedness when learning about digestion. Respect views of others.

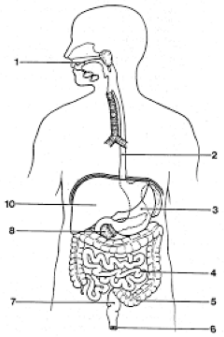
Teacher's Notes:

It is very important for students to know that digestion is important for breaking down food into nutrients which the body uses for energy, growth and cell repair. Ensure that a picture of the digestive system is prepared before class time.

1. Where does the digestive system begin?
2. How does the food move through the alimentary canal?

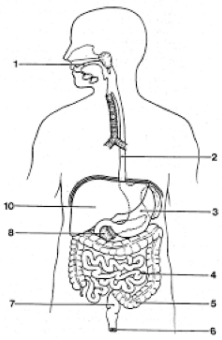
LESSON PROCEDURE

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. Where do all these food that we eat go to? Introduce the lesson title and key question of the lesson.	**Key Question** How do we calculate concentration of a solution?	Students will use their prior knowledge link to today's lesson on concentration of a solution.

Body **35 mins**	**Making predictions** Teacher gives time to the students to discuss in groups and give their assumptions. **Activity:** Label the parts of the digestive organs as shown on the chart.  Once the students can identify the different organs, then teacher should explain the function of each organ starting from the mouth to the rectum. Discussion questions on findings Lead students through the discussion and pose a question based on their findings for the activity. Question: How does food move through the alimentary canal? Introduce the key words for the lesson; “alimentary canal, oesophagus, pancreas and rectum”	**Making predictions** Students discuss in groups and share assumptions with the teacher. **Activity:** Students refer to chart showing the human digestive system and label accordingly. (refer to chart diagram attached) 1. Mouth 2. Oesophagus 3. Liver 4. Large Intestine 5. Stomach 6. Pancreas 7. Small intestine 8. Rectum Discussion questions on findings Students to go through discussions based on the question and give their feedbacks. Response: 1. Once the food enters the mouth, it goes down the throat into the swallowing tube (oesophagus) 2. The oesophagus delivers food to the stomach 3. From the stomach, the food goes to the small intestine 4. The large intestine empties the stool into the rectum. The rectum stores stool until it pushes it out of the body. Key words 1. Alimentary canal 2. Oesophagus 3. Pancreas 4. Rectum	**Concepts and Misconceptions** Strategy: Work in groups Recall their previous knowledge of the heart to describe its function. Write the key words on the blackboard.

Conclusion **5 mins**	• In our today's lesson, what did you discover or learn from this lesson? Refer students to their predictions for the key question: What happens to food from the time it enters the mouth? Guide students by having them to summarize what they have learnt about the functions of the digestive organs.	Summary: • The digestive system is made up of the alimentary canal (also called the digestive tract) and the liver, pancreas and gall bladder. • The alimentary canal is the long tube of organs that runs from the mouth to the anus. • After food is being chewed and swallowed, it enters the oesophagus. The oesophagus is a long tube that runs from the mouth to the stomach. • The stomach is a large, sac-like organ that stores food and mixes it with digestive juices. • The liver produces a digestive juice called bile. • The large intestine absorbs water and any remaining nutrients and changes the waste from liquid to stool. • The rectum stores solid waste until it pushes it out of the body through the anus.	The students' conclusion should reflect the key concepts in the lesson.

BLACK BOARD PLAN

Title: Digestive Organs and its Functions **Key question:** **What happens to food from the time it enters the mouth?** **Activity:** **Label the parts of the digestive system.** 	Discussion Question: How does food move through the alimentary canal? Response: 1. Once the food enters the mouth, it goes down the throat into the swallowing tube (oesophagus) 2. The oesophagus delivers food to the stomach 3. From the stomach, the food goes to the small intestine 4. The large intestine empties the stool into the rectum. The rectum stores stool until it pushes it out of the body. Key words 1. Alimentary canal 2. Oesophagus 3. Pancreas 4. Rectum	Summary • The digestive system is made up of the alimentary canal (also called the digestive tract) and the liver, pancreas and gall bladder. • The alimentary canal is the long tube of organs that runs from the mouth to the anus. • After food is being chewed and swallowed, it enters the oesophagus. The oesophagus is a long tube that runs from the mouth to the stomach. • The stomach is a large, sac-like organ that stores food and mixes it with digestive juices. • The liver produces a digestive juice called bile. • The large intestine absorbs water and any remaining nutrients and changes the waste from liquid to stool. • The rectum stores solid waste until it pushes it out of the body through the anus.

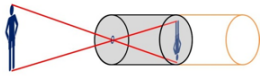
Challenge for students:

1. **Which organs absorb nutrients?**
2. **How long does it take for waste to pass through the stomach?**

Guided lesson sample 5

Lesson Title: Pinhole Camera	Lesson No: 45
Strand: Physical Science	**Unit: Energy**
Topic: Light and Lens	Sub-topic: Lens
Content Standard:	7.2.2. Students will be able to investigate the relationship between light and convex lens.
Benchmark:	7.2.2.4. Explain the mechanism of convex lens such as the eye and camera.
Key Question:	How does a pin-hole camera work?
Lesson objective:	By the end of the lesson the students should be able to: • make a pinhole camera and use it successfully. • know the created image is upside down because of light and hole which acts as a lens.
Teaching period:	80 minutes (2 periods)
Preparation	Tins (old fish tins), nails, piece of thin paper(typing, tracing or greased paper), newspaper, rubber bands and string.
Key word(s)	image, object

Learning content

Knowledge	Skills	Attitudes and Values
• Light passes from the object through the hole on to the screen and forms an image. • An image is a picture of an object that appears on the screen • The created image is backward and upside down because small hole acts as lens. • Since light travels in a straight line, the light rays enters the pin-hole, they are inverted as it reaches the inside of the tin can.	• Making hypothesis on how a pin-hole camera works. • Construct a pinhole camera using given materials. • infer that light entering the pin-hole is inverted resulting in the image being seen as upside down.  • Communicate ideas and findings on how a camera works using verbal, written and pictorial.	• Develop curiosity to learn more about how pin-hole camera works. • Show open-mindedness when learning about the function of pin-hole camera. • Show perseverance to construct a pin-hole camera. • Respect views of others.

Teacher's Notes:

In this lesson we introduce the idea that images can be formed.

You will need to make a pinhole camera before this lesson.

1. Punch a small hole in the bottom of a tin with a nail. Make the hole small first. If the picture is not bright, then make the hole a little bigger. DO NOT MAKE THE HOLE TOO BIG.
2. Cover the open end of the tin with a piece of thin tracing paper. Use a rubber band to hold the paper. This is the screen.
3. Roll a newspaper round the tin to form a viewing tube. Tie the newspaper to the tin with a piece of string.

Problems that may arise

1. If the hole is too small the picture will be dim. If the hole is too big the picture will not be clear.
2. Make sure the thin tracing paper over the end of the tin is not wrinkled. Pull it tight and make it smooth. This is the screen.

1. Construct a pin-hole camera and explain how an image is created.

Time segments	Teacher activity	Student activity	Points to notice
Introduction 5 mins	Access prior knowledge Tell the children that they are going to make a simple instrument that makes pictures. This is called the pinhole camera. Show them the prepared pinhole camera Introduce lesson title and key question?	Key Question  Which part of the container has the highest pressure?	

Body **35 mins**	Making hypothesis Ask students to give their ideas and answers on how a pinhole camera works. Activity: Making a Pinhole camera Explain the steps of making the pinhole camera. Step 1: Make a small hole in the bottom center of the tin using a nail. (It is through this hole that light comes in) Step 2. Cover the open end of the tin with a piece of thin paper (typing, tracing or greased paper). (this is the screen on which the picture will be formed.) Use a rubber band or a piece of string to hold the paper to the tin. Step 3: Tie with a string a piece of newspaper around the tin to form a tube. This makes the screen dark. The picture is easier to see in the dark. Step 4: Point the camera towards the door or windows. Allow them to look at the trees, buildings through the pinhole camera. Discussion questions on findings Lead students through the discussion and pose questions based on their findings for the activity. Question: 1. Why do we need a hole in the tin? 2. What does the image look like? Introduce the key words for the lesson: "image and objet"	Making hypothesis Discuss in groups and provide answers on how a pinhole camera works. Activity: Listen attentively and follow as instructed by the teacher. Step 1: Make a small hole in the bottom center of the tin using a nail. Step 2. Cover the open end of the tin with a piece of thin paper (typing, tracing or greased paper). Use a rubber band or a piece of string to hold the paper to the tin. Step 3: Tie with a string a piece of newspaper around the tin to form a tube. This makes the screen dark. The picture is easier to see in the dark. Step 4: Point the camera towards the door or windows and look at the trees, buildings through the pinhole camera. Discussion questions on findings Students to go through discussions based on the question and give their feedbacks. Response: 1. To allow the light to get in, in order to see the image. 2. The image is upside down and coloured. Key words 1. Image **2. Object**	Concepts Light enables us to see things. The light rays coming from the left of the hole reaches the inside of the tin can slightly to the right and the light from the right also reaches the inside of the box slightly to the left forming an upside down image. Strategy: Working in pairs Note: if the children go outside with their cameras, the image becomes so light that they can hardly see the image. (Darken the newspaper by coloring with a black or darker

Conclusion **5 mins**	Discussion questions on findings Lead students through the discussion and pose questions based on their findings for the activity. Question: 1. Why do we need a hole in the tin? 2. What does the image look like? Introduce the key words for the lesson: "image and objet"	Summary: Summary: • Light is needed in order to see. • The picture that forms on the screen is called the image. • When you look at an object in a pinhole camera, the image is upside down. • Light entering the small pin-hole is inverted resulting in the image been upside down.	The students' conclusion should reflect the key concepts in the lesson.

BLACK BOARD PLAN

Title: Pinhole Camera Key question: How does a pin-hole camera work? Activity: Making a Pinhole camera Write steps 1-4 on the black board.	**Discussion** Question: 1. Why do we need a hole in the tin? 2. What does the image look like? Key words 1. Image 2. Object	**Summary** Light is needed in order to see The picture that forms on the screen is called the image. When you look at an object in a pinhole camera, the image is upside down. Light entering the small pin-hole is inverted resulting in the image been upside down.

Challenge for students:

1. Compare and contrast the functions of eye and the camera.

Guided lesson sample 6

Lesson Title: Pressure in liquids	Lesson No: 51
Strand: Physical Science	Unit: Force and Motion
Topic: Pressure	Sub-topic: Pressure
Content Standard:	7.2.3. Students will be able to investigate the properties of pressure and examine pressure applied in solid, liquid, and gas.
Benchmark:	7.2.3.2. Examine the pressure applied in solid, liquid, and gas.
Key Question:	Which part of the container has the highest pressure?
Lesson objective:	**By the end of the lesson the students should be able to;** • relate depth to pressure in a liquid • explain pressure in a liquid and state that P=hpg
Teaching period:	40 minutes (1 period)
Preparations:	4x pet bottles/ tin, water, nail,
Key word(s):	Pressure, dense, exert

Learning content

Knowledge	Skills	Attitudes and Values
• The pressure in liquids increases with depth. • Pressure in liquids acts equally in all direction. • Pressure in liquids does not depend on the area of its surface. • The pressure at two points at the same level in the same liquid is equal. • Pressure does not depend on the shape or size of the container. • More dense liquids exert more pressure. • The pressure in a liquid is affected by the force of gravity.	Making hypothesis on which part of the container has the highest pressure. Infer on the pressure in liquid. Conduct experiment to differentiate high pressure and low pressure in liquids. Communicate findings on the high and low pressure using verbal, written and pictorial.	Develop curiosity to learn more about pressure in liquids. Show open-mindedness when learning about pressure in liquids. Respect views of others.

Teacher's Notes:

In liquids the molecules are less tightly bound than in solids, and so can move at random in all directions. It is this random molecular motion that accounts for pressure in all directions.

In solids the molecules are tightly bound so that the weight of a solid acts in a downwards direction. To illustrate the concept, punch several holes in the side of a tin; then fill the can with water. Water comes squirting out in all directions where there is a hole; therefore there must be pressure in all these directions. If all the molecules were joined together than all the water would come out of one of the holes only, that is, pressure would act in one direction.

1. Which part of the container has the highest pressure?
2. Why is the pressure very high at the bottom of the container?

Lesson Procedure

Time segments	Teacher activity	Student activity	Points to notice
Intro **5 mins**	**Access prior knowledge** Ask students questions to elicit their ideas about the lesson title. How do particles behave in liquid form? Introduce the lesson title and the key question for the lesson.	**Key Question** Which part of the container has the highest pressure?	Students will use their prior knowledge about particles in liquids to link to today's lesson.
Body **35 mins**	**Making hypothesis** Show students a container. Ask them to give answers on which part of the container will spurt out further if a hole was created. **Activity: Investigating pressure in liquid** 1. Fill the tin/pet bottle with water to the brim. 2. Using a nail , make a hole 2cm or 3cm below the brim 3. Observe and record what you see 4. Using another tin/ pet repeat step 2 and 3 but this time at the halfway mark. 5. Using another tin/ pet repeat step 2 and 3 but this time at the base of the tin/pet bottle. 6. Share your results with the class **Discussion questions on findings** Lead students through the discussion and pose a question based on their findings for the activity. **Question:** Why is the pressure in liquid increasing as we go further and further down? Introduce the key words for the lesson "pressure, dense and exert"	**Making hypothesis** Students discuss in groups and present their ideas and answers to the class. **Activity:** 1. Fill the tin/pet bottle with water to the brim. 2. Using a nail , make a hole 2cm or 3cm below the brim 3. Observe and record what you see 4. Using another tin/ pet repeat step 2 and 3 but this time at the halfway mark. 5. Using another tin/ pet repeat step 2 and 3 but this time at the base of the tin/pet bottle. 6. Share your results with the class **Discussion questions on findings** Students to go through discussions based on the question and give their feedbacks. Response: "Because the water at the bottom supports the weight of the water at the top." **Key words** 1. Pressure 2. Dense 3. exert	**Concepts and Misconceptions** **Strategy:** Work in groups Write the key words on the blackboard.

Conclusion **5 mins**	In our today's lesson, what did you discover or learn from this lesson? Refer students to their hypothesis for the key question: Which part of the container has the highest pressure? Guide students by having them to summarize what they have learnt about pressure in liquids.	Summary: • The pressure in liquids increases with depth. • Pressure in liquids acts equally in all direction. • Pressure does not depend on the shape or size of the container. • More dense liquids exert more pressure. • The pressure in a liquid is affected by the force of gravity.	The students' conclusion should reflect the key concepts in the lesson.

BLACK BOARD PLAN

Title: Forces and Pressure Key question: Which part of the container has the highest pressure? Activity: Investigating pressure in liquid 1. Fill the tin/pet bottle with water to the brim. 2. Using a nail , make a hole 2cm or 3cm below the brim 3. Observe and record what you see 4. Using another tin/ pet repeat step 2 and 3 but this time at the halfway mark. 5. Using another tin/ pet repeat step 2 and 3 but this time at the base of the tin/pet bottle. 6. Share your results with the class	Discussion Question: Why is the pressure in liquid increasing as we go further and further down? Response: Because the water at the bottom supports the weight of the water at the top. Key words: 1. Pressure 2. Dense 3. Exert	Summary • The pressure in liquids increases with depth. • Pressure in liquids acts equally in all direction. • Pressure does not depend on the shape or size of the container. • More dense liquids exert more pressure. • The pressure in a liquid is affected by the force of gravity.

Challenge for students:

Why fluids exert pressure?

Guided lesson sample 7

Lesson Title: Concentration of solutions	Lesson No: 76
Strand: Physical Science	**Unit: Matter**
Topic: Properties of Solutions	Sub-topic: Solubility
Content Standard:	7.2.5. Students will be able to investigate the properties and functions of solutions.
Benchmark:	7.2.5.6. Compare concentration of solutions and methods of separating them.
Key Question:	How can we describe the concentrated solutions, when we are comparing two solutions with same type of solute and solvent?
Lesson objective:	**By the end of the lesson the students should be able to;** • Compare the concentration of solutions using simple descriptions such as dilute and concentrated.
Teaching period:	40 minutes (1 period)
Preparations:	Sugar, water, beaker and glass rod (stirring rod).
Key word(s):	diluted solution, concentrated solution

Learning content

Knowledge	Skills	Attitudes and Values
• The ratio of solute to solvent is called the concentration of solution. • Concentration is a measure of how much solute is dissolved within the solvent. • A dilute solution has a small amount of solute in a large amount of solvent. • A concentrated solution has a large amount of solute in a small amount of solvent.	• Making predictions on how to describe the concentrated solutions. • Infer on the concentrated solutions as dilute and concentrated solutions. • Compare two solutions (dilute and concentrated) with same type of solute and solvent. • Use water and sugar to demonstrate diluted and concentrated solutions. • Communicate ideas and findings on the concentration of solutions using verbal and written.	Develop curiosity to learn more about diluted and concentrated solutions. Show open-mindedness when learning about the comparing concentrated solutions. Show perseverance to demonstrate diluted and concentrated solutions. Respect views of others.

Teacher's Notes:

When comparing the concentrations of two solutions with the same type of solute and solvent, we can use simple description such as: dilute and concentrated.

1. What is the difference between the both solutions?
2. How do we describe concentration of two solutions with the same solute and solvent?

Lesson Procedure

Time segments	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 are solutions? Introduce the lesson title and the key question.	**Key Question**  How can we describe the concentrated solutions, when we are comparing two solutions with same type of solute and solvent?	Students will use their prior knowledge on solutions to link to today's lesson on concentration of solutions.

Body **35 mins**	Making predictions Allow students to share their ideas and give assumptions on how to compare solutions. Activity: Comparing concentrated solutions. Experiment: 1. Add 3mL of table sugar in 200mL of water. Stir with the spoon and leave it for a minute. 2. Add 1 mL of table spoon and in 200 mL of water. Stir with the spoon and leave the solution for a minute. Observe carefully and compare the two solutions. Discussion questions on findings Lead students through the discussion and pose questions based on their findings for the activity. Question: 1. Describe the solution in experiment 1. 2. Describe the solution in experiment 2. 3. What do we call these solutions in experiment 1 and 2? Introduce the key words for the lesson; dilute solution and concentrated solution.	Making predictions Share ideas and give assumptions on how to compare solutions to the class. Activity: Comparing concentrated solutions. Experiment: 1. Add 3mL of table sugar in 200mL of water. Stir with the spoon and leave it for a minute. 2. Add 1 mL of table spoon and in 200 mL of water. Stir with the spoon and leave the solution for a minute. Make observation and comparison of the two solutions. Discussion questions on findings Students to go through discussions based on the question and give their feedbacks. Response: 1. The solution in experiment 1 has small amount of sugar is small and the volume of water is large. 2. The solution in experiment 2 has large amount of sugar in small amount of water. 3. The solution in experiment 1 is called dilute solution and the solution in experiment 2 is called concentrated solution. Key words 1. Dilute solution 2. Concentrated solution	Concepts and Misconceptions Strategy: Work in groups After students have answered the discussion questions, explain to the students that when comparing the concentrations of two solutions with the same type of solute and solvent, we can use simple description such as: dilute and concentrated. Write the key words on the blackboard.

Conclusion **5 mins**	*In our today's lesson, what did you discover or learn from this lesson?* *Refer students to their predictions for the key question:* *How can we describe the concentrated solutions, when we are comparing two solutions with same type of solute and solvent?* *Guide students by having them to summarize what they have learnt about calculating concentration of solution.*	• Summary: • • When comparing the concentrations of two solutions with the same type of solute and solvent, we can use simple description such as: dilute and concentrated. • • A dilute solution has a small amount of solute in a large amount of solvent. • • A concentrated solution has a large amount of solute in a small amount of solvent.	The students' conclusion should reflect the key concepts in the lesson.

BLACK BOARD PLAN

Title: Concentration of solutions Key question: How can we describe the concentrated solutions, when we are comparing two solutions with same type of solute and solvent? Activity: Comparing concentrated solutions. Experiment: 1. Add 3mL of table sugar in 200mL of water. Stir with the spoon and leave it for a minute. 2. Add 1 mL of table spoon and in 200 mL of water. Stir with the spoon and leave the solution for a minute.	Discussion Question: 1. Describe the solution in step 1. 2. Describe the solution in step 2. 3. What is the difference in both solutions? Key words 1. Diluted solution 2. Concentrated solution	Summary • When comparing the concentrations of two solutions with the same type of solute and solvent, we can use simple description such as: dilute and concentrated. • A dilute solution has a small amount of solute in a large amount of solvent. • A concentrated solution has a large amount of solute in a small amount of solvent.

Challenge for students:

Guided lesson sample 8

Lesson Title: Compositions of atmosphere	Lesson No: 79
Strand: Earth and Space	**Unit: Weather and Climate**
Topic: Weather Change	Sub-topic: Atmosphere
Content Standard:	7.3.3. Students will be able to explore the earth's atmosphere, types of clouds, and the weather patterns in Papua New Guinea.
Benchmark:	7.3.3.1. Investigate the composition of the Earth's atmosphere and the properties of its layers.
Key Question:	What is the Earth's atmosphere made of?
Lesson objective:	**By the end of the lesson the students should be able to;** • identify the different gases that make up the Earth's atmosphere.
Teaching period:	40 minutes (1 period)
Preparations:	Chart showing the different composition of the atmosphere.
Key word(s):	atmosphere, nitrogen, oxygen, carbon dioxide, argon, water vapour

Learning content

Knowledge	Skills	Attitudes and Values
• The Earth's atmosphere is about 78 per cent nitrogen and 21 per cent oxygen. The remaining 1 per cent includes carbon dioxide, water vapour, and argon. • The atmosphere also contains tiny pieces of solid materials such as dust, salt, pollen and ice. • The atmosphere also holds small water droplets both in and apart from the clouds.	• Making predictions on what makes up the atmosphere. • Infer on the different gases that makes up the atmosphere. • Interpret data on the different gases that makes up the atmosphere. • Represent the composition of atmosphere using a pie graph. • Communicate ideas and findings on the different components of the Earth's atmosphere using verbal, written and pictorial.	Develop curiosity to learn more about the Earth's atmosphere. Show open-mindedness when learning about the Earth's atmosphere. Handle and communicate data with integrity. Respect views of others.

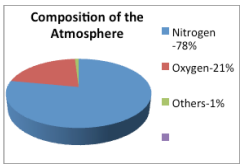
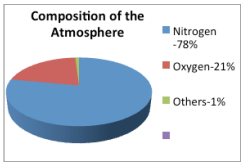
Teacher's Notes:

Students should already know the names of some gases present in the atmosphere. Copy the table on the composition of the atmosphere and briefly explain the importance each gas. Stress that other substances are also present in the atmosphere- water vapour, dust, micro-organisms. Also emphasize air is a mixture and its composition is not fixed, that is, the amount of water vapour and dust varies daily and from place to place.

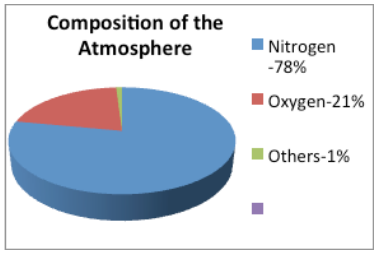
1. Draw a pie chart using the data of the different gases that makes up the atmosphere.
2. What is the most abundant gas found in the atmosphere?
3. How many gases are found in the atmosphere?

Lesson Procedure

Time segments	Teacher activity	Student activity	Points to notice
Intro **5 mins**	Access prior knowledge Ask students questions to elicit their ideas about the lesson title. Q: What are the characteristics of the atmosphere? Introduce the lesson title and the key question for the lesson.	 **Key Question** What is the Earth's atmosphere made of?	Students will use their prior knowledge about the atmosphere to link to today's lesson.

Body **35 mins**	Making predictions Ask students to give their answers on what the atmosphere is made up of. Activity Give the students the following data and ask them to draw a pie chart to illustrate the composition of the atmosphere. Nitrogen- 78% Oxygen – 21% Others -1% Explain the pie chart to the students.  Discussion questions on findings Lead students through the discussion and pose a question based on their findings for the activity. Questions: 1. How many gases are present in the atmosphere? 2. What is the most abundant gas found in the atmosphere? Introduce the key words for the lesson “atmosphere, nitrogen, oxygen, carbon dioxide, argon, water vapour”	Making predictions Provide answers to what the atmosphere is made up of. Activity Use the data given to draw a pie chart. Copy the diagram into their books  Discussion questions on findings Students to go through discussions based on the question and give their feedbacks. Responses: 1. There are four main gases found in the atmosphere apart from small amounts of other gases. 2. Nitrogen is the abundant gas found in the atmosphere. Key words 1. Atmosphere 2. Nitrogen 3. Carbon dioxide 4. Argon 5. Water vapour	Concepts and Misconceptions The Earth’s atmosphere is about 78% nitrogen and 21% oxygen. The remaining 1% includes carbon dioxide, water vapour, and argon. Strategy: Work in Groups Write the key words on the blackboard.
Conclusion **5 mins**	In our today’s lesson, what did you discover or learn from this lesson? Refer students to their predictions for the key question: What is the Earth’s atmosphere made of? Guide students by having them to summarize what they have learnt about composition of the Earth’s atmosphere.	Summary: • The Earth’s atmosphere is about 78% nitrogen and 21% oxygen. The remaining 1% includes carbon dioxide, water vapour, and argon. • The atmosphere also contains tiny pieces of solid materials such as dust, salt, pollen and ice • The atmosphere also holds small water droplets both in and apart from the clouds	The students’ conclusion should reflect the key concepts in the lesson.

Black Board Plan Sample

Title: Composition of Atmosphere Key question: What is the Earth's atmosphere made of? Activity: Draw a pie chart to represent the composition of the atmosphere. Nitrogen- 78% Oxygen – 21% Others -1%  	Discussion Questions: 1. How many gases are present in the atmosphere? 2. What is the most abundant gas found in the atmosphere? Responses: 1. There are four main gases found in the atmosphere apart from small amounts of other gases. 2. Nitrogen is the abundant gas found in the atmosphere. Key words; 1. Atmosphere 2. Nitrogen 3. Carbon dioxide 4. Argon 5. Water vapour	Summary • The Earth's atmosphere is about 78% nitrogen and 21% oxygen. The remaining 1% includes carbon dioxide, water vapour, and argon. • The atmosphere also contains tiny pieces of solid materials such as dust, salt, pollen and ice • The atmosphere also holds small water droplets both in and apart from the clouds

Challenge for students:

1. Why does nitrogen makes up most of the atmosphere?
2. Is the percentage of gases in the atmosphere always constant?

Guided lesson sample 9

Lesson Title: Components of ecosystem	Lesson No: 92
Strand 1: Life	**Unit 4: Interaction and Relationship in the Environment**
Topic: Living together	Sub-topic: Ecosystems
Content Standard:	7.1.4. Students will be able to explain the relationship between living things and their environments.
Benchmark:	7.1.4.1. Investigate the different components of an ecosystem.
Key Question:	What are the different components an ecosystem?
Lesson objective:	By the end of the lesson the students should be able to; • identify the different components of an ecosystem.
Teaching period:	40 minutes (1 period)
Preparations:	Chart with the concept showing the link of ecosystem to biotic and abiotic. See more information in the content background information on ecosystems.
Key word(s):	ecosystem, abiotic, biotic

Learning content

Knowledge	Skills	Attitudes and Values
• The components of the ecosystem are categorized into abiotic or non-living and biotic or living components. Both the components of ecosystem and environment are same. • Biotic components are made up of plants and animals. • Abiotic animals are made up of soil, air, sunlight and water.	• Making predictions on the different types of ecosystems. • Infer on the different types of ecosystems. • Classify the different ecosystems into the two main types of ecosystems: terrestrial and aquatic. • Communicate ideas and findings on the on the different types of ecosystems using verbal, written and pictorial.	Develop curiosity to learn more about ecosystems. Show open-mindedness when learning about ecosystems. Show responsibility by taking care of the different ecosystems in the environment. Respect views of others.

Teacher's Notes:

This lesson is an introductory lesson to biotic and abiotic lesson that will follow after this lesson. It is therefore important for students to understand the two biotic and abiotic so that students can describe their relationship in the next lesson.

1. What makes up the biotic component of an ecosystem?
2. What makes up the abiotic component of an ecosystem?
3. Are the components of ecosystem similar or different from one ecosystem to another? Explain your answer.

Lesson Procedure

Time segments	Teacher activity	Student activity	Points to notice
Intro **5 mins**	Access prior knowledge Revise the lesson by asking the following questions Q: What is an ecosystem? Introduce the lesson title and the key question.	**Key Question** What are the components of ecosystem?	Students will use their prior knowledge about ecosystem to link to today's lesson.

Body **35 mins**	Making predictions Allow students to discuss in groups and share their ideas and assumptions on the different components of an ecosystem. Show chart with concept map of components of ecosystem. Activity: Answer the following questions. 1. What are the two main components of an ecosystem? 2. What makes up the biotic component of an ecosystem? 3. What makes up the abiotic component of an ecosystem? Discussion questions on findings Lead students through the discussion and pose questions based on their findings for the activity. Questions: 1. What is biotic in your own words? 2. What is abiotic in your own words? 3. Are the components of ecosystem similar or different from one ecosystem to another? Explain your answer. Introduce the key words for the lesson; ecosystem, biotic, abiotic	Making predictions Discuss in groups and present ideas and assumptions to the class on the different components of an ecosystem. Observe the chart with the concept map of components of ecosystem. Activity: Answer the following questions. 1. The two main components of an ecosystem are biotic components and abiotic components. 2. Plants and animals make up the biotic component of an ecosystem. 3. Soil, air, sunlight and water makes up the abiotic component of an ecosystem. Discussion questions on findings Students to go through discussions based on the question and give their feedbacks. Responses: Key words 1. Ecosystem 2. Biotic 3. Abiotic	Concepts and Misconceptions Use the concept map of components of the ecosystem in the content background information in this teacher guide. Strategy: Work in groups Write the key word on the black board.

Conclusion **5 mins**	In our today's lesson, what did you discover or learn from this lesson? Refer students to their predictions for the key question: What are the different components of ecosystem? Guide students by having them to summarize what they have learnt about components of ecosystem.	Summary: • The components of the ecosystem are categorized into abiotic or non-living and biotic or living components. Both the components of ecosystem and environment are same. • Biotic components are made up of plants and animals. • Abiotic animals are made up of soil, air, sunlight and water.	The students' conclusion should reflect the key concepts in the lesson.

BLACK BOARD PLAN

Title: Types of Ecosystem **Key question:** **What are the different components of ecosystem?** **Activity:** **Answer the following questions.** **1. What are the two main components of an ecosystem?** **2. What makes up the biotic component of an ecosystem?** **3. What makes up the abiotic component of an ecosystem?**	Discussion Questions: 1. What is biotic in your own words? 2. What is abiotic in your own words? 3. Are the components of ecosystem similar or different from one ecosystem to another? Explain your answer. Key words 1. Ecosystem 2. Biotic 3. Abiotic	Summary • The components of the ecosystem are categorized into abiotic or non-living and biotic or living components. Both the components of ecosystem and environment are same. • Biotic components are made up of plants and animals. • Abiotic animals are made up of soil, air, sunlight and water.

Challenge for students:

1. List the different types of ecosystems in Papua New Guinea.

Guided lesson sample 10

Lesson Title: Causes of day and night	Lesson No: 113
Strand: Earth and Space	**Unit: Space**
Topic: Earth's Motion	**Sub-topic: Day and Night**
Content Standard:	7.3.4. Students will be able to investigate the relationship between the Earth's movement and the Sun.
Benchmark:	7.3.4.2. Relate changes on the Earth such as day and night to the Earth's rotation and its orbit around the sun.
Key Question:	What causes day and night on Earth?
Lesson objective:	**By the end of the lesson the students will be able to;** • • demonstrate the causes of day and night on Earth by modelling using given materials.
Teaching period:	80 minutes (2 period)
Preparations:	Torch, partner, pencil, dark room, paper, scissors, tape and globe.
Key word(s):	day, night, axis

Knowledge	Skills	Attitudes and Values
• Earth turns around its axis, an imaginary line that goes through its center. This motion is called rotation. • Earth takes about 24 hours to rotate around its axis once. • When a place on Earth faces the sun, it has daytime. When it faces away from the sun, it has night.	• Making predictions on the causes of day and night. • Infer on the causes of day and night. • Simulate or demonstrate the concept of day and night using available materials • Communicate findings on the causes of day and night using verbal, written and models.	Develop curiosity to learn more about causes of day and night. Show open-mindedness when learning about day and night. Respect views of others.

As the Earth spins on its axis in an anti-clockwise direction, the darkened parts move from darkness to light and into darkness again.

The term day is often referred to describe the time during which half of the earth is facing the sun. The term night is referred to the other half which is turned away from the sun.

The Earth spins one complete circle every twenty-four hours. This is why in each day those of us who live in the equator have 12 hours of daylight and 12 hours of darkness (night). Other parts of the world do not have twelve hours of day and night in a twenty-four hour period.

Lesson Procedure

Time segments	Teacher activity	Student activity	Points to notice
Intro **5 mins**	Access prior knowledge Ask students questions to elicit their ideas about the lesson title. What is the difference between rotation and revolving? Introduce the lesson title and the key question.	Key question What is the cause of Day and Night?	Students will use their prior knowledge on day and night to link to today's lesson.

Body **35 mins**	Making predictions Allow students to give their answers on what causes day and night. Activity 1: Simulate Day and Night 1. Obtain a light source that shines in all directions. 2. Darken the room as much as possible. 3. Have two children stand back to back with elbows interlocked, one facing the lamp. 4. Ask them to turn together, each child moving in and out of the light. 5. Ask the class to identify when each person is in daylight or darkness. Activity 2 Locating countries 1. Locate PNG on the globe. Draw, cut out and stick a little house on the spot. 2. Fold a page in half. Label one side as “Day” and the other as “Night”. 3. Make the room dark. Ask your partner to shine the torch onto the globe. 4. Turn the globe until your house is in the ‘daylight’. Now find a place on the opposite side. Write its name under ‘night’. 5. Add more countries into the day list and night list. Discussion questions on findings Lead the students through the discussion about their findings. Question: Explain how the motion of the Earth causes day and night.	Making predictions Discuss in groups and give answers to the key question. Activity 1 Observe the demonstration of day and night. Activity 2 1. Locate PNG on the globe. Draw, cut out and stick a little house on the spot. 2. Fold a page in half. Label one side as “Day” and the other as “Night”. 3. Make the room dark. Ask your partner to shine the torch onto the globe. 4. Turn the globe until your house is in the ‘daylight’. Now find a place on the opposite side. Write its name under ‘night’. 5. Add more countries into the day list and night list. Discussion questions on findings Students to go through discussions based on the question and give their feedbacks. Response: Earth turns around its axis, an imaginary line that goes through its center. This motion is called rotation. Earth takes about 24 hours to rotate around its axis once. When a place on Earth faces the sun, it has daytime. When it faces away from the sun, it has night.	Concepts and Misconceptions Earth turns around its axis, an imaginary line that goes through its center. This motion is called rotation. Strategy: Work in groups

Conclusion **5 mins**	In our today's lesson, what did you discover or learn from this lesson? Refer students to their hypothesis for the key question: "What causes of day and night on Earth?" Guide students by having them to summarize what they have learnt about causes of day and night on Earth.	Summary: • Earth turns around its axis, an imaginary line that goes through its center. This motion is called rotation. • Earth takes about 24 hours to rotate around its axis once. • When a place on Earth faces the sun, it has daytime. When it faces away from the sun, it has night.	The students' conclusion should reflect the key concepts in the lesson.

Black Board Plan Sample

Title: Types of Ecosystem Key question: What are the different components of ecosystem? Activity: Answer the following questions. 1. What are the two main components of an ecosystem? 2. What makes up the biotic component of an ecosystem? 3. What makes up the abiotic component of an ecosystem?	Discussion Questions: 1. What is biotic in your own words? 2. What is abiotic in your own words? 3. Are the components of ecosystem similar or different from one ecosystem to another? Explain your answer. Key words 1. Ecosystem 2. Biotic 3. Abiotic	Summary • The components of the ecosystem are categorized into abiotic or non-living and biotic or living components. Both the components of ecosystem and environment are same. • Biotic components are made up of plants and animals. • Abiotic animals are made up of soil, air, sunlight and water.

KSAVs for the Grade 7 Lessons

STRAND: LIFE	UNIT: PLANTS	TOPIC: REPRODUCTION AND HEREDITY OF PLANTS

Content standard: 7.1.1 Students will be able to investigate flowering and non-flowering plants, and their characteristics.

Lesson Title: Characteristics of flowering plants — Lesson No. 01

Benchmark: 7.1.1.1 Investigate the characteristics of flowering and non-flowering plants.

Key question: What are some characteristics of flowering plants?

Lesson objective: By the end of the lesson, the students should be able to;
- describe the main characteristics of flowering plants.

Knowledge	Skills	Attitude & value
Flowering plants are also known as angiosperm. Angiosperms are plants that have flowers and their reproduction is done by flowers. All flowering plants produce seeds. And it is covered by a fruit. Angiosperms have complicated flowers with complicated structure. There are 2 types of Angiosperms namely Dicotyledonous Plants and Monocotyledonous plants.	Making predictions on the characteristics of flowering. Infer on the main characteristics of flowering plants. Communicated ideas and findings on the characteristics of flowering plants using verbal, written and pictorial.	Develop curiosity to know about to know more about characteristics of flowering plants. Show open-mindedness when learning about types of characteristics of flowering plants. Be responsible by taking care of plants. Respect views of others.

Lesson Title: Characteristics of non-flowering plants — Lesson No. 02

Benchmark: 7.1.1.2 Classify and profile different types of flowering and non-flowering plants.

Key question: What are some characteristics of non-flowering plants.

Lesson objective: By the end of the lesson, the students should be able to;
- describe the characteristics of non-flowering plants.

Knowledge	Skills	Attitudes

These plants do not produce flowers, fruits and seeds. Non flowering plants vary in their shape, size and colour. They are mainly characterized by spore production, absence of flowers and true roots. These plants are simpler compared to those flowering plants. Reproduction in non-flowering plants is asexually by producing spores. Gymnosperms are the first nonflowering plants to produce seeds. Non-flowering plants do not carry flowers they produce spores, fungi or cones the are used for propagation (reproduction). Algae, moss, fern and conifer are no flowering plants	Making predictions on the characteristics of non-flowering. Infer on the main characteristics of non-flowering plants. Communicated ideas and findings on the characteristics of non-flowering plants using verbal, written and pictorial.	Develop curiosity to know about to know more about characteristics of non-flowering plants. Show open-mindedness when learning about types of characteristics of non-flowering plants. Be responsible by taking care of plants. Respect views of others.

Lesson Title: Classification of flowering plants Lesson No. 03

Benchmark: 7.1.1.2 Classify and profile different types of flowering and non-flowering plants.

Key question: How can we classify flowering plants?

Lesson objective: By the end of the lesson, the students should be able to;
- classify flowering plants using their characteristics.

Knowledge	Skills	Attitudes
Different types of flowers (the Angiosperms) can easily be identified by dividing them into Monocots or Dicots. Monocotyledons have one cotyledon (seed leaf), which is the food store of a seed. They also have leaves with parallel veins, and flower parts in multiples of three. Dicotyledons have two cotyledons, leaves with branching, netlike veins, and flower parts in groups of four or five.	Making predictions on how to classify flowering plants. Observe the similarities and differences in flowering plants. Infer on classifying flowering plants. Communicate ideas and findings on classification of flowering plants using verbal, written and pictorial.	Develop curiosity to know about to know more about classifying flowering plants. Show open-mindedness when learning about classifying flowering plants. Be responsible by taking care of plants. Respect views of others.

Lesson Title: Classification of non-flowering plants Lesson No. 04

Benchmark: 7.1.1.2 Classify and profile different types of flowering and non-flowering plants.

Key question: How can we classify non-flowering plants?

Lesson objective: By the end of the lesson, the students should be able to;
- classify non-flowering plants using their characteristics.

Knowledge	Skills	Attitudes

Non-flowering plants do have reproductive organs available in the flowers. Non-flowering plants can further classified as with seeds and without seeds. Gymnosperms are plant with seeds and the embryo is inside a seed. The seed is not covered not covered (enclosed) in a fruit. These are the less advanced type of seed plants.	Making predictions on how to classify non-flowering plants. Observe the similarities and differences in non- flowering plants. Infer on classifying non-flowering plants. Communicate ideas and findings on classification of flowering plants using verbal, written and pictorial.	Develop curiosity to know about to know more about classifying non-flowering plants. Show open-mindedness when learning about classifying non-flowering plants. Be responsible by taking care of plants. Respect views of others.

Lesson Title: Fruiting plant life cycle - Tomato Lesson No. 05

Benchmark: 7.1.1.3 Examine the reproduction process in flowering and non-flowering plants.

Key question: How does tomato plant reproduce?

Lesson objective: By the end of the lesson, the students should be able to;
- describe the reproduction of tomato plant.

Knowledge	Skills	Attitudes
Tomato plants belong to the plant group known as flowering plants or angiosperms. The tomato plant reproduces sexually, meaning that it requires both female and male organs to produce seeds. Every tomato seed has a tiny tomato plant inside. When the conditions are just right, tomato seeds will germinate.	• Making hypothesis on how flowering plants reproduce. • Draw reproductive structures and describe parts and functions • Compare the difference between sexual and asexual reproduction. • Infer on the fertilization process in plants. • Compare the difference self-pollinated from cross-pollinated. • Communicate ideas on reproduction process in flowering plants.	Develop the curiosity to learn about the reproduction process of flowering plants.

Lesson Title: Conifer life cycle Lesson No. 06

Benchmark: 7.1.1.3 Examine the reproduction process in flowering and non-flowering plants.

Key question: How does conifer plant reproduce?

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

- describe the reproduction process of conifer plant.

Knowledge	Skills	Attitudes
Conifer is a type of gymnosperm plant that produces seeds but do not produce flowers or fruit. The life cycle of conifer plant: 1. Small cones produce male sex cells that are carried to the large cones in pollen. Large cones produce female sex cells. 2. After fertilization, a seed coat develops around the plant embryo. The seed provides nourishment. 3. The seed sprout and grows into a young plant called seedling. 4. The mature tree will produce male and female cones. The life cycle will begin again.	• Making predictions on how conifer plant reproduces. • Infer on the life cycle of conifer plant including fertilization reproduction process. • Compare the difference between sexual and asexual reproduction. Communicate ideas and findings on the life cycle of tomato plant using verbal, written and pictorial.	Develop the curiosity to know more about the reproduction process of other types of gymnosperm plants Show open-mindedness when learning about life cycle of conifer plant. Be responsible by taking care of plants. Respect views of others.

TOPIC REVIEW ON GROUPING PLANTS	**LESSON 7**
UNIT REVIEW ON PLANTS	**LESSON 8**

Strand: Life	Unit: Animals	Topic: Groups Of Animals

Content Standard: 7.1.2. Students will be able to investigate groups of animals that are vertebrates and invertebrates, and their characteristics.

Lesson Title: Vertebrates and Invertebrates — Lesson No. 09

Benchmark: 7.1.2.1. Investigate animals that are vertebrates and invertebrates, and draw appropriate conclusions.

Key question: What are vertebrates and invertebrate animals?

Lesson objective: By the end of the lesson, the students should be able to;
- identify animals that are vertebrates and invertebrates.

Knowledge	Skills	Attitudes
• Vertebrates are animals with backbone or spinal column such as fish, dog, frogs or lizard. • Invertebrates are animals without backbones or spinal column such as jellyfish, starfish or earthworms.	Makin predictions on vertebrates and invertebrates. Infer on vertebrates and invertebrates. Compare vertebrates and invertebrates. Communicate ideas and findings on vertebrates and invertebrates using verbal, written and pictorial.	Develop curiosity to know about to know more about vertebrates and invertebrates. Show open-mindedness when learning about vertebrates and invertebrates. Be responsible by taking care of vertebrates and invertebrates. Respect views of others.

Lesson Title: Types of vertebrates and invertebrates — Lesson No. 10

Benchmark: 7.1.2.2. Evaluate the types of vertebrates and invertebrate.

Key question: What are the different types of vertebrates and invertebrates?

Lesson objective: By the end of the lesson, the students should be able to;
- Identify different types of vertebrates and invertebrates.

Knowledge	Skills	Attitudes
• Vertebrates can be warm-blooded or cold-blooded • Reptiles, amphibians and most fish are cold blooded. • The body temperature of cold-blooded animals depends on the temperature outside their bodies. • Birds and mammals are warm-blooded vertebrates. They maintain constant internal body temperatures. • Invertebrates are the largest groups of animals. • Types of invertebrates include echinoderms, mollusks, arthropods, cnidarians, sponge, worms	Making predictions on the different types of vertebrates and invertebrates. Infer on the different types of vertebrates and invertebrates. Compare different types of vertebrates and invertebrates. Communicate ideas and findings on types of vertebrates and invertebrates using verbal, written and pictorial.	Develop curiosity to know about types of vertebrates and invertebrates. Show open-mindedness when learning about vertebrates and invertebrates. Be responsible by taking care of different types of vertebrates and invertebrates. Respect views of others.

Topic Review On Grouping Animals	**Lesson 12**
Unit Review On Animals	**Lesson 13**

Strand: Physical Science	Unit: Energy	Topic: Electricity 3

CONTENT STANDARD: 7.2.1. Students will be able to investigate the function of electricity and the relationship between electrical currents and voltage.

Lesson Title: Regularity of electric current in circuits Lesson No. 14

Benchmark: 7.2.1.1. Discover the regularity of the electric current flowing through each point of the circuit.

Key question: How do we determine the regularity of current and voltage in a circuit?

Lesson objective: By the end of the lesson, the students should be able to;
- discover the regularity of electric current flowing through each point of the circuit.

Knowledge	Skills	Attitudes
• The three basic principles; • Voltage is the difference in charge between two points. • Current is the rate at which charge is flowing. • A Parallel circuit has certain characteristics and basic rules: • A parallel circuit has two or more paths for current to flow through. • Voltage is the same across each component of the parallel circuit. • The sum of the currents through each path is equal to the total current that flows from the source.	• Making hypothesis on the regularity of electric current flowing through the circuit. • Infer on the regularity of electric current flowing through the circuit. • Use the ammeter and voltmeter to determine the regularity of current and voltage in the circuit. • Communicate ideas and findings on the regularity of current and voltage using verbal, written and pictorial.	• Develop curiosity to know about regularity of current and voltage in a circuit. • Show open-mindedness when learning about regularity of current and voltage in a circuit. • Respect views of others.

Lesson Title: Measuring electric current in circuits Lesson No. 15

Benchmark: 7.2.1.2. Use ammeter and voltmeter to measure electric current and voltage in series and parallel circuits.

Key question: How do we measure electric current in series and parallel circuits?

Lesson objective: By the end of the lesson, the students should be able to;
- measure electric current in series and parallel circuits using ammeter.

Knowledge	Skills	Attitudes

• Electric current is measured using a device called an ammeter. • The ammeter is always connected in series in the circuit. • The SI unit (International accepted unit of measurement) for measuring an electric current is the ampere (amp) and the unit symbol ampere (amp) is A.	• Making hypothesis on how to measure electric current in circuits. • Measure electric current using ammeter in circuits. • Taking readings of the electric current in series and parallel circuits. • Compare the electric current in measured in series and parallel circuit. • Communicate ideas and findings on measuring electric currents using written, verbal and pictorial.	• Develop curiosity to know about measuring electric currents in circuits. • Show open-mindedness when learning about measuring electric current in circuits. • Communicate data with integrity. • Respect views of others.

Lesson Title: Measuring voltage in circuits Lesson No. 16

Benchmark: 7.2.1.2. Use ammeter and voltmeter to measure electric current and voltage in series and parallel circuits.

Key question: How do we measure voltage in circuits?

Lesson objective: By the end of the lesson, the students should be able to;
- measure voltage in series and parallel circuits using the voltmeter.

Knowledge	Skills	Attitudes
Voltage is the amount of push and is measured in 'volts' which has the symbol V. A voltmeter is always wired in parallel where the voltage will be taken, e.g. dry cell or bulb. The voltage supplied by the battery is shared between all the components in a series circuit.	Making hypothesis on how to measure voltage in circuits. Measure electric current using ammeter in series and parallel circuits. Compare the electric current in measured in series and parallel circuits. Communicate ideas and findings on measuring electric currents using written, verbal and pictorial.	Develop curiosity to know about measuring electric currents in circuits. Show open-mindedness when learning about measuring electric current in circuits. Communicate data with integrity. Respect views of others.

Lesson Title: Resistance in wires Lesson No. 17

Benchmark: 7.2.1.3. Determine that metal wires have resistance to electricity when measuring the electric current and voltage.

Key question: How do wires affect the resistance in a circuit when measuring electric current and voltage?

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

- investigate resistance in wires and their effects on voltage and the flow of electric current in a circuit.

Knowledge	Skills	Attitudes
• Resistance is the property of an object that resists the flow of electric current in an electric circuit. • When electric current moves through conductors there is always some resistance to the current. Some conductors do not allow electric current to flow easily through them making it a greater electrical resistance. • The total amount of resistance to charge flow within a wire of an electric circuit is affected by some clearly identifiable variables: • the total length of the wires will affect the amount of resistance. The longer the wire, the more resistance that there will be. • the wider the wire, the less resistance that there will be to the flow of electric charge. When all other variables are the same, charge will flow at higher rates through wider wires with greater cross-sectional areas than through thinner wires. • the material that a wire is made of. Not all materials are created equal in terms of their conductive ability. Some materials are better conductors than others and offer less resistance to the flow of charge.	• Making hypothesis on the effects of wires on the electrical resistance when measuring electric current and voltage. • Infer on the effect of wires on the electrical resistance when measuring electric current and voltage. • Investigate the resistance in wires to determine that metal wires have resistance when measuring voltage and electric current in a circuit. • Compare the electrical resistance in different metal wires. • Communicate ideas and findings on the resistance in wires using verbal, written and pictorial.	• Develop curiosity to know about electrical resistance. • Show open-mindedness when learning about how wires have resistance to the flow of electric currents and voltage. • Respect views of others

Lesson Title: Electric Current, Voltage and Resistance Lesson No. 18

Benchmark: 7.2.1.4. Explain and compare the relationship between the voltage, electric current, and resistance.

Key question: What is the relationship between the voltage, current and resistance?

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

- explain the relationship between voltage, current and resistance.

Knowledge	Skills	Attitudes

Ohm's law states that the amount of current passing through a conductor is directly proportional to the voltage across the conductor and inversely proportional to the resistance of the conductor. The relationship between voltage, current, and resistance is described by Ohm's law. This equation, i = v/r, tells us that the current, i, flowing through a circuit is directly proportional to the voltage, v, and inversely proportional to the resistance, r. In other words, if we increase the voltage, then the current will increase. But, if we increase the resistance, then the current will decrease.	Making predictions on the relationship between voltage, current and resistance. Infer on the relationship between voltage, current and resistance. Compare voltage and current and; current and resistance. Communicate ideas and findings on the relationship between voltage, current and resistance.	Develop curiosity to know about the relationship between voltage, current and resistance. Show open-mindedness when learning about the relationship between voltage, current and resistance. Respect views of others

Lesson Title: Properties of static electricity Lesson No. 20

Benchmark: 7.2.1.6. Investigate the properties and the functions of static electricity.

Key question: What are the properties of static electricity?

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

- investigate the properties of static electricity by demonstration using two balloons.

Knowledge	Skills	Attitudes
• Static electricity is the build-up of an electrical charge on the surface of an object. It's called "static" because the charges remain in one area rather than moving or "flowing" to another area. • There are two types of charge in static electricity- positive and negative charge. • 1. When two objects have the like charges they repel each other and when two objects have two unlike charges they attract each other. For example: objects with like charged repel. Two positively charged objects placed close to each will push each other away; they repel each other. • 2. Two negatively charged objects placed close to each will push each other away; they repel each other. For example: objects with unlike charged attract. When one object has a negative charge and the other a positive charge they pull towards each other; they attract each other.	• Making predictions on the properties of static electricity. • Infer on the properties of static electricity. • Evaluate effects of positive and negative charges created by rubbing the two balloons. • Investigate the properties of static electricity using two balloons. • Communicate ideas and findings on the properties of static electricity using verbal, written and pictorial.	• Develop curiosity to know about the properties of static electricity. • Show open-mindedness when learning about static electricity. • Respect views of others.

Lesson Title: Static electricity at work Lesson No. 21

Benchmark: 7.2.1.6. Investigate the properties and the functions of static electricity.

Key question: What are some examples of static electricity in everyday life?

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

- identify examples of static electricity in our day to day life.

Knowledge	Skills	Attitudes
Some examples of static electricity in our day to day life: • When we walk on a carpeted floor and getting shock when touching a door knob or any other metal object is one of the best examples of static electricity. • Clothes stuck to one another after being in the dryer is another example of static electricity. • When plastic pen passes through a woollen garment, a static electricity is generated. Because of this the plastic pen can attract small pieces of papers. • Lightning is one of the main examples of static electricity. The positive and negative charges inside the cloud make the electric current and cause the lightning.	Making predictions on examples of static electricity in everyday life. Infer on examples of static electricity that occurs in our day to day life. Compare different examples of static electricity in our day to day life. Communicate ideas and findings on examples of static electricity using verbal, written and pictorial.	Develop curiosity to know about examples of static electricity in daily life. Show open-mindedness when learning about examples of static electricity that occurs in our day to day life. Respect views of others.

TOPIC REVIEW ON ELECTRICITY LESSON 22

Strand: Earth And Space	Unit: Our Earth	Topic: Earth's Structure
CONTENT STANDARD: 7.3.1. Students will be able to explore the composition and the structure of the Earth.		

Lesson Title: Composition of the Earth — Lesson No.23

Benchmark: 7.3.1.1. Examine the composition and the structure of the Earth.

Key question: How is the Earth structured?

Lesson objective: By the end of the lesson, the students should be able to;
- describe the composition of the Earth.

Knowledge	Skills	Attitudes
The earth is made up of land and cover with water and atmosphere. The earth's crust is made of l% potassium and sodium 2%. The mantle under the crust is composed of mostly silicate rocks rich in magnesium and iron. The core has two parts. The solid, inner core is composed of iron. The outer core is composed of nickel-iron alloy. About 70% of the earth's surface is cover in water. The earth atmosphere is mainly nitrogen and oxygen with smaller amounts of carbon dioxide, vapour and other gases.	Making predictions on the composition of the Earth. Infer on the composition of the Earth. Communicate ideas and findings on the composition of the Earth using verbal, written and pictorial.	Develop curiosity to know about composition of the Earth. Show open-mindedness when learning about composition of the Earth. Respect views of others.

Lesson Title: Movement of tectonic plates — Lesson No. 25

Benchmark: 7.3.1.2. Investigate the different movement of tectonic plates divergent, convergent and transformed faults.

Key question: How do plates move around the earth's surface?

Lesson objective: By the end of the lesson, the students should be able to;
- describe the movement of plates around the earth's surface.

Knowledge	Skills	Attitudes

The earth's crust is broken into separate pieces called tectonic plates. The crust and the upper part of the mantle form a rigid layer called the lithosphere. The lithosphere is broken up into seven major plates and many smaller plates. In the mantle hot material rises towards the lithosphere (like hot air rising out of an open oven - ever opened an oven door and felt the blast of hot air coming past your face?). The hot material reaches the base of the lithosphere where it cools and sinks back down through the mantle. The cool material is replaced by more hot material, and so on forming a large "convection cell". This slow but incessant movement in the mantle causes the rigid tectonic plates to move (float) around the earth's surface (at an equally slow rate).	Making predictions on the movement of plates around the earth's surface. Infer on the causes of movement of plates around the earth's surface. Communicate ideas and findings on the movement of plates using verbal, written and pictorial.	Develop curiosity to know about the cause of moving plates around the earth's surface. Show open-mindedness when learning about moving plates. Respect views of others.

Lesson Title: Tectonic boundaries Lesson No. 26

Benchmark: 7.3.1.2. Investigate the different movement of tectonic plates divergent, convergent and transformed faults.

Key question: How do tectonic boundaries occur?

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

- explain how convergent boundary, divergent boundary and transform boundary occur.

Knowledge	Skills	Attitudes
The earth's continents are constantly moving due to the motions of the tectonic plates. The border between two tectonic plates is called a boundary. All the tectonic plates are constantly moving — very slowly — around the planet, but in many different directions. Some are moving toward each other, some are moving apart, and some are sliding past each other. Because of these differences, tectonic plate boundaries are grouped into three main types. 1. A convergent boundary occurs where two plates are pushing toward each other. 2. A divergent boundary marks two plates that are moving apart from each other. 3. A transform boundary occurs where two plates slide past each other.	Making predictions on how tectonic boundaries occur. Infer on how tectonic boundaries occur. Compare the three types of tectonic boundaries. Communicate ideas and findings on the how tectonic boundaries occur using verbal, written and pictorial.	Develop curiosity to know about how tectonic boundaries occur. Show open-mindedness when learning about tectonic boundaries. Respect views of others.

Lesson Title: Effects of moving plates 1: Earthquake Lesson No: 27

Benchmark: 7.3.1.3. Analyse the types of geological events caused by tectonic plate movements such as earthquakes, volcanoes, and the formation of mountains.

Key question: How do earthquakes form on plate boundaries?

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

- explain the effects of movements of plates along the transform plate boundaries in relation to the formation of volcanoes.

Knowledge	Skills	Attitudes
Earthquakes occur along the transform fault boundary because the edge of the boundary is not smooth. The location where the movement of the earthquake first occurs is called the focus. The point on the surface above the focus is called the epicentre. The shaking is caused by the energy released when rock moves and is always great at the epicentre.	Making hypothesis on how earthquakes form on the plate boundaries. Model the transform plate boundary to demonstrate its effect to cause earthquake to form. Draw pictures to demonstrate their understanding of effects of transform plate boundary. Communicate ideas and findings on effects of moving plates on the formation of earthquakes using verbal, written, and pictorial and models.	Develop curiosity to know about how earthquakes form on plate boundaries. Show open-mindedness when learning about the effects of moving plates along plate boundaries. Show creativity to build model of the transform plate boundary to demonstrate the formation of earthquakes. Respect views of others.

Lesson Title: Effects of moving plates 2: Volcanoes Lesson No. 28

Benchmark: 7.3.1.3. Analyse the types of geological events caused by tectonic plate movements such as earthquakes, volcanoes, and the formation of mountains.

Key question: How do volcanoes form on plate boundaries?

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

- explain the effects of movements of plates along the convergent plate boundaries in relation to the formation of volcanoes.

Knowledge	Skills	Attitudes

4. If two tectonic plates collide, they form a convergent plate boundary. Usually, one of the converging plates will move beneath the other, which is known as subduction. Deep trenches are often formed where tectonic plates are being subducted and earthquakes are common. As the sinking plate moves deeper into the mantle, fluids are released from the rock causing the overlying mantle to partially melt. The new magma (molten rock) rises and may erupt violently to form volcanoes, often building arcs of islands along the convergent boundary. These island arcs are always landward of the neighboring trenches.	• Making predictions on how earthquakes form on the plate boundaries. • Model the convergent boundary to demonstrate its effect to cause volcanoes to form. • Draw pictures to demonstrate their understanding of effects of transform plate boundary. • Communicate ideas and findings on effects of moving plates on the formation of volcanoes using verbal, written, and pictorial and models.	• Develop curiosity to know about how volcanoes form on the plate boundaries. • Show open-mindedness when learning about the effects of moving plates along plate boundaries. • Show creativity when building model of the converging plate boundary to demonstrate the formation of volcanoes. • Respect views of others.

Lesson Title: Effects of moving plates 3: Mountains Lesson No. 29

Benchmark: 7.3.1.3. Analyse the types of geological events caused by tectonic plate movements such as earthquakes, volcanoes, and the formation of mountains.

Key question: How do mountains form on plate boundaries?

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

• explain the effects of movements of plates along the convergent plate boundaries in relation to the formation of mountains.

Knowledge	Skills	Attitudes

Mountains are usually formed at what are called convergent plate boundaries, meaning a boundary at which two plates are moving towards one another. This type of boundary eventually results in a collision. Tectonic plate collisions take a long time, as plates only shift a few centimeters each year, but they can still be powerful enough to form the Earth's largest mountain ranges. Fold mountains occur when two tectonic plates collide at a convergent plate boundary, causing the crust to overthicken. This process forces the less dense crust to float on top of the denser mantle rocks – with material being forced upwards to form hills, plateaus or mountains – while a greater volume of material is forced downward into the mantle. Block mountains are caused by faults in the crust, a seam where rocks can move past each other. Also known as rifting, this process occurs when rocks on one side of a fault rise relative to the other. The uplifted blocks become block mountains (also known as horsts) while the intervening dropped blocks are known as graben (i.e. depressed regions).	Making predictions on how mountains form on the plate boundaries. Model the convergent boundary to demonstrate its effect to cause mountains to occur. Draw pictures to demonstrate their understanding of effects of transform plate boundary. Communicate ideas and findings on effects of moving plates on the formation of mountains using verbal, written, and pictorial and models.	Develop curiosity to know about how mountains form on the plate boundaries. Show open-mindedness when learning about the effects of moving plates along plate boundaries. Show creativity to build model of the converging plate boundary to demonstrate the formation of the mountains. Respect views of others.
Topic Review On Earth's Structure	**Lesson 30**	

Strand: Life	Unit: Human Body	Topic: Digestive System
Content Standard: 7.3.1. Students will be able to explore the composition and the structure of the Earth.		

Lesson Title: Types of nutrients Lesson No. 31

Benchmark: 7.1.3.1. Investigate different types of nutrients and their functions.

Key question: What types of nutrients are there in the food?

Lesson objective: By the end of the lesson, the students should be able to;
- identify the different types of essential nutrients that are needed for the body.

Knowledge	Skills	Attitudes
There are some essential nutrients that the body needs; 1. Carbohydrates 2. Protein 3. Fat 4. Water 5. Vitamins 6. Minerals	Make predictions on the types of nutrients needed for the body. Infer on the different types of nutrients. Compare the different types of nutrients needed for the body. Communicate ideas and findings on types of nutrients using verbal, written and pictorial.	Develop curiosity to know about types of nutrients. Show open-mindedness when learning about types of nutrients. Respect views of others.

Lesson Title: Functions of nutrients Lesson No. 32

Benchmark: 7.1.3.1. Investigate different types of nutrients and their functions.

Key question: What is the function of various nutrients in the body?

Lesson objective: By the end of the lesson, the students can should be able to;
- state the function of each nutrients in the body.

Knowledge	Skills	Attitudes
• Carbohydrates are the main energy source for the brain. Without carbohydrates, the body will not function properly. Example fruits, bread, starchy vegetables and sugar • Protein is the major structural component of cells and is responsible for the building and repair of body tissues. Protein is broken down into amino acids, which are building blocks of protein. • Fat is an energy source that when consumed, increases the absorption of fat-soluble vitamins including vitamins A, D, E and K. • Vitamins. Vitamin C is necessary for the synthesis of collagen, which provides structure to blood vessels, bone and ligaments. • Minerals • Water helps to maintain homeostasis in the body and transports nutrients to cells. Water also assists in removing waste products from the body.	Make predictions on the function of each nutrient in the body. Infer on the function of each nutrients in the body. Compare functions of each nutrient in the body. Communicate ideas and findings on function of each nutrient using verbal, written and pictorial.	Develop curiosity to know about functions of nutrients. Show open-mindedness when learning about function of each nutrient. Respect views of others.

Lesson Title: Digestive organs Lesson No. 33

Benchmark: 7.1.3.2. Examine the various organs of digestive system and their functions.

Key question: What are the main organs of the digestive system?

Lesson objective: By the end of the lesson, the students should be able to;
- identify the main organs of the digestive system.

Knowledge	Skills	Attitudes
Main organs passageway: 1. Mouth (includes salivary glands) 2. Esophagus 3. Stomach 4. Small intestine 5. Large intestine 6. Anus Additional organs necessary: Pancrease, liver, and gallbladder all secrete enzymes into the small intestine.	Making predictions on the main organs of the digestive system. Infer on the main organs of the digestive system. Compare main organs of the digestive system. Communicate ideas and findings on the main organs of the digestive system.	Develop curiosity to know about main organs of the digestive system. Show open-mindedness when learning about main organs of the digestive system. Respect views of others.

Lesson Title: Mechanism of digestion Lesson No. 35

Benchmark: 7.1.3.3. Investigate the mechanism of the digestive system.

Key question: How does digestion take place in the body?

Lesson objective: By the end of the lesson, the students should be able to;
- explain the mechanism of digestion in the body.

Knowledge	Skills	Attitudes

Digestion refers to the breakdown of food into smaller parts that can be absorbed into the blood stream. It allows the body to get the nutrients and energy it needs from the food you eat. How does digestion work? The mouth is the beginning of the alimentary canal. Digestion starts in the mouth as soon as you take the first bite of a meal. Chewing breaks the food into pieces that are more easily digested, while saliva mixes with food to begin the process of breaking it down into a form your body can use. As food passes through the alimentary canal, it mixes with digestive juices, causing large particles of food to break down into smaller and simpler forms of nutrients. The body then absorbs these simpler nutrients through the walls of the small intestine into the bloodstream, which delivers them to the rest of the body. Waste products of digestion pass through the large intestine and out of the body as a solid matter.	Making predictions on how digestion takes place. Infer on the mechanism of digestion in the body. Analyse the mechanism of digestion in the body. Communicate ideas and findings on the mechanism of digestion in the body.	Develop curiosity to know about how digestion takes place. Show open-mindedness when learning about mechanism of digestion. Respect views of others.

Lesson Title: Roles of enzymes Lesson No. 36

Benchmark: 7.1.3.4. Explain the roles of enzymes in the digestion of food.

Key question: What is the role of ezymes during digestion?

Lesson objective: By the end of the lesson, the students should be able;
- describe the roles of ezymes during digestion in the body.

Knowledge	Skills	Attitudes
Enzymes in the digestive system are protein molecules that break down a specific substance. The enzymes mentioned under the description of the pancrease and small intestine are important in breaking down specific components of human diet (carbohydrates, proteins, fats) Enzymes involved in digestion include: Salivary amylase – breaks down starch in the mouth Pepsin – breaks down protein in the stomach Gastric lipase – breaks down fat in the stomach Trypsin and erepsin – break down wholly and partially digested proteins into amino acid in the duodenum.	Making predictions on the roles of enzymes during digestion. Infer on the roles of enzymes during digestion. Compare different enzymes and their functions. Communicate ideas and findings on the roles of enzymes using verbal, written and pictorial.	Develop curiosity to know about the roles of enzymes during digestion. Show open-mindedness when learning about roles of enzymes during digestion in the body. Respect views of others.

Topic Review On Digestive System Lesson 37

Unit Review On Human Body Lesson 38

Strand: Physical Science	Unit: Energy	Topic: Light And Lens
CONTENT STANDARD: 7.2.2. Students will be able to investigate the relationship between light and convex lens.		

Lesson Title: Speed of light — Lesson No. 39

Benchmark: 7.2.2.1. Investigate the properties of light and the speed of light.

Key question: How fast does the light travels?

Lesson objective: By the end of the lesson, the students should be able to;
- describe the speed of light.

Knowledge	Skills	Attitudes
Light moves at the fastest known speed in the universe. Nothing moves faster than (or even close to) the speed of light. In a vacuum, where there is nothing to slow it down, light travels 186,282 miles per second. When light travels through matter, like air or water, it slows down some, but it's still pretty fast. To give an idea as to how fast light is. The Sun is almost 93 million miles from the Earth. It takes around 8 minutes for light to get from the Sun to the Earth. It takes around 1.3 seconds for light to go from the moon to the Earth. Light travels at a speed of 300 000 km (186,000 mi) per second. Light can travel seven times at 300 000km/second in a distance of 40 000km (circumference of the Earth)	Making predictions on how fast the light travels. Infer on the speed of light. Communicate ideas and findings on the speed of light using verbal, written and pictorial.	Develop curiosity to know about the speed of light. Show open-mindedness when learning about the speed of light. Respect views of others.

Lesson Title: Properties of light — Lesson No. 40

Benchmark: 7.2.2.1. Investigate the properties of light and the speed of light.

Key question: How does light behave when it strikes an object?

Lesson objective: By the end of the lesson, the students should be able to;
- identify the properties of light.

Knowledge	Skills	Attitudes

Properties of light: Light travels very fast. Light travels in a straight line. Light interacts with matter. Light is comprised of many colours.	Making predictions on the properties of light. Infer on the properties of light. Compare different properties of light. Communicated ideas and findings on the properties of light using verbal, written and pictorial.	Develop curiosity to know about the properties of light. Show open-mindedness when learning about the properties of light. Respect views of others.

Lesson Title: Reflection of light Lesson No. 41

Benchmark: 7.2.2.2. Establish that reflection and refraction of light occurs through different interfaces such as water and glass.

Key question: Why do lights reflect?

Lesson objective: By the end of the lesson, the students should be able to;
- explain the cause of lights reflecting on the surfaces.

Knowledge	Skills	Attitudes
Reflection: • Light is reflected when light falls on a smooth polished surface or shinny surface. • The ray of light is reflected in another direction after striking the mirror. • Light rays that strike the surface (plane mirror) is called the incident ray and the ray that comes back from the surface (plane mirror) after reflections is known as the reflected ray. • Angle of incidence (□i) is the angle between the normal and the incident ray and the angle of reflection is between the reflected ray and the normal. • The angle of incidence is always equal to the angle of reflection. This is known as the Law of reflection.	Making predictions on why lights reflect. Infer on the causes of lights being reflected on the surfaces. Use a mirror to demonstrate the cause of reflection of light. Communicate ideas and findings on reflection of light using verbal, written and pictorial.	Develop curiosity to know about the reflection of light. Show open-mindedness when learning reflection of light. Respect views of others.

Lesson Title: Refraction of light Lesson No. 42

Benchmark: 7.2.2.2. Establish that reflection and refraction of light occurs through different interfaces such as water and glass.

Key question: Why do lights refract?

Lesson objective: By the end of the lesson, the students should be able to;
- explain the cause of lights refracting on the surfaces.

Knowledge	Skills	Attitudes

Refraction: • Refraction is the bending, or changing of direction of light rays when they pass from one material to another. Example through the air, through the glass then into the air • If the rays pass through the surface of material at an angel other than 90 degrees to the surface, they will refract. • Light moves at different speeds through different materials. • Light travels faster in air, slow in water and slower still in glass. The slower light is in a medium, the more it refracts/ bends in it.	Making predictions on why lights refract. Infer on the causes of lights being refracted on the surfaces. Use a pen in a glass cup filled with water to demonstrate the cause of refraction of light. Communicate ideas and findings on refraction of light using verbal, written and pictorial.	Develop curiosity to know about the refraction of light. Show open-mindedness when learning refraction of light. Respect views of others.

Lesson Title: Properties of convex lens — Lesson No. 43

Benchmark: 7.2.2.3. Examine the properties and functions of convex lens.

Key question: How does a convex lens behave?

Lesson objective: By the end of the lesson, the students should be able;
- investigate convex lens and how it behaves.

Knowledge	Skills	Attitudes
A lens is a transparent material that refracts light in such a way as to form an image. A convex lens is thick in the middle and thin at the edges. A convex lens bends light inwards. So it is called converging lens. Properties and characteristics of convex lens: • Convex lens are thicker at center. • Converging lens (refract parallel light rays so they meet) • A convex causes light to converge at a focal point.	Making predictions on how convex lens behave. Infer on the characteristics of convex lens. Use a hand lens to demonstrate the characteristics of convex lens. Communicate ideas and findings on properties of convex lens using verbal, written and pictorial.	Develop curiosity to know about characteristics of convex lens. Show open-mindedness when learning about the characteristics of convex lens. Respect views of others.

Lesson Title: Function of convex lens — Lesson No. 45

Benchmark: 7.2.2.3. Examine the properties and functions of convex lens.

Key question: How can you change the image produced by a convex lens?

Lesson objective: By the end of the lesson, the students should be able to;
- investigate the function of convex lens.

Knowledge	Skills	Attitudes

The type of image formed by a convex lens depends on the distance of the object from the lens. If the distance is less than one focal length, the image will be right-side up and enlarged. A hand lens produces this type of image. If the distance between the object and the lens is between one and two focal lengths, the image formed will be up-side down and enlarged. If the distance is more than two focal lengths, the image will be up-side down and reduced in size.	Making predictions on how to change the image produced by convex lens. Infer on the function of convex lens. Use convex lens to change image of objects and adjust the distance of the object. Communicate ideas and findings on the function of convex lens using verbal, written and pictorial.	Develop curiosity to know about the function of convex lens. Show open-mindedness when learning about function of convex lens. Respect views of others.

Lesson Title: Application of convex lens — Lesson No. 46

Benchmark: 7.2.2.4. Explain the mechanism of convex lens such as the eye and camera.

Key question: What are some uses of convex lens?

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

- identify uses of convex lens in day to day life.

Lenses are used in glasses and contacts to help correct vision. They are used in telescopes to help view items that are far away and are used in microscopes to help view very small items. Magnifying glasses and microscopes use convex lenses. A magnifying glass makes an object look bigger. Holding it close to an object makes a virtual image of the object form on the same side of the glass as the object. When you look through the magnifying glass, this virtual object seems to be larger than the real one. The thicker the lens, the larger the virtual image. If you are near sighted, your eye lens focuses a scene just in front of the retina in your eye and the image you see is blurred. A concave lens spreads out the light rays before they enter the eye, so that they are focused on the retina and the image is sharp.	Making predictions on the uses of convex lens. Infer on the uses of convex lens. Compare different uses of convex lens. Communicate ideas and findings on findings on the different uses of convex lens using verbal and written.	Develop curiosity to know about the function of convex lens. Show open-mindedness when learning about function of convex lens. Respect views of others.

Topic Review On Light And Lens	**Lesson 47**
Unit Review On Energy	**Lesson 48**

Strand: Physical Science	Unit: Force And Motion	Topic: Forces And Pressure

CONTENT STANDARD: 7.2.3. Students will be able to investigate the properties of pressure and examine pressure applied in solid, liquid, and gas.

Lesson Title: Properties of pressure — Lesson No. 49

Benchmark: 7.2.3.1. Investigate the properties of pressure.

Key question: What are the different properties of pressure?

Lesson objective: By the end of the lesson, the students will be able to;
- identify the properties of pressure.

Knowledge	Skills	Attitudes
Pressure acts on solids, liquids and gases There is a connection to the size of the force and its area -The smaller the surface area, the higher the pressure. -The bigger the surface area the smaller the pressure	Making hypothesis on the properties of pressure. Investigate the properties of pressure by experimenting. Communicate ideas and findings on the properties of pressure.	Appreciate the use of pressure in daily life Respect the views of their classmates

Lesson Title: Pressure in solids — Lesson No. 50

Benchmark: 7.2.3.2. Examine the pressure applied in solid, liquid, and gas.

Key question: How can we identify high and low pressure in solids?

Lesson objective: By the end of the lesson, the students will be able to;
- describe the pressure when a solid comes in contact with a solid.

Knowledge	Skills	Attitudes
The pressure of a solid exerted on another solid surface is its weight in newtons divided by its area in square metres Pressure = force (f) / area (a) To increase pressure- increase the force or reduce the area the force acts on. To reduce pressure - decrease the force or increase the area the force acts on.	Making hypothesis on the high and low pressure in solids. Investigate high pressure and low pressure in solids by experimenting. Measure the pressure by Use the formulae (P = f x a). Communicate ideas and findings.	Appreciate the use of pressure in daily life Apply the understanding of increasing and reducing pressure in daily life

Lesson Title: Pressure in liquids — Lesson No. 51

Benchmark: 7.2.3.2. Examine the pressure applied in solid, liquid, and gas.

Key question: Which part contains the high pressure and which part has low pressure.

Lesson objective: By the end of the lesson, the students will be able to;
- investigate the behaviour of pressure in liquids by experimenting.

Knowledge	Skills	Attitudes
The pressure in liquids increases with depth Pressure in liquids acts equally in all direction Pressure in liquids does not depend on the area of its surface The pressure at two points at the same level in the same liquid are equal Pressure does not depend on the shape or size of the container More dense liquids exert more pressure The pressure in a liquid is affected by the force of gravity	Making hypothesis on the pressure in liquids. Investigate the high and low in liquids by experimenting. Infer on how pressure can be increased or decreased. Communicate ideas and findings on the high and low pressure in liquids.	Appreciate the use of pressure in daily life Apply the understanding of increasing and reducing pressure in daily life Respect views of classmates

Lesson Title: Pressure in gas Lesson No. 52

Benchmark: 7.2.3.2. Examine the pressure applied in solid, liquid, and gas.

Key question: How can we identify low and high pressure in gas?

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

- investigate how air behaves when pressure is exerted by experimenting.

Knowledge	Skills	Attitudes
The pressure of air is the force that air exerts on objects. The weight of air is called the air pressure Pressure in air acts equally in all direction The pressure in gas decreases as you go higher the altitude	Making hypothesis on the pressure in gas. Investigate the high and low in gas by experimenting. Infer on how pressure can be increased or decreased. Communicate ideas and findings on the high and low pressure in liquids.	Appreciate the use of pressure in daily life Apply the understanding of increasing and reducing pressure in daily life Respect views of classmates

Lesson Title: Calculating pressure Lesson No. 53

Benchmark: 7.2.3.3. Use the formula to calculate pressure. (Pressure = Force/Area)

Key question: How can we measure pressure?

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

- measure the pressure by using the formula.

Knowledge	Skills	Attitudes

Manometers and barometers are used to measure pressure The standard unit of pressure is the Pascal (Pa) One Pascal equals one newton per square meter. (N/m2)	Making hypothesis on how to measure pressure. Measure the pressure of solids, liquids and gases by using the formula. Communicate ideas and findings on how to measure pressure.	Appreciate the use of pressure in daily life Develop an attitude to calculate and express pressure in measurements Respect views of classmates

Lesson Title: Uses of pressure in daily life Lesson No. 54

Benchmark: 7.2.3.4. Evaluate the different uses of pressure.

Key question: How is pressure used in our daily life?

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

- identify uses of pressure in daily life.

Knowledge	Skills	Attitudes
Application of pressure in daily life: **High Pressure** • Hammering a nail. • Cutting vegetables. • Cutting a tree with an axe. • Wearing high-heeled shoes. **Low Pressure** • Wearing flat shoes • Snow shoes reduce pressure between weight and ice • Tankers and caterpillars (machinery) do not use tyres because of their weight.	Making hypothesis on the different uses of pressure in daily life. Identify different applications of pressure in daily life. Comparing the amount of pressure applied by various daily activities. Communicating ideas and findings on the applications of pressure in daily life.	Appreciate the use of pressure in daily life Develop the sense of applying the knowledge of pressure in their daily activities Respect views of classmates

Topic Review On Pressure Lesson 55

Strand: Physical Science	Unit: Force And Motion	Topic: Density

Content Standard: 7.2.4. Students will be able to investigate the density of different matter.

Lesson Title: Characteristics of density — Lesson No. 56

Benchmark: 7.2.4.1. Investigate and describe the characteristics of density.

Key question: What are the characteristics of density?

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

- understand that density is a characteristics property of a substance.

Knowledge	Skills	Attitudes
Density is a characteristic property of a substance. The density of a substance is the relationship between the mass of the substance and how much space it takes up (volume). The mass of atoms, their size, and how they are arranged determine the density of a substance. Density equals the mass of the substance divided by its volume; D = m/v. Objects with the same volume but different mass have different densities.	Making predictions on the characteristics of density. Infer on the characteristics of density. Communicate ideas and findings on the characteristics of density using verbal, written and pictorial.	Develop curiosity to know about the function of convex lens. Show open-mindedness when learning about function of convex lens. Respect views of others.

Lesson Title: Comparing density of matter — Lesson No. 57

Benchmark: 7.2.4.2. Compare and contrast the density of different matter.

Key question: How do we compare density of different matter?

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

- compare density of different matter using their properties.

Knowledge	Skills	Attitudes
The density of a quantity of matter is its mass divided by its volume. It is usually measured at 0 °C and at 1 atmosphere of pressure. Density is important in determining the bouyancy of materials in fliuds, as well as in comparing materials and in other measurements.	Make predictions to compare density of different matter. Infer on how compare density of different matter. Compare density of different matter using their properties. Communicate ideas and findings on comparing matter using verbal, written and pictorial.	Develop curiosity to know more about the comparing density. Show open-mindedness when learning about comparing density. Respect views of others.

Lesson Title: Calculating density Lesson No. 58

Benchmark: 7.2.4.3. Use the formula to calculate the density. DENSITY = Mass/Volume

Key question: How can we calculate density?

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

- calculate the density of different matter.

Knowledge		Attitudes
Density is the measurement of the amount of mass per unit of volume. In order to calculate density, you need to know the mass and volume of the item. Density is how much matter is contained within a volume. A dense object weighs more than a less dense object that is the same size. An object less dense than water will float on it; one with greater density will sink. The density equation is density equals mass per unit volume or D = M / V. The standard unit of density is kg/m3. However, they can also be in g/cm3, as well as kg/L and lb/ft3. Gases are usually stated in kg/m3, while liquids and solids are stated in g/cm3.	Make predictions on how to calculate density. Use the equation to calculate the density of different matter. Compare measurements of density of different matter. Communicate ideas and findings on calculating density using verbal and written.	Develop curiosity to know more about calculating density. Show open-mindedness when learning about calculating density. Respect views of others.

Lesson Title: Uses of density Lesson No. 59

Benchmark: 7.2.4.4. Appraise the uses of density.

Key question: How do we use density in everyday life?

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

- identify the use and importance of density.

Knowledge		Attitudes

One of the most common uses of density is in how different materials interact when mixed together. Wood floats in water because it has a lower density, while an anchor sinks because the metal has a higher density. Helium balloons float because the density of the helium is lower than the density of the air. One well-known application of density is determining whether or not an object will float on water. If the object's density is less than the density of water, it will float; if its density is less than that of water, it will sink. Ships can float because they have ballast tanks that hold air; these tanks provide large volumes of little mass, thus decreasing the density of the ship. Together with the buoyant force that the water exerts on the ship, this reduced density enables the ship to float. In fact, submarines dive below the surface of the water by emptying their ballast tanks.	Make predictions on the uses of density in everyday life. Infer on the uses of density in everyday life. Compare uses of density in different situations. Communicate ideas and findings on uses of density using verbal, written and pictorial.	Develop curiosity to know more about the uses of density. Show open-mindedness when learning about the uses of density. Respect views of others.
Topic Review On Density		**Lesson 60**
Unit Review On Physical Science		**Lesson 61**

Strand: Earth And Space	Unit: Our Earth	Topic: Natural Resources

Content Standard: 7.3.2. Students will be able to investigate the different natural resources in Papua New Guinea

Lesson Title: Types of natural resources — Lesson No. 62

Benchmark: 7.3.2.1. Identify and classify the different types of natural resources into renewable and non-renewable resources.

Key question: What are the different types of natural resources?

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

- classify the different types of natural resources as renewable and non-renewable resources.

Knowledge	Skills	Attitudes
There are two different types of natural resources. They are called non-renewable resources and renewable resources. Non-renewable resources are not easily replaced. Non-renewable resources include oil, natural gas, and coal, which are examples of fossil fuels. Resources that are easily replaced or that can be used over and over again are called renewable resources. Farm crops, animals, trees, oxygen and fresh water are examples of renewable resources.	Making predictions on different types of natural resources. Infer on the different types of natural resources. Compare different types of natural resources. Classify types of natural resources as renewable and non-renewable resources. Communicate ideas and findings on the types of natural resources using verbal, written and pictorial.	Appreciate and value the different types of natural resources.

Lesson Title: Importance and uses of Natural Resources — Lesson No. 63

Benchmark: 7.3.2.2. Examine the importance and uses of natural resources for humans and other living things.

Key question: Why are natural resources important and how are they useful?

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

- explain the importance and state the usefulness of natural resources.

Knowledge	Skills	Attitudes

Humans use the natural resources to build houses, grow crops, and raise livestock.	Making predictions on why natural resources are important and how useful they are in people's lives. Infer on the importance and usefulness of the natural resources. Compare the importance and uses of different natural resources. Communicate ideas and findings on the importance of natural resources using verbal, written and pictorial.	Develop curiosity to know more about the importance and uses of natural resources. Show open-mindedness when learning about the importance and uses of natural resources. Respect views of others.

Lesson Title: Conservation of natural resources Lesson No. 64

Benchmark: 7.3.2.3. Use basic research skills to investigate how natural resources are conserved and suggest ways to make improvements.

Key question: How do we conserve natural resources?

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

- propose ways to conserve the natural resources.

Knowledge	Skills	Attitudes
Forest should be selectively logged so that only		

Topic Review On Natural Resources	**Lesson 65**
Unit Review On Our Earth	**Lesson 66**

Strand: Physical Science	Unit: Matter	Topic: Properties Of Solutions
Content Standard: 7.2.5. Students will be able to investigate the properties and functions of solutions.		

Lesson Title: Solute, solvent and solution Lesson No. 67

Benchmark: 7.2.5.1. Examine the terms solute, solvent and solution.

Key question: What is the difference between solute, solvent and solution?

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

- distinguish the difference between a solution and suspension.

Knowledge	Skills	Attitudes
A solute is a substance that dissolves materials to form a solution. A solvent is a substance that dissolves materials to form a solution. A solution is a mixture of two or more components that form a homogenous mixture. The component referred to the solute and/or solutes and solvent and/ or solvents.	Making predictions on the terms solute, solvent and solution. Compare the difference between solute, solvent and solution. Communicate ideas and findings on solute, solvent and solution using verbal and written.	Show open-mindedness when learning about the solute, solvent and solution. Respect views of others.

Lesson Title: Types of solutions Lesson No. 68

Benchmark: 7.2.5.2. Investigate different types of solutions such as solid to liquid; liquid to liquid; and liquid to gas.

Key question: What are the different types of solutions?

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

- identify the different types of solutions such as solid to liquid, liquid to liquid and liquid to gas.

Knowledge	Skills	Attitudes

Solutions exist in all states of matter. Types of solutions: 1. Gas in gas (for example, air) - Solvent – nitrogen; Solute – oxygen 2. Gas in liquid (for example, soda) - Solvent – water; Solute – Carbon Dioxide 3. Liquid in liquid (for example, vinegar) - Solvent – water; Solute – Ethylene gycol 4. Solid in liquid (for example, ocean water) - Solvent – water; Solute – Sodium Chloride 5. Solid in solid (for example, air) - Solvent – iron; solute - carbon	Make predictions on the different types of solutions. Infer on the different types of solutions. Compare the different types of solutions. Communicate ideas and findings on the types of solutions using verbal and written.	Develop curiosity to know more about the types of solutions. Show open-mindedness when learning about types of solutions. Respect views of others.

Lesson Title: Solute in a solution - Carbon dioxide Lesson No. 69

Benchmark: 7.2.5.3. Explain solute in a solution such as carbon dioxide (CO_2).

Key question: Can carbon dioxide be a solute in a liquid solution?

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

- Explain how carbon dioxide can be a solute in liquid solution such soda water and soft drinks.

Knowledge	Skills	Attitudes
Most solutions are made of solids dissolved in liquids. Solutes, solvents, and solutions can be gases, liquids and solids. Most liquid solutions are obtained by dissolving a gas, liquid, or solid in some liquid. Soda water, for example, consists of a solution of carbon dioxide gas in water.	Making predictions if carbon dioxide can be a solute in a liquid solution. Infer on carbon dioxide as a solute in a liquid solution. Communicate ideas and findings on carbon dioxide as a solute in solution using verbal and written.	Develop curiosity to know more about gas in a liquid solution. Show open-mindedness when learning about gas in a liquid solution. Respect views of others.

Lesson Title: Functions of solution – hydrochloric acid Lesson No. 70

Benchmark: 7.2.5.4. Investigate the functions of solution such as hydrochloric acid in terms of changing the property of metal.

Key question: What are the effects of hydrochloric acid on metals?

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

- describe the effects of hydrochloric acid on metals.

Knowledge	Skills	Attitudes

Hydrochloric acid (HCl) is a clear colorless liquid that is highly corrosive, and considered a strong mineral acid. The main applications of HCl are for pickling steel, acid treatment for oil wells, chemical cleaning, and chemical processing for large scale production of vinyl chloride. HCl is a strong reducing acid, which makes it highly corrosive when in contact with most materials. HCl is monoprotic, which means it has a high level of dissociation in water, this creates an overabundance of H+ ions in solution. The overabundance of H+ ions means it has a very low pH level of 0-1. This indicates that it is a highly corrosive substance, and only a few materials are resistant. Metals such as aluminum, cast iron, steel, copper, and titanium will suffer rapid attack from HCl at all concentrations and temperatures. Most stainless steel grades will be subject to attack, because their chromium content is not sufficient in forming a protective passive layer. Without the passive layer the stainless steel will then begin to corrode actively, which leads to rapid corrosion rates, pitting, and stress corrosion cracking.	Making prediction on the effects of hydrochloric acid on metals. Infer on the effects of hydrochloric acid on metals. Communicate ideas and findings on the effects of hydrochloric acid on metals using verbal and written and pictorial.	Develop curiosity to know more about the effect of hydrochloric acid. Show open-mindedness when learning about effects of hydrochloric acid. Respect views of others.

Lesson Title: Acid Solutions Lesson No. 71

Benchmark: 7.2.5.5. Distinguish the properties of Acid, Alkaline and Neutral solutions.

Key question: How can you describe an acidic solution?

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

- Identify various acidic solutions.

Knowledge	Skills	Attitudes
Acidic solutions are any solutions that have a higher concentration of hydrogen ions than water Acids may be solids, liquid or gases Acids contain the element hydrogen Foods contains weak acids Most acids used in laboratories are strong acids and can be corrosive Acidic solutions are any solutions that have a higher concentration of hydrogen ions than water An acid solution that does not contain very much water in it is said to be concentrated solution and watered down acid solution is diluted solution Litmus paper in acid will turn RED if placed in a solution	Identify food that contain weak acids- citrus fruits Identify three common acids that are used in laboratories and state the uses. Differentiate between concentrated acidic solutions and diluted acidic solutions Use the universal indicator to find out if the solution is acidic or not	Appreciate the importance acids play in foods Take extra care when handling acids as strong acids are corrosive

Lesson Title: Alkaline Solution Lesson No. 72

Benchmark: 7.2.5.5. Distinguish the properties of Acid, Alkaline and Neutral solutions.

Key question: What is an alkaline solution?

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

- describe alkaline solution as a mixture of base solids dissolved in water.
- give examples of alkalis in daily life.

Knowledge	Skills	Attitudes
alkaline solution is a mixture of base solids dissolved in water. Bases that are soluble in water are known as alkalis Alkali does not react with metals An alkaline solution is a mixture of base solids dissolved in water. An alkaline solution contains more hydroxide ions than the hydrogen Litmus paper in bases will turn blue.	Describe common uses of alkalis in daily life Practice using litmus paper to find if solution is an alkaline	Appreciate the uses of alkalis in our daily life Take extra care when handling bases

Lesson Title: Neutral Solution Lesson No. 73

Benchmark: 7.2.5.5. Distinguish the properties of Acid, Alkaline and Neutral solutions.

Key question: How can you describe a neutral solution?

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

- describe neutral solution.

Knowledge	Skills	Attitudes
When acids and bases react together they combine to form a salt and water. This is known as neutralisation An acidic solution becomes less acidic when a base is added. This is called neutralising the acid. A basic solution becomes less basic when an acid is added. This is called neutralizing the base. Litmus paper turns green in a neutral solution on a scale of pH7	Investigate an acidic solution if a base is added to an acidic solution Investigate the effect of neutral solution on a litmus indicator	Show curiosity to learn how to neutralise acids and bases. Develop a willingness to learn about neutralizing acidic and basic solutions.

Lesson Title: Indicators Lesson No. 74

Benchmark: 7.2.5.5. Distinguish the properties of Acid, Alkaline and Neutral solutions.

Key question: Is it an acid or base?

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

- identify several indicators that are used to test acids and bases.

Knowledge	Skills	Attitudes
Indicators are chemical dyes that are one colour in acidic solutions but change to a different colour in a basic solution. Indicators commonly used in the laboratory are litmus, phenolphthalein, methyl orange and bromothymol blue. A universal indicator is a mixture of many indicators and shows by its colour change how acidic or basic substances are. Describe acidity, neutrality and alkalinity in terms of the pH scale as whole numbers.	Investigate the effect of acidic, alkaline and neutral solutions on indicators (Universal and litmus indicators Use the pH scale to identify acids or bases Compare the colour of indicators against the universal scale for acidity and basic	Show curiosity to learn about how universal indicator can be used to determine pH value of a solution

Lesson Title: Solubility Lesson No. 75

Benchmark: 7.2.5.5. Distinguish the properties of Acid, Alkaline and Neutral solutions.

Key question: What is solubility?

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

- explain solubility and the relationship between solubility and temperature.

Knowledge	Skills	Attitudes
Solubility is the amount of solute that can dissolve in water. The solubility of most substances can be increased by shaking, stirring or increasing the temperature of the solvent. There is a limit in the number solids that can dissolve in a given volume.	Apply appropriate techniques to increase the solubility of substances Draw graphs to show the relationship between temperature and solubility rate	Show curiosity to learn about the solubility of substances.

Lesson Title: Concentration of solution Lesson No. 76

Benchmark: 7.2.5.6. Compare concentration of solutions and methods of separating them.

Key question: How can we identify saturated, unsaturated and diluted solutions based on the solute concentration?

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

- Compare the different types of solutions based on the solute concentration.

Knowledge	Skills	Attitudes
Types of solutions according to solute concentration. **Saturated solution:** Solution contains maximum amount of solute at a given temperature. **Unsaturated solution:** Solution contains less than the maximum quantity of solute, or if the solution is not saturated. **Dilute solution:** Quantity of solute is very less in solution.	Making hypothesis on how to identify saturated, unsaturated and diluted solutions based on the solute concentration. Infer on the saturated, unsaturated and diluted solutions using the solute concentration. Conduct experiment to identify three solutions using the solute concentration. Compare the three solutions based on their solute concentration. Communicate ideas and findings using verbal and written.	Develop curiosity to know more about the types of solutions. Show open-mindedness when learning about comparing types of solutions. Respect views of others.

Lesson Title: Separating solutions Lesson No. 77

Benchmark: 7.2.5.6. Compare concentration of solutions and methods of separating them.

Key question: How do we separate the concentrated solutions?

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

- Use different methods to separate concentrated solutions such as evaporation and crystallisation.

Knowledge	Skills	Attitudes
Evaporation is a process in which a liquid changes into gaseous form on heating, allowing the liquid to evaporate, leaving soluble behind. Crystallisation is method used to obtain pure crystals from a solution. It is done by heating the solution in an evaporating dish until it is saturated. The hot solution is then allowed to cool. Crystal will be formed on cooling. They are dried between the sheets of filter paper.	Making hypothesis on how to separate concentrated solutions. Conduct experiment using evaporation and crystallisation process to separated solutions. Infer on how to separate solutions. Compare evaporation and crystallisation process of separating solutions. Communicate ideas and findings on separating solutions using verbal, written and pictorial.	Develop curiosity to know more about the separating solutions using evaporation and crystallisation methods. Show open-mindedness when learning about separating soltions. Respect views of others.

Topic Review On Properties Of Solutions Lesson 78

Strand: Earth And Space	Unit: Weather And Climate	Topic: Weather Changes

Content Standard: 7.3.3. Students will be able to explore the earth's atmosphere, types of clouds, and the weather patterns in Papua New Guinea.

Lesson Title: Layers of atmosphere — Lesson No. 80

Benchmark: 7.3.3.1. Investigate the composition of the Earth's atmosphere and the properties of its layers.

Key question: What are the different layers of the Earth's atmosphere?

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

- describe the different layers of the Earth's atmosphere.

Earth's atmosphere can be divided into four distinct layers. 1. The layer closest to the Earth, where almost weather occurs, is the troposphere. 2. The stratosphere lies above the troposphere. Air in this layer is much colder and drier than air in the troposphere. It contains the ozone layer. 3. The mesosphere lies above the stratosphere. The top of the mesosphere is the coldest part of Earth's atmosphere. 4. The thermosphere contains a very low density of gas molecules. Therefore, the absorption of a small amount of energy causes a large increase in temperature. The thermosphere extends to an altitude of about 600km.	Making prediction on the different layers of the Earth's atmosphere. Infer on the different layers of the Earth's atmosphere. Compare the different layers of the Earth's atmosphere. Analayse the different layers of the Earth's atmosphere. Communicating ideas and findings on the different layers of the Earth's atmosphere using verbal, written and pictorial.	Develop curiosity to know more about the different layers of the Earth's atmosphere. Show open-mindedness when learning about the different layers of the Earth's atmosphere. Respect views of others.

Lesson Title: Types of air pressure 1: Low Pressure — Lesson No. 81

Benchmark: 7.3.3.2. Examine the types of air pressure such as low and high pressure.

Key question: What causes low pressure in the atmosphere?

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

- describe the causes of low pressure in the atmosphere.

Knowledge	Skills	Attitudes
Low pressure is caused by the less dense warmer air rising. High-pressure areas and low-pressure areas result from the way Earth's surf ace is heated by the Sun. Low pressure circulate counter clockwise Lower counter clockwise circulation forces air upwards resulting in condensation, cloud formation and precipitation	Making predictions on the causes of low pressure in the atmosphere. Infer the causes of low pressure in the atmosphere. Communicate ideas and findings on the causes of low pressure in the atmosphere.	Show open mindedness and curiosity to learn about low pressure

Lesson Title: Types of air pressure - High pressure Lesson No. 82

Benchmark: 7.3.3.2. Examine the types of air pressure such as low and high pressure.

Key question: What causes high pressure in the atmosphere?

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

- describe the cause of high pressure in the atmosphere.

Knowledge	Skills	Attitudes
High pressure is caused by the much denser cold air which sinks High-pressure areas and low-pressure areas result from the way Earth's surf ace is heated by the Sun. Higher pressure circulate clockwise High clockwise circulation causes a sinking motion in the atmosphere resulting in fair/clear and often sunnier skies	Making hypothesis on the causes of high pressure in the atmosphere. Identify the causes of high pressure. Infer the causes of high pressure in the atmosphere. Communicate ideas and findings on the causes of high pressure in the atmosphere.	Show open mindedness and curiosity to learn about high pressure.

Lesson Title: Atmospheric movements Lesson No.83

Benchmark: 7.3.3.3. Analyse atmospheric movements and the effects on oceans.

Key question: How can atmospheric movements affect the ocean?

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

- describe the movement of air in the atmosphere and the effect it has on the ocean.

Knowledge	Skills	Attitudes
Air rises or sinks because of its density. Warm air is less dense than cold air, so it rises. Cold air is denser than warm air, so it sinks. The rising and sinking of air creates a loop of moving air called convection current. Convection currents or movements of air, occur on a large scale as well as on local scale The uneven heating results in low air pressure at the equator and high pressure at the poles. Therefore the air tends to move from poles to the equator.	Making hypothesis on how atmospheric movement affect the ocean. Draw pictures or model the movement of air in the atmosphere. Infer on movement of air in the atmosphere. Communicate ideas and findings on the movement of air and effect it has on the ocean.	Show curiosity to learn about atmospheric movements and its effect on the ocean.

Lesson Title: Greenhouse effects Lesson No.84

Benchmark: 7.3.3.4. Investigate the effects of Greenhouse gas in relation to global warming and change in weather patterns.

Key question: How do greenhouse gases increase the temperature of the atmosphere?

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

- explain effects of the greenhouse gas in the atmosphere.

Knowledge	Skills	Attitudes
The Earth's atmosphere acts as a glass panel of a green house. Gases in the atmosphere allow radiation from the Sun to pass through and warm the surface. Earth's surface radiates that energy back into the air The greenhouse effect is the process by which heat from the Sun builds up near Earth's surface and is trapped there by the atmosphere. The greenhouse effect depends on certain gases called green-house gases. These gases include water vapour, methane, nitrous oxide, and especially carbon dioxide The greater these gases amount, the warmer the atmosphere becomes Energy from the Sun stays in the atmosphere longer before eventually escaping	Making hypothesis on effects of greenhouse gas. Infer the effects of greenhouse gas in the atmosphere.	Show curiosity in learning about greenhouse Value the importance of atmosphere Be responsible

Lesson Title: Types of clouds Lesson No.85

Benchmark: 7.3.3.5. Examine the types of clouds and their formation.

Key question: What are the four main types of clouds?

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

- identify the four main types of clouds.

Knowledge	Skills	Attitudes

A cloud is classified by its appearance and altitude The prefix Nimbo refers to rain, stratus indicates layers and cumulo or cumulus indicates a cloud that forms vertically There are four different types of clouds; 1. Stratus clouds are low level-clouds that form in layers. Stratus clouds usually bring steady rain.it may cover large parts of the sky 2. Cumulus clouds are fluffy and have flat bases. They form low in the sky. They usually mean fair weather. 3. Cirrus clouds are thin, feathery clouds made of ice crystals. They form high in the sky. Cirrus clouds indicate fair weather. 4. Cumulonimbus clouds bring heavy rain or thunderstorms. They may extend up through the troposphere	Making hypothesis on the four main types of clouds. Infer the four main types of clouds. Communicating ideas and findings on the four main types of clouds. Describing and comparing the different types of clouds	Show curiosity to learn about the different clouds and how they get their names.
Lesson Title: Weather and clouds Benchmark: 7.3.3.6. Explain the relationship between weather and clouds. Key question: What is the relationship between weather and clouds? Lesson objective: By the end of the lesson, the students should be able to; • explain how changes in the air causes weather.		Lesson No.86
Knowledge	**Skills**	**Attitudes**

Major changes in weather come from the movement of air masses An air mass is a body of air that can cover thousands of square kilometres. The leading edge of an air mass, a front, has clouds and precipitation. A front is named for the type of air mass, cold or warm, that is moving into an area. A cold front often brings stormy weather. At its edge, dense cold air pushes warm air out. The warm air cools as it rises. If the warm air is moist, water vapour will condense and cumulus clouds will form. If the warm air rises quickly, severe thunderstorm will be the result. Usually cold front moves quickly. After it passes, the weather is cooler and drier. A warm front often brings light, steady precipitation. Along its edge, warm air mass moves over retreating cold air. This forms stratus clouds and light rain or snow. A warm front moves slowly than a cold front. After a warm front passes, the weather is warmer. A long a stationary front, a warm air mass meets a cold air mass, but neither is moving. The weather on the either side of the front is unlikely to change much until the front begins moving again.	Making predictions on the relationship between weather and clouds. Infer on the relationship between weather and clouds. Communicate ideas and findings about the relationship between weather and clouds using verbal, written and pictorial.	Show curiosity to learn about the relationship between weather and clouds. Show open-mindedness when learning about the relationship between weather and clouds. Respect views of others.

Lesson Title: Water cycle on Earth — Lesson No. 87

Benchmark: 7.3.3.6. Explain the relationship between weather and clouds.

Key question: How does water from the earth's surface move the Earth's atmosphere back to surface?

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

- explain the process of water cycle on Earth.

Knowledge	Skills	Attitudes
The water cycle is the continuous movement of water from Earth's surface to Earth's atmosphere and back to the surface. Energy from the sun causes water in the oceans and on land to heat up. When this happens water evaporates and changes from the liquid state to the gas state. Water vapour in the atmosphere can condense into tiny droplets of water and form clouds. When the droplets become heavy enough, they fall to the Earth as rain, sleet, hail or snow	Making hypothesis on the process of water cycle on Earth. Infer on the process of water cycle. Compare the different states involved in the process of water cycle. Communicate ideas and findings on the process of water cycle on Earth using verbal, written and pictorial.	Show curiosity to learn about the process of water cycle on Earth. Show open-mindedness when learning about the process of water cycle on Earth. Respect views of others.

Lesson Title: Characteristics of weather in Papua New Guinea — Lesson No. 88

Benchmark: 7.3.3.6. Explain the relationship between weather and clouds.

Key question: What are some characteristics of weather in PNG?

Lesson objective: By the end of the lesson, the students should be able to;
- describe the characteristics of weather in PNG.

Knowledge	Skills	Attitudes
Papua New Guinea has a climate characterized by high temperatures and humidity throughout the year. The North West Monsoon season is from December to March while the South West Monsoon season is from May to October. Rainfall is at its heaviest in the highlands with average annual precipitation varying between 2,000 and 5,000 mm (79 to 197 inches). Average monthly temperature ranges in for example Port Moresby from 26 degrees Celsius (79 degrees Fahrenheit) to 28 degrees Celsius (82 degrees Fahrenheit) throughout the year	Making prediction of the characteristics of weather in PNG. Infer on the characteristics of weather in PNG. Compare characteristics of weather in the highlands and coasts of PNG. Communicate ideas and findings on weather in PNG using verbal, written and pictorial.	Show curiosity to learn about thecharacteristics of weather in PNG. Show open-mindedness when learning about weather of PNG. Respect views of others.

Lesson Title: Weather patterns in Papua New Guinea — Lesson No. 89

Benchmark: 7.3.3.7. Evaluate the characteristics of weather and weather patterns in Papua New Guinea.

Key question: What is the weather pattern like in Papua New Guinea?

Lesson objective: By the end of the lesson, the students should be able to;
- identify the weather patterns of Papua New Guinea.

Knowledge	Skills	Attitudes
It is colder in the highlands than on the coast because the air temperature decreases with altitude The mountain regions play an important part in the weather experienced The height and the direction of the mountain ranges have an effect on the winds	Making predictions on the weather pattern of Papua New Guinea. Infer on the weather pattern of Papua New Guinea. Communicate ideas and findings on weather patterns of Papua New Guinea.	Show curiosity to learn about the weather patterns in Papua New Guinea. Respect views of others.

Topic Review On Weather Changes	**Lesson 90**
Unit Review On Weather And Climate	**Lesson 91**

Strand: Life	Unit: Interaction And Relationship In The Environment	Topic: Living Together

Content Standard: 7.1.4. Students will be able to explain the relationship between living things and their environments.

Lesson Title: Living and non-living in the ecosystem — Lesson No. 93

Benchmark: 7.1.4.2. Examine the relationships of living and non-living organisms in an ecosystem.

Key question: What is the relationship between the living and non-living organism in the ecosystem?

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

- explain the relationship between the living and non-living organisms in the ecosystem.

Knowledge	Skills	Attitudes
The two most important things to emphasize about an ecosystem are that all the members (living and non-living) are connected and that changes in one habitat or organism cause changes in another. Some relationships between members are direct and obvious. Other relationships are not so obvious. All living (biotic) and nonliving (abiotic) parts of an environment as well as the interaction among them. Interactions may include; Producers (obtain energy by making their own food; plants-photosynthesis) Consumers (obtain energy by consuming their food) Decomposers (get energy by breaking down dead organisms and the wastes of everything); bacteria, fungi (mold, muschrooms, etc), worms, termites, etc	Making predictions on the relationship between living and non-living in the ecosystem. Infer on the relationship between living and non-living in the ecosystem. Communicated ideas and findings on the relationship between living and nonliving in the ecosystem using verbal, written and pictorial.	Show curiosity to learn about the relationship between living and nonliving in the ecosystem. Show open-mindedness when learning about the relationship between living and nonliving in the ecosystem. Respect views of others.

Lesson Title: Roles of organisms in the ecosystem — Lesson No. 94

Benchmark: 7.1.4.3. Evaluate the roles of organisms in the ecosystem.

Key question: What are roles of organisms in the ecosystem?

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

- state the roles of the producers and consumers in an ecosystem.

Knowledge	Skills	Attitudes

Many interactions between living things are the result of the need for living things to feed. All living things must have a source of food. Food is made by organisms called producers. All green plants are producers. Plants do not eat food. Plants make their own food through the process of photosynthesis. Plants take in carbon dioxide and water from their environment, producing a sugar called glucose. This glucose serves as food for the plant. Consumers are organisms that eat to obtain food needed for energy production and can be classified by the kinds of organisms they eat. Consumers consume the food made by the producers Herbivores are animals that eat plants for food Carnivores are animals that eat other animals for food Omnivores are animals that eat both plants and animals -Predators eat prey	Describing the roles of producers and consumers Classify consumers by the kind of organisms they eat Conclude that many interactions between living things are the result of the need for living things to feed	Appreciate learning about the roles of organisms in the ecosystem

Lesson Title: Causes of Population change Lesson No. 95

Benchmark: 7.1.4.4. Analyse possible causes and effects of population change of organisms in an ecosystem such as competing for resources; water, food and space.

Key question: What are some factors that cause population to change in the ecosystem?

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

- Identify factors that cause population to change of organisms in the ecosystem.

Knowledge	Skills	Attitudes
Population change of organisms in an ecosystem such as competing for resources; water, food and space.	Identify different types of plant and animal population in a given habitat. Use graph to show the relationships between two animals in a an ecosystem Justify why the population of an organism is more than the other in a particular area.	Show concern by being respectful towards the environment and the organisms living in it.

Lesson Title: Effects of population change Lesson No. 96

Benchmark: Analyse possible causes and effects of population change of organisms in an ecosystem such as competing for resources; water, food and space.

Key question: What would happen if there is a population change of organisms in the ecosystem?

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

- explain the effects of population change of organisms in the ecosystem.

Knowledge	Skills	Attitudes
Population numbers depend on resources, prey-predator relationships, diseases, and competition. In any population, growth is limited by factors such as competition, predation, water and disease. If the population in the areas exceeds that number, many animals won't get enough to drink. To survive, they must find water elsewhere. The water available to animals at this watering hole is a limiting factor in the ecosystem. A limiting factor is something that restricts the growth and distribution of a population. Limiting factors include resources such as food, water and space. They can also involve competition, predation, disease, invasive species, and human activities.	Making predictions on the effects of population change of organisms in the ecosystem. Infer on the effects of populating change of organisms in the ecosystem. Communicate ideas and findings on the effects of populating change in the ecosystem using verbal, written and pictorial.	Show curiosity to learn about the effect of population change in the ecosystem. Show open-mindedness when learning about effects of population change in the ecosystem. Respect views of others.

Lesson Title: Types of communities in the ecosystem Lesson No. 97

Benchmark: 7.1.4.5. Investigate and profile different types of communities in the environment such as ponds, oceans, and soil.

Key question: What are the different types of communities in the ecosystem?

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

- Identify the different types of communities in the ecosystem.

Knowledge	Skills	Attitudes

Biological community is a group of interacting populations (different species) living together in the same area at the same time. There are types of communities that live in the ecosystem such as pond, ocean, soil, river, rainforest, grassland and etc.	Making predictions on the different types of communities in the ecosystem. Infer on the different types of communities in the ecosystem. Compare different types of communities in the ecosystem. Communicated ideas and findings on types of communities in the ecosystem using verbal, written and pictorial.	Show curiosity to learn about the types of communities in the ecosystem. Show open-mindedness when learning about the types of communities in the ecosystem. Respect views of others.
Topic Review On Living Together		**Lesson 98**
Unit Review On Interaction And Relationship In The Environment		**Lesson 99**

Strand: Physical Science	Unit: Matter	Topic: Elements, Atoms And Compounds
Content Standard: 7.2.6. Students will be able to explain the composition of matter in terms of atoms, molecules, elements and compounds.		

Lesson Title: Characteristics of atoms — Lesson No. 100

Benchmark: 7.2.6.1. Examine the characteristics of atoms and elements.

Key question: What is an atom made of?

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

- identify the characteristics of an atom.

Knowledge	Skills	Attitudes
The protons have a positive charge and the neutrons have no charge. The electrons have a negative charge and are much smaller than the protons and neutrons The protons and neutrons are closely packed in the centre of the atom called the nucleus. The electrons move rapidly around the nucleus and are attracted by the positively charged nucleus Different atoms have different number of protons, neutrons and electrons The number of protons is the same as the number of electrons	Create models of atoms using available materials Differentiate between protons, neutrons and electron	show an awareness that technologies resulting from knowledge of the atom have created social and ethical issues, risks and costs (e.g. atomic bomb)

Lesson Title: Characteristics of elements — Lesson No. 101

Benchmark: 7.2.6.1. Examine the characteristics of atoms and elements.

Key question: What are some characteristics of elements?

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

- describe the characteristics of elements.

Knowledge	Skills	Attitudes

An element is a pure substance that cannot be broken down into simpler substances. State that elements are the basic building blocks of living and non-living matter Not many elements in nature are found on their own. There are over 100 known elements and can be classified into solid, liquid or gas An element is a pure substance that cannot be broken down into simpler substance. All elements have a Chemical symbol. Elements can be divided into two groups- metals and non-metals.	Make predictions on the characteristics of elements. Infer on the characteristics of elements. Communicate ideas and findings on characteristics of elements using verbal, written and pictorial.	Show curiosity to learn about the characteristics of elements. Show open-mindedness when learning about characteristics of elements. Respect views of others.

Lesson Title: Atoms and elements — Lesson No. 102

Benchmark: 7.2.6.2. Distinguish between atoms and elements.

Key question: What is the difference between atoms and elements?

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

- Explain the difference between atoms and elements.

Knowledge	Skills	Attitudes

Atom is the smallest particle of matter. Atoms are very small in size and cannot be seen through naked eyes. Atom does not exist in free-state in nature. But atom takes part in a chemical reaction. The properties of matter depend upon the characteristics of atoms. An element is matter that is made of only one kind of atom. All of the atoms of an element are alike. There are 92 naturally occurring elements. Elements can be identified by their properties. Some properties are colour, texture, density, malleability, ductility, ability to dissolve in water, and ability to conduct heat or electricity.	Make predictions on the difference between atoms and elements. Infer on the difference between atoms and elements. Compare the characteristics of atoms and elements. Communicate ideas and findings on atoms and elements using verbal, written and pictorial.	Show curiosity to learn about the differences between atoms and elements. Show open-mindedness when learning about the difference between atoms and elements. Respect views of others.

Lesson Title: Classifying elements Lesson No. 103

Benchmark: 7.2.6.3. Classify common elements in the periodic table into metals and non-metals.

Key question: How can we classify elements using the periodic table?

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

- classify elements in the periodic table into metals and non-metals.

Knowledge	Skills	Attitudes
A common way to of classifying elements is to put them into groups with other chemical that have similar properties. There are three large groups; Metals, non-metals, and metal-loids. The arranging of elements into different groups on the basis of the similarities in their properties is called classification of elements. The classification of similar elements into groups makes the study of elements easier. There are 114 elements known so far.	Making predictions on how to classify elements using the periodic table. Infer on the classification of elements using the periodic table. Compare the classification of three groups of elements. Communicate ideas and findings on classification of elements using verbal, written and pictorial.	Show curiosity to learn about the differences between atoms and elements. Show open-mindedness when learning about the difference between atoms and elements. Respect views of others.

Lesson Title: Characteristics of molecules in matter — Lesson No. 104

Benchmark: 7.2.6.4. Examine the characteristics of molecules with symbols.

Key question: What are the characteristics of molecule?

Lesson objective: By the end of the lesson, the students should be able to;
- understand the characteristics of molecules.

Knowledge	Skills	Attitudes
A molecule is defined as stable neutral groups of at least two atoms in a definite arrangement held together by very strong chemical bonds. It can also be defined as a unit of two or more atoms held together. For example: two hydrogen atoms bond with an oxygen atom and form a molecule of water (H_2O)	Making predictions on the characteristics of molecules. Infer on the characteristics of molecules. Draw or model molecules of water. Communicate ideas and findings on characteristics of molecules using verbal, written and models or pictorial.	Show curiosity to learn about the characteristics of molecules. Show open-mindedness when learning about characteristics of molecules. Respect views of others.

Lesson Title: Molecule of elements and their symbols — Lesson No. 105

Benchmark: 7.2.6.4. Examine the characteristics of molecules with symbols.

Key question: What are some symbols of molecules of elements?

Lesson objective: By the end of the lesson, the students should be able to;
- identify symbols of molecules of elements.

Knowledge	Skills	Attitudes
Atoms of the same element that are chemically joined together form molecules of element. Symbols and names of some elements: Hydrogen – H Oxygen – O Nitrogen – N Carbon – C Sodium – Na Magnesium – Mg Aluminium - Al Potassium – K Zinc – Zn Gold – Au Copper – Cu Silver - Ag Gold - Au Mercury - Hg	Making predictions of the symbols of molecules of elements. Infer on the symbols of molecules of elements. Communicate ideas and symbols of molecules of elements.	Show an appreciation of scientific attitudes such as creativity and open-mindedness in creating models to explain the fundamental nature of things and willingness to re-examine existing models

Lesson Title: Common compounds and their elements — Lesson No. 106

Benchmark: 7.2.6.5. Analyse the characteristics of common compounds and their elements.

Key question: What are the common compounds and their elements?

Lesson objective: By the end of the lesson, the students should be able to;
- Identify common compounds and the elements.

Knowledge	Skills	Attitudes
Some examples of common compounds and their elements. Compound / Elements Water — Hydrogen and oxygen Sodium chloride (table spoon) — Sodium and chlorine Carbon dioxide — Carbon and oxygen Calcium oxide (lime) — Calcium and oxygen Copper sulphate — Copper, sulphur and oxygen Hydrochloric acid — Hydrogen and chlorine Sugar — Carbon, hydrogen and oxygen	Investigate the different types of compounds Use available resources to draw or model the different types of compounds.	Show curiosity to learn about the compounds

Lesson Title: Examples of compounds in everyday life — Lesson No. 107

Benchmark: 7.2.6.5. Analyse the characteristics of common compounds and their elements.

Key question: What are some examples of compounds in everyday life?

Lesson objective: By the end of the lesson, the students should be able to;
- identify examples of compounds in everyday life.

Knowledge	Skills	Attitudes
Some examples of compounds in everyday life. Table salt Sugar Water Hydrogen peroxide Carbon Dioxide Baking soda	Making predictions on examples of compounds in everyday life. Infer on some examples of compounds in everyday life.	Show curiosity to learn about the compounds

Topic Review On Elements, Atoms, And Molecules	**Lesson 108**
Unit Review On Matter	**Lesson 109**

Assessment Recording and Reporting

Assessment and reporting is an integral part of the delivery of any curriculum used in the schools. In Standard Based Curriculum (SBC) assessment encourages the use of benchmarks and commended types of assessment that promote standards for a range of purposes.

Standards Based Assessment

What does standards based assessment looks like?
It is based on the academic achievement of the student;
Establishes clear guidelines for proficiency (rubrics)
Compares each student's performance to preset standards, not to the performance of other students.

Assessment

Assessment is the process of identifying, gathering and interpreting information about students' learning. It is purposely done to provide information on student's achievement and progress. It directs teachers in ongoing teaching and learning.

Effective and meaningful assessment must be maintained at all times. The content standards stated in the expected curriculum for this grade are prescribed by units and sets the basis for planning and conducting ongoing assessment.

Ongoing classroom assessment is done to:

- support student learning
- monitor student learning
- diagnose student learning needs
- evaluate teaching program and
- inform student reporting process

Teachers are encouraged to use two or more types of assessment when assessing students learning. SBC specifically promotes three types of assessment. These are assessment;

- **for** learning
- **as** learning and
- **of** learning

Types of Assessment Strategies and Methods

Teachers are encouraged to use two or more types of assessment when assessing students learning. SBC specifically promotes three types of assessment. These are assessment;

- **for** learning
- **as** learning and
- **of** learning

Assessment for **Learning**

Assessment for learning is assessment which takes place during the course of teaching. It is an on-going assessment and asks the question 'where are you in the learning of this unit?'. It is used mainly to inform teachers on how much and how well teaching and learning program has been delivered and received. It is also known as formative assessment.

This assessment type helps teachers to identify students' strength and weakness areas in the content learned. For example: In a week's teaching of the unit,' Animals' the assessment task on how different animals reproduce their young revealed that most students lack knowledge of how reptiles and birds reproduce their young. This evidence will assist teachers to plan effective remedial and re-teaching lessons to improve weakness area/s identified in students immediately.

Assessment as **and** in **Learning**

Assessment as learning means that children are involved in assessing their own work and the work of other children in the class. For example, If a teachers learning objective is to use adjectives to make a sentences more interesting a child will read out a sentence and the other will assess it. They might have to say which words are adjectives and whether they think they make the sentence interesting

Assessment of **learning**

Summative assessment is assessment that takes place at the end of a unit of study, a term, year or a program. It is used to provide information on student achievements and effectiveness of the content engaged in. This type of assessment asks the question; 'What did you learn?' For example: The class teacher may want to evaluate his or her teaching in term 1 on animal reproduction, so asks the students,' what did you learn about animal reproduction in term1? The teacher can then use the students' responses to plan for revisit and revision on particular content areas in preparation for the new content to be learned.

Teachers need to apply processes for assessment. Recording and reporting enables them to determine which content standards and benchmarks students have achieved and to report these achievements to parents in ways that make sense to them. The students' knowledge and skills are continually developing in a healthy classroom environment. It is important for teachers to be aware of and record, what the students know

and what they can do. When teachers have this information, programming can be made purposeful. It can be directed at the learning weakness and matches the student's needs.

Assessment Strategies

Assessment strategies are used to conduct or deliver the assessment tasks planned for the students. There are many options available for teachers to choose from. The few listed below are recommended for all the teachers to use to assess students. These include:

- Observations
- Portfolios
- Tests and
- Self and peer assessment

1. Observation

To observe is to look and listen carefully to a student or students to make an assessment of and about what they know, understand and can do. The teachers while listening and looking can ask questions and look at or observe how the student/s can work as a group or an individual to complete a task. The teacher should do this to gather information about students:

- Ability to work alone or in a group
- Understanding of the content of the learning task
- Way of thinking how
- Leadership behavior and
- Interaction with each other

This strategy is very suitable for peer assessing. Students can be tasked to observe a friend and later report what they saw.

2. Portfolios- Studying Work Samples

The teacher thinks about and examines work samples from students. Work samples can be written tasks on paper, small chalkboards or slates, worksheets, drawing or models. Studying work samples helps the teachers to assess;

- the students level of knowledge and understanding of the learning taking place
- students thinking skills and their ability to present their own ideas and be creative
- how much time and effort the students used to do the assigned tasks
- the skills the students used to produce the work and
- if the work meets the result of the content standard.

3. Test

Test is an assessment strategy used to assess student performances of their learning formatively or summative. Class teachers prepare these

tests with careful considerations of;

- the knowledge and skills to assess the students on
- the language level to be used
- the construction of questions – clear and precise
- the content of the intended part of the curriculum content
- how much each question is worth and
- how to award marks the questions.

4. Self and Peer Assessment

In peer assessment organized structure is partner work. Each student performs a skill and the other acts as the observer. They change places when they complete their task. The observer records the partner's performance on an agreed checklist or recording journal. The recoding of each other's performance is recorded and reported against an agreed set of criteria.

Assessment Tasks

It is important to plan assessment for the whole year using the content overview and the yearly or term plans. Assessment tasks form the basis of the assessment processes, of assessing each learner in relation to the content standards.

Assessment tasks are learning activities created from the benchmarks. These are written and specifically designed and planned before administering. This particular activity has key knowledge, skills, attitudes and values that must be achieved at the end of performing the assessable tasks.

Assessment Plan

To plan assessment tasks, teachers must decide which type of assessment methods will be used to demonstrate the achievement of the content standard. Content standards are the starting points in the process of identifying and planning assessment tasks.

Learning activities and assessment tasks must be planned before delivery. In the process of writing and planning an assessment task, the following are some points that you may consider;

- choose assessment methods suitable for the assessment task
- develop assessment criteria by breaking down the knowledge, skills, attitudes and values that the students will need to demonstrate to complete the activity successfully
- consulting Bloom's Taxonomy as per the students cognitive levels

Teachers are the best assessors of the students and must ensure that all assessment tasks are;

- clearly stated in language students can interpret
- link to the content standards
- balanced, comprehensive, reliable and fair
- engages the learner.

Best practice in Assessment

- clear understanding that the purpose of assessment is for students to develop and improve in their learning and for teachers to plan and teach effectively
- the use of diagnostic tools to determine what the students already know, understand and can do
- ongoing assessment through a variety of differentiated tasks and strategies, both formal and informal, so that sufficient evidence is gathered to make sound judgments about individual students' learning
- students being actively involved in, and having some control over, their learning
- learning goals that are explicit in that students know what they are learning, why the learning is important, what products are expected, and how they will be assessed
- assessment tasks that are differentiated through offering quality choices of ways for students to demonstrate knowledge, understanding and skills
- assessment tasks and strategies that are fair and enable all students to demonstrate their learning achievements
- the giving of specific and timely feedback, for example, through conversations between students and the teacher, written feedback, peer assessment and self-assessment
- students' work being discussed and moderated through shared concepts and language
- assessment tasks that are integrated/embedded in instruction so that they are a planned and essential part of teaching and learning
- authentic assessment tasks that align with the ways such knowledge and skills.

Assessment Tasks Overview

It is important to plan assessment for the whole year using the content overview and the yearly or term plans for the school year. Assessment tasks form the basis of the assessment process, of assessing the achievements of each individual learner in relation to the content standards.

The assessment tasks are written from the listed benchmarks stated for each content standard. This particular activity must have key knowledge skills attitudes and values that must be assessed. Teachers are the best assessors of the students and must ensure the all assessment tasks are:

- clearly stated in language students can interpret
- link to the benchmarks and content standards
- balanced, comprehensive, reliable and fair and
- engages the learner.

According to the suggested grade 6 content overview and yearly plan, a suggested yearly assessment plan for assessment tasks has been planned and placed according to the number of teaching weeks in the school year. You are given the flexibility to formulate your own assessment tasks if you are not comfortable with the suggested specific assessment tasks.

Yearly plan of suggested assessment tasks for Grade 7

Strand	Unit	Topic	Content Standard	Benchmark	Assessment Task
Life	**Unit 4:** Interaction and relationship in the environment	Living together	**7.1.4**	**7.1.4.1.** Investigate the different components of an ecosystem.	Explore an ecosystem around the school, collect data and present a report on the findings to explain the simple ecosystem
				7.1.4.4. Analyse possible causes and effects of population change of organisms in an ecosystem such as competing for resources; water, food and space.	Write a brief explanation of what will happen if the population of a habitat grows
				7.1.4.5. Investigate and profile different types of communities in the environment such as ponds, oceans, and soil.	Make a mini model of a community in an ecosystem

Earth and Space	**Unit 1:** Our Earth	Earth's structure	**7.3.1**	7.3.1.1. Examine the composition and the structure of the Earth.	Make a model of the structure of the earth and label the different layers.
				7.3.1.3. Analyse the types of geological events caused by tectonic plate movements such as earthquakes, volcanoes, and the formation of mountains.	Explain how geological events are caused as a result of tectonic plate's movement. Do a research and highlight areas in PNG that are affected by earthquake
Life	**Unit 1:** Plants	Groups of plants	**7.1.1**	**7.1.1.2.** Classify and profile different types of flowering and non-flowering plants**.**	Use the plants characteristics chart and classify them under seed plants and non-seed plants.
				7.1.1.3. Examine the reproduction process in flowering and non-flowering plants.	Draw pictures of the Reproduction process of flowering plants and write brief descriptions to accompany the Pictures
Physical Science	**Unit 1:** Energy	Light and Lens	**7.2.2**	**7.2.2.4.** Explain the mechanism of convex lens such as the eye and camera.	Describe the application of mechanism of convex lens such as eye, camera
Earth and Space	**Unit 1:** Our Earth	Natural Resources	**7.3.2**	**7.3.2.3.** Use basic research skills to investigate how natural resources are conserved and suggest ways to make improvements.	Select a natural resource and explain ways of conserving this natural resource.
Life	**Unit 2:** Animals	Groups of animals	**7.1.2**	**7.1.2.3.** Classify and profile groups of vertebrates according to their characteristics.	Outline the classification of the five different groups of vertebrates.
Life	**Unit 3:** Human Body	Digestive system	**7.1.3**	**7.1.3.2.** Examine the various organs of digestive system and their functions.	Draw and label the digestive system Explain the functions of the internal organs of the digestive system
Physical Science	Unit 2: Force and Motion	Pressure	7.2.3	**7.2.3.2.** Examine the pressure applied in solid, liquid, and gas.	Draw and use diagrams to indicate the type of pressure in solids, liquids and gas.

Physical Science	**Unit 1:** Energy	Electricity	**7.2.1**	**7.2.1.2.** Use ammeter and voltmeter to measure electric current and voltage in series and parallel circuits.	Construct a parallel circuit with one bulb and two dry cells and measure the current and voltage.
Physical Science			7.2.4		Do an experiment to identify the different types of water solutions by using the indicator to describe the colour of acid, alkaline and neutral solution.
Earth and Space	**Unit 2:** Weather and Climate	Weather change	**7.3.3**	**7.3.3.1.** Investigate the composition of the Earth's atmosphere and the properties of its layers.	Outline the importance of earth's atmosphere and identify the main gases that make up the atmosphere.
Earth and Space	**Unit 3:** Earth and Space	Earth's motion	**7.3.4**	**7.3.4.3.** Investigate the causes of seasons in relation to the tilt of the Earth and the position of the Sun.	Explain the causes of the seasons on Earth.
Physical Science	**Unit 3:** Matter	Atoms, molecules and compounds	**7.2.5**		Explain the relationship between molecules, atoms, elements, molecules and compounds.

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: LIFE **UNIT:** HUMAN BODY **TOPIC:** DIGESTIVE SYSTEM

Lesson Title: Digestive organs and its functions **Lesson No. 72**

Content Standards: 7.1.3. Students will be able to investigate the functions of nutrients and the digestive system.

Benchmark: 7.1.3.2. Examine the various organs of digestive system and their functions.

Assessment Type	Assessment Task	Assessment Criteria	Assessment Method	Recording & Reporting Method
Assignment	Construct a model of the main parts of the digestive system, state their functions and present to the class.	The students will be assessed using the following criteria: • Construct a model of the digestive system with the inclusion of mouth, oesophagus, liver, large intestine, stomach, pancreas, small intestines and rectum. • Recognise the main parts of the digestive and state their functions. • Attitude	Observation, checklist and rubrics	Students portfolio

Sample Assessment Rubrics

Proficiency or achievement levels of the benchmark.

Sample scale for the assessment criteria used in Sample Assessment – Task 2

Proficiency Levels					
Performance Criteria (quality)	**Level of Mastery (Scale)**				**Rating (score)**
	1. Limited Proficiency	**2. Some proficiency**	**3. Proficiency**	**4. Higher Proficiency**	**3 0 marks**
Construct a model with the main parts of the digestive system included- mouth, oesophagus, liver, large intestine, stomach, pancreas, small intestines and rectum.	Could not be able to construct model of the digestive parts **0-6**	Can construct model of the digestive system with assistance from the teacher **7-9**	Construct model of the digestive system without teacher's supervision **10-12**	Independently construct model of the digestive system with all the digestive parts **13-15**	
Recognise the main parts of the digestive and state its function- mouth, oesophagus, liver, large intestine, stomach, pancreas, small intestines and rectum.	Could not be able to recognise and state the functions of the main parts of the digestive system **0-6**	Can recognise the main parts of the digestive system but could not fully state the functions. **7-9**	Can recognise the main parts of the digestive system and state their functions. **10-12**	Can recognise the main parts of the digestive system and fully state the functions. **13-15**	
Presentation Skills- able to explain the functions of each part, loud voice, confidence	Could not be able to explain functions of each part of the digestive system and lack confidence. **0-2**	Can explain the functions of each part of the digestive system but lack confidence. **3-5**	Can explain the functions of each part of the digestive system with little confidence. **6-8**	Can explain the functions of each part of the digestive system with confidence. **9-10**	
Other details	**0-2**	**3-5**	**6-8**	**9-10**	**10 marks**
Attitude	Often is publically critical of work and openly displays a negative attitude	Occasionally has a negative attitude about the assigned task	Usually has a positive attitude about the assigned task	Always has a positive attitude about the assigned task	
Total Score:					**50 marks**

Teacher's comments

Sample recording and Reporting Method

Sample recording strategy for the assessment task identified from the sample assessment task 2

Name	CRITERIA				TOTAL MARKS	PERCENTAGES
	Construct a model with the main parts of the digestive system included- mouth, oesophagus, liver, large intestine, stomach, pancreas, small intestines and rectum.	**Recognise the main parts of the digestive and state its function- mouth, oesophagus, liver, large intestine, stomach, pancreas, small intestines and rectum.**	**Presentation Skills- able to explain the functions of each part, loud voice, confidence**	**Attitude**		
	15	**15**	**10**	**10**	**50**	**100%**
Joshua	10	8	7	5	30	60%
Gelma	12	10	6	5	33	66%
Peter	9	6	4	2	21	42%
Jennifer	15	10	7	7	39	78%
Emily	5	10	9	5	29	58%
Fredrick	8	12	5	9	34	68%

Recording and Reporting

The recording and reporting of student achievements in the classroom is very important, as teachers use a range of tasks to ensure that commended standard statements are equally assessed and reported. This helps the teachers to reflect the effectiveness of their teachings.

Teachers should keep almost accurate records of how well the students have achieved the knowledge, skills, attitudes and values in the content standards or specifically in the benchmarks in grade six.

Strategies for recording
Teachers can record the evidence of students' demonstration of achieving the content standards, using assessment instruments that are manageable. The types of strategies teachers may want to use in recording student achievements must be easily interpreted to the expected audience. Here are some recording methods;

- Checklist
- Student portfolio
- Work sample

Students are given constructive feedback by the teacher on what they can do well and what they need to do to improve. Likewise, teachers are focused on the content they are assessing and are able to apply fair and consistent assessments.

Reporting
Reporting is important in assessment and must be done effectively. Teachers should report what students have done well and how they can improve further. Formal reporting through written reports and interviews are done to inform parents and guardians of the students' learning progress and other related areas such as behaviours. Teachers must ensure that the student has demonstrated and achieved the content standards independently on a number of occasions. These can be done formally or informally.

The achievements are reported to the respective stakeholders in relation to;

- Weaknesses
- Strengths
- Parent and guardian support and
- Evaluation of content learning.

Samples of recording and reporting templates

Keeping informed records of student performances on formal recording tools is very important both for the student, guardians, parents and teachers of the next grade level. Some recording tools are shown below as samples for teachers to use apart from those currently used in the classroom.

Sample Anecdotal Notes – Class Grid

- Record the dates of assessment tasks
- Write comments on the performance observed as per the criteria given.
- One box is for a student.
- This same grid can be used for a term depending on the type and number of assessment tasks prepared.

Individual sample recording strategy for all the assessment tasks in a term

Individual termly assessment record

Name: Gelma **Grade: 7** **Term: 1**

Assessment type	Total Score	Date	Student Score	%	Proficiency Level	Benchmark/CS	Evaluation/ Remarks
Assignment	50		33	66%	Satisfactory achievement	7.1.3.2.	Meets expectations
Project	30		20	50%	High Achievement	7.2.5.2 7.2.5.6	Meets expectations
Test	20		18	90%	High Achievement	7.1.3 7.2.5 7.2.6	Exceeds expectations

Key

Proficiency Level	Low Achievement (LA)	Satisfactory Achievement (SA)	High Achievement (HA)	Very High Achievement (VHA)
% scale score range	<50%	50-69%	70-89%	90-100%
Criteria/Evaluation	Does not meet the benchmark(s)	Meets expectations of the benchmark(s)	Meets expectations of the benchmark(s)	Exceeds expectations of the benchmark(s)

Class Sample recording strategy for all the assessment tasks in a term

Termly Assessment Record – Class Overview Grade: 7 Term: 3 Year: 2019						
Name	Assessment type			Total Score	%	Evaluation/Remarks
	Assignment 1	Assignment 2	Test			
	50	30	20	100	100%	
	7.1.3.2	7.2.5.2 7.2.5.6	7.1.3. 7.2.5. 7.2.6.			
Joshua	30	25	10	65	65%	Meets expectations
Gelma	33	30	17	80	80%	Exceeds expectations
Peter	21	10	15	46	46%	Needs improvement
Jennifer	39	20	11	70	70%	Meets expectations
Emily	29	25	9	63	63%	Exceeds expectations
Fredrick	34	26	7	67	67%	Meets expectations

Resources

Teaching Science lessons require resources to help the students understand and meaningfully learn the main concepts and also practice the skills to explore and follow processes and instructions.

There are resources that teachers themselves can access in the surrounding environment and provide for the students and for themselves. Here are some suggested resources that students and teachers can access to plan and prepare science lessons.

SCIENCE RESOURCE BOOKS	
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

These are the words that are used in the teaching and learning of content for Grade 7 science.

Words	Definitions
abiotic factor	the non-living part of the ecosystem. temperature, precipitation, wind, soil and non-living parts of the environment
acid	a substance that tastes sour and turns blue litmus paper red when dissolved in water
atmosphere	the mixture of gases, liquids that surrounds earth
atoms	the basic building block of matter
asexual reproduction	reproduction in which one parent produces offspring that are identical
biotic factors	any living part of the ecosystem. they include all animals, plants and micro-organisms.
circuits	a complete path that an electric current flows.
concave	curving inward
compound	a pure substance made up of two or more chemically combined elements
crust	a thin outermost layer of the earth
consumer	an organism that that eats other organisms
convex	curving outward
diffusion	process that spreads substances through a gas or liquid from higher to lower concentration
earthquake	violent shaking of earth's crust as a built-up energy is released.
ecosystem	all the different living and non-living things in an area
electric current	continuous flow of electric charge along a path.
element	a substance that cannot be broken down into other substance
fertilization	the process in which a male gamete joins a female gamete to produce a new cell that develops into an organism.
indicator	a chemical that changes colour when mixed with an acid or a base.
invertebrate	an animal without a backbone
mantle	the thick layer of dense rock that sits beneath earth's crust
mixture	two or more substances that may be combined
molecule	a group of two or more atoms held together by covalent bonds.
non- vascular plant	a simple plant that lacks true leaves, stems and roots
periodic table	the table that arranges the elements according to atomic number
ph scale	system of measuring the strength of different acids and bases
plate boundary	the edge of a tectonic plate
plate tectonics	theory that giant plates of crust are moving slowly across earth's surface
pressure	the amount of force exerted per unit area
producer	an organism that produces its own food
reflection	light bouncing off a surface
refraction	the bending of light rays when they pass from one material into another.
renewable resources	a resource that can be used without running out
revolution	complete orbit around an object
rotation	a complete turn about an axis.

sexual reproduction	production of off-spring by the union of male and female gametes
seismic wave	a wave that carries the energy released when rock moves at plate boundaries
solubility	measure of how much of one substance can dissolve in another substance.
solute	a substance that is dissolved in a solution.
solution	mixtures that are evenly mixed at the molecular level.
solvent	substance that dissolves the solute in a solution
static electricity	the build-up of electric charges
tectonic plate	an irregular section of the lithosphere that floats on earth's mantle.
troposphere	a layer of earth's atmosphere closest to earth's surface and containing about three-quarters of the atmosphere's gases
vascular plant	a plant with specialised tissues and organs for transporting materials
volume	the amount of space that a substance fills
vertebrate	an animal that has an internal skeleton or backbone.
voltage	measure of the force that moves electrons
epicenter	point on earth's surface directly above the focus of an earthquake.

Reference

Department of Education 2018, Primary Science Syllabus, Grade 6, 7 & 8, Papua New Guinea.

Peter, S. & Ken, W. 2006, Third Edition, Science World 7.

Houghton Mifflin Company 2007, Science, USA.
1988, First published, Fundamental Science for Melanesia

John,A. (1985a).Fundamental Science for Melanesia, Book 1.

John,A. (1985b).Fundamental Science for Melanesia, Book 2.

John,A. (1985c).Fundamental Science for Melanesia, Book 3.

Kenneth, R. (2008). Science Grade 6 Student Book. South Melbourne, Oxford University Press.

Kenneth, R. (2008). Science Grade 6 Teacher Resource Book. South Melbourne Oxford University Press.

Appendices

The appendices section contains template of lesson plan, student worksheet, sample timetable and other useful information for teachers to choose from and use in the teaching, learning and assessing of students in the classroom.

Appendix 1: SCIENCE LESSON TEMPLATE

Lesson Title:	Lesson No:
Strand:	**Unit:**
Topic:	**Sub-topic:**
Content Standard:	
Benchmark:	
Key Question:	
Lesson objective:	**By the end of the lesson the students will be able to;**
Teaching period:	40 minutes
Preparations:	
Key word(s):	

Knowledge	Skills	Attitudes & Values

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?)

……
……
……
……
……..

Key word(s):

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.

<table>
<tr><th>TIME</th><th>MONDAY</th><th>TUESDAY</th><th>WEDNESDAY</th><th>THURSDAY</th><th>FRIDAY</th></tr>
<tr><td>8:00 – 8:15</td><td>Assembly</td><td>Assembly</td><td>Assembly</td><td>Assembly</td><td>Assembly</td></tr>
<tr><td>8:15 - 8:40</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>9:20 – 10:00</td><td>English</td><td>Assembly</td><td>Assembly</td><td>Assembly</td><td>Assembly</td></tr>
<tr><td>10:00 – 10:30</td><td colspan="5">RECESS BREAK</td></tr>
<tr><td>10:30 – 11:10</td><td>Mathematics</td><td>Mathematics</td><td>Mathematics</td><td>Mathematics</td><td>Mathematics</td></tr>
<tr><td>11:10 – 11:50</td><td></td><td></td><td rowspan="2">Christian Religious Education</td><td></td><td>Science</td></tr>
<tr><td>11:50 – 12:30</td><td>Science</td><td>Science</td><td>Science</td><td>Arts</td></tr>
<tr><td>12:30 - 1:00</td><td colspan="5">LUNCH BREAK</td></tr>
<tr><td>1:00 – 1:40</td><td>Health/Physical Education</td><td>Health/Physical Education</td><td>Health/Physical Education</td><td>Health/Physical Education</td><td>Social Science</td></tr>
<tr><td>1:40 – 2:20</td><td>Social Science</td><td>Social Science</td><td>Social Science</td><td rowspan="2">Making a Living (80min)</td><td rowspan="2"></td></tr>
<tr><td>2:20 – 3:00</td><td>Mathematics</td><td>Making a Living (40min)</td><td>Making a Living (40min)</td></tr>
<tr><td>3:00 – 4:06</td><td colspan="5">Teachers Planning and Preparation</td></tr>
</table>

Suggested Sample time break up - Analyses

Revised SBC (2018)	Total min/week	%	(40/60) Slots/week
English	280	16.9	7x40
Maths	240	14.5	6x40
Science	200	12.1	5x40
Social Science	160	9.7	4x40
Arts	140	8.5	2x40 and 1x60
PE/Health	180	8.5	3x40 and 1x60
Making a Living	160	9.7	2x40 and 1x80
Citizenship & Christian Values Education	120	6	3x40
Assembly	75	4.5	5x15
Access (Movement)	35		
Sports	60	3.6	1x60
Total time allocation	**1650**	**100**	**36 lesson/week - 36x35=1260 annually**

Appendix 4: BLOOM'S TAXANOMY (promoting thinking)

These action verbs will help you as the teacher to enhance students in their learning and as well promoting their thinking skills from low level to higher order level using the Blooms Taxanomy.

Definitions	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Bloom's definitions	Exhibit memory of previously learned material by recalling facts, terms, basic concepts and answers.	Demonstrate understanding of facts and ideas by organizing, comparing and translating, interpreting, giving descriptions, and stating main ideas.	Solve problems to new situations by applying acquired knowledge, facts, techniques and rules in a different way	Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations.	Present and defend opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria.	Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions.
Verbs	Choose Define Find How Label List Match Name Omit Recall Relate Select Show Spell Tell What When Where Which Who Why	Classify Compare Contrast Demonstrate Explain Extend Illustrate Infer Interpret Outline Relate Rephrase Show Summarize Translate	Apply Build Choose Construct Develop Experiment with Identify Interview Make use of Model Organize Plan Select Solve Utilize	Analyze Assume Categorize Classify Compare Conclusion Contrast Discover Dissect Distinguish Divide Examine Function Inference Inspect List Motive Relationships Simplify Survey Take part in Test for Theme	Agree Appraise Assess Award Choose Compare Conclude Criteria Criticize Decide Deduct Defend Determine Disprove Estimate Evaluate Explain Importance Influence Interpret Judge Justify Mark Measure Opinion Perceive Prioritize Prove Rate Recommend Rule on Select Support Value	Adapt Build Change Choose Combine Compile Compose Construct Create Delete Design Develop Discuss Elaborate Estimate Formulate Happen Imagine Improve Invent Make up Maximize Minimize Modify Original Originate Plan Predict Propose Solution Solve Suppose Test Theory

Appendix 5: TYPES OF KNOWLEDGE, SKILLS, ATTITUDES AND VALUES

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
- Modelling
- Simulating

Reasoning Skills
Reason is a skill used in making a logical, just, and rational judgement.

Decision-Making Skills
Decision-making involves selection of the best solution from various alternatives based on specific criteria and evidence to achieve a specific aim.

Problem Solving Skills
Problem solving skills involve finding solutions to challenges or unfamiliar situations or unanticipated difficulties in a systematic manner.

High Level Thinking Skills
High level thinking skills include analysis, synthesis, and evaluation skills.

Analysis Skills
Analysis skills involve examining in detail and breaking down information into parts by identifying motives or causes, underlying assumptions, hidden messages; making inferences and finding evidence to support generalisations, claims, and conclusions.

Synthesis Skills
Synthesis skills involve changing or creating something new, compiling information together in a different way by combining elements in a new pattern proposing alternative solutions.

Evaluation Skills
Evaluation skills involve justifying and presenting and defending opinions by making judgements about information, validity of ideas or quality of work based on set criteria.

Types of Values

Personal Values (Importance, worth, usefulness) **Core Values** • Sanctity of life • Truth • Aesthetics • Honesty • Human • Dignity • Rationality • Creativity • Courage • Liberty • Affectivity • Individuality	**Sustaining Values** • Self-esteem • Self-reflection • Self-discipline • Self-cultivation • Principal morality • Self-determination • Openness • Independence • Simplicity • Integrity • Enterprise • Sensitivity • Modesty • Perseverance

Social Values Core Values	Sustaining Values
• Equality • Kindness • Benevolence • Love • Freedom • Common good • Mutuality • Justice • Trust • Interdependence • Sustainability • Betterment of human kind • Empowerment	• Plurality • Due process of law • Democracy • Freedom and liberty • Common will • Patriotism • Tolerance • Gender equity and social inclusion • Equal opportunities • Culture and civilisation • Heritage • Human rights and responsibilities • Rationality • Sense of belonging • Solidarity • Peace and harmony • Safe and peaceful communities

Types of Attitudes

Attitudes (Ways of thinking and behaving, points of view)	
• Optimistic • Participatory • Critical • Creative • Appreciative • Empathetic • Caring and concern • Positive • Confident • Cooperative	• Responsible • Adaptable to change • Open-minded • Diligent • With a desire to learn • With respect for self, life, equality and excellence, evidence, fair play, rule of law, different ways of life, beliefs and opinions, and the environment.

Appendix 6: STEAM and STEM Education

- By exposing students to STEAM and giving them opportunities to explore STEAM-related concepts, they will develop a passion for it and, hopefully, pursue a job in a STEAM field.
- Providing real life experiences and lessons, e.g., by involving students to actually solve a scientific, technological, engineering, or mathematical, or Arts problem, would probably spark their interest in a STEAM career path. This is the theory behind STEAM education.
- By integrating STEAM content and real life learning experiences at different levels of the curriculum process (e.g., Curriculum frameworks, content standards, benchmarks, syllabi, teachers' guides and students' books, curriculum design and development, annual and term school programs and lesson plans, teaching methodologies.
- Teaching methodologies – Problem and project-based learning, partnerships with external stakeholders e.g., high education institutions, private sector, research and development institutions, and volunteer and community development organizations.
- They underpin STEM education. They are the main enablers of STEM education.
- The **21st century skills** movement, which broadly calls on schools to create academic programs and learning experiences that equip students with the most essential and in-demand knowledge, skills, and dispositions they will need to be successful in higher-education programs and modern workplaces.
- The term **21st century skills** refers to a broad set of knowledge, skills, work habits, and character traits that are believed—by educators, school reformers, college professors, employers, and others—to be critically important to success in today's world, particularly in collegiate programs and contemporary careers and workplaces.
- Generally speaking, 21st century skills can be applied in all academic subject areas, and in all educational, career, and civic settings throughout a student's life.
- The skills students will learn will reflect the specific demands that will be placed upon them in a complex, competitive, knowledge-based, information-age, technology-driven economy and society.

Appendix 7: Additional information on rubric

The rubric communicates what the outcome really means because it specifies the criteria for assessing its mastery.

What are rubrics?
Rubrics provide the criteria for assessing students' work. They can be used to assess virtually any product or behavior, such as essays, research reports, portfolios, work of art, recitals, oral presentations, performances, and group activities. Judgments can be self-assessments by students; or judgments can be made by others, such as faculty, other students, fieldwork supervisors, and external reviewers.

Rubrics can be used to clarify expectations to students, to provide formative feedback to students, to grade students, and/or to assess courses and programs.

Types of rubrics
There are two major types of rubrics:

1. Holistic rubric — one global, holistic score for a product or behavior
2. Analytic rubric — separate, holistic scoring of specified characteristics of a product or behavior.

Why use rubrics?

- A way to provide feedback
- Defines characteristics of high quality assignment
- Establishes a range of performance categories
- Helps students understand expectations
- Provides students with a way to evaluate their own performance (self-assessment, reflection)

Parts of a rubric

Criteria/Dimensions (Rows)
Elements that characterise good performance of task

Descriptors
Specify the meaning of each criterion, describe levels of performance

Levels of Mastery/Scales (Columns)

1. Numerical
   (For example; 1-5 or actual point's value)
2. Qualitative

For example;

- exemplary, acceptable, unacceptable
- distinguished, proficient, basic, unacceptable
- novice, apprentice, expert

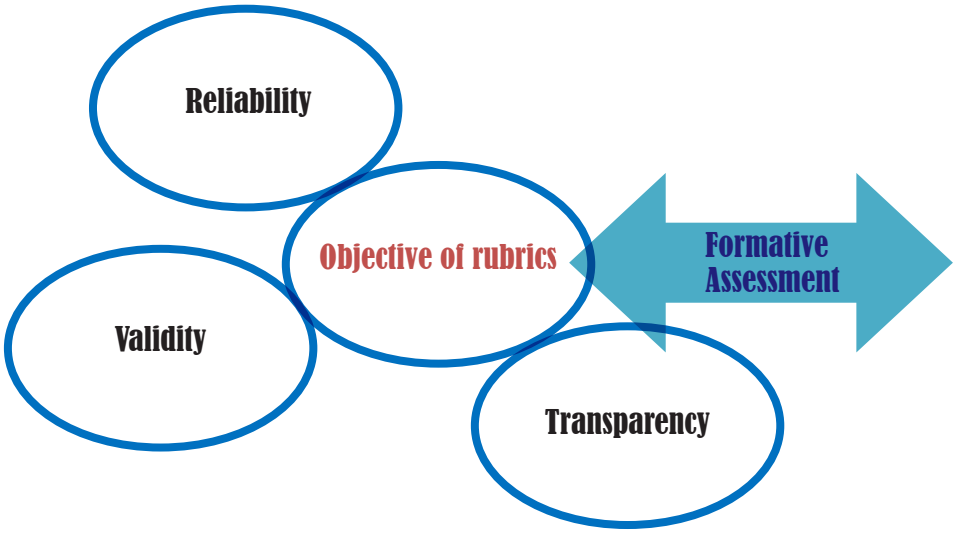
Creating a rubric for your assessment

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)