SAMPLES OF PHYSICS SCRIPTED LESSONS

LOWER SECONDARY (S1-S3)

FOREWORD

Dear Teachers,

Rwanda Basic Education Board (REB) is honoured to present to you the samples of physics scripted lessons book for lower secondary.This book serves as a reference to competence-based teaching and learning that infuses the 5E Instructional Model to ensure consistency and coherence in the learning of the Physics content.

In line with efforts to improve the quality of education, the Government of Rwanda emphasizes the importance of aligning teaching and learning materials with the syllabus to facilitate their learning process. Many factors influence what they learn, how well they learn and the competences they acquire. Those factors include the relevance of the specific content, the quality of teachers' pedagogical approaches, the assessment strategies, and the instructional materials.

In this regards, Rwanda Basic Education Board (REB) is implementing the "Rwanda Quality Basic Education for Human Capital Development" Project. Some of the Project's objectives are: (a) increase teacher content knowledge; (b) improve classroom teaching practices; (c) ensure availability of critical teaching materials and ICT tools in the classroom; and (d) provide continuous support to teachers in their work. This aims at enhancing teacher effectiveness for improved student learning through support of professional development of Mathematics and Science teachers (Sub-component 1.2 in which the University of Rwanda College of Education (URCE) is partnering the implementation).

The project is helping teachers to use technology and improve their way of teaching through a complete yet simple package to use in the classroom. Again, the project helped teachers from schools without electricity by developing these sample scripted lessons. They are developed to serve you as reference of a detailed description of all steps of a lesson that respects the 5E Instructional Model. This model consists of cognitive stages of learning that comprise ***engage, explore, explain, elaborate, and evaluate.***

Through this approach, students redefine, reorganize, elaborate, and change their initial concepts through self-reflection and interaction with their peers and their environment. As a result, learners interpret objects and phenomena observed in their real-life experience and internalize those interpretations in terms of their current conceptual understanding.

Even though this book contains the guidance on the main steps of the lesson, you are requested to regularly plan your lessons as usual basing on the current situation of your class environment: level of pupils, teaching materials, and motivating situation available at your school.

I wish to sincerely express my appreciation to the people who contributed towards the development of this booklet, particularly, REB staff, UR-CE Lecturers, Teachers, and experts from Local and international Organizations for their technical support.

Dr. MBARUSHIMANA Nelson

Director General, REB

ACKNOWLEDGEMENT

I wish to express my appreciation to the people who played a major role in the development of this book of samples of physics scripted lessons for lower secondary (S1-S3). It would not have been successful without active participation of different education stakeholders.

I owe gratitude to University of Rwanda College of Education and other schools in Rwanda that allowed their staffs to work with REB in the in-house textbooks production initiative.

I wish to extend my sincere gratitude to lecturers and teachers whose efforts during writing exercise of this booklet of sample scripted lessons was very much valuable.

Finally, my word of gratitude goes to the Rwanda Basic Education Board staff who were involved in the whole process of producing this Teaching and Learning Resource.

Joan MURUNGI

Head of CTLR Department

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INTRODUCTION

Rwanda Basic Education Board (REB) is implementing the "Rwanda Quality Basic Education for Human Capital Development" Project.

The subcomponent 1.2 of this project is being implemented by REB in collaboration with University of Rwanda College of Education (UR-CE). The subcomponent aims at enhancing teacher effectiveness for improved student learning through support of professional development of Mathematics and Science teachers.

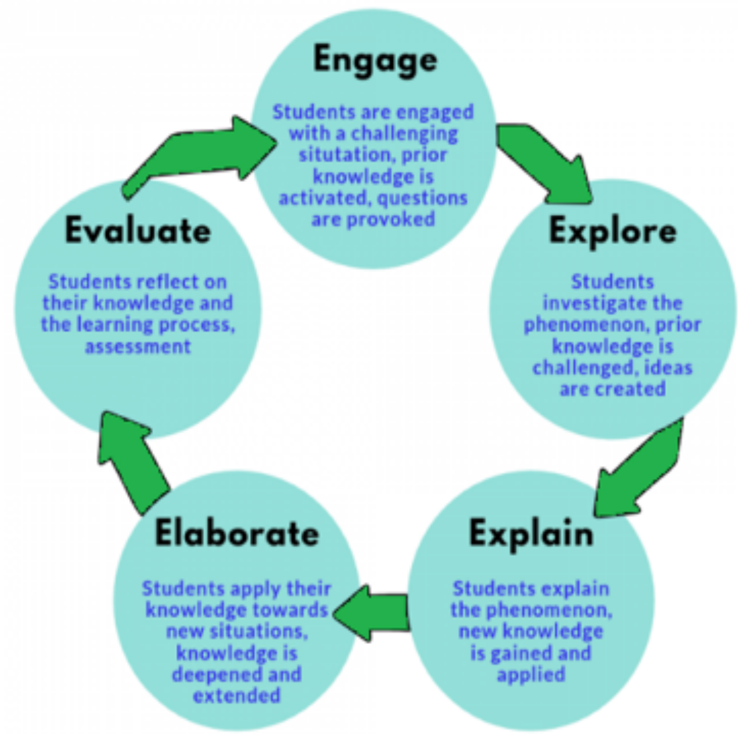
Firstly, the project is helping teachers to use technology to improve their way of teaching through a complete yet simple package that includes the scripted lessons developed in One Note to be used in the classroom. These scripted lessons in One Note incorporate the 5E instructional Model.

Secondarily, the project helps teachers from schools without electricity by developing, in Microsoft word, the sample scripted lessons. This book contains such lessons and serves as a reference to competence-based teaching and learning that infuses the 5E Instructional Model to ensure consistency and coherence in the learning of the mathematics and science content.

The detailed explanation of this model is given in the following paragraphs.

The 5Es instructional model

"The 5E Model of Instruction is a teaching and learning model that promotes active learning. It states that teaching and learning progresses through five phases: **Engage, Explore, Explain, Elaborate and Evaluate**.



In this model, students are involved in more than listening and reading. They learn to ask questions, observe, model, analyse, explain, draw conclusions, argue from evidence, and talk about their own understanding. With the 5 Es instructional model, students work collaboratively with peers to construct explanations, solve problems, and plan and carry out investigations."

PHASE 1: ENGAGE

The first phase of the 5E Model engages students by having them mentally focus on a phenomenon, object, problem, situation, or event. The activities in the Engage phase are designed to help students make connections between past and present learning experiences, expose prior conceptions, and organize thinking toward the essential questions and learning outcomes of the learning sequence.

The role of the teacher in the Engage phase is to present a situation, identify the instructional task, and set the rules and procedures for the activities. The teacher also structures initial discussions to reveal the range of ideas, experiences, and language that students use which become resources for upcoming lessons.

Teaching Strategies

- Raises questions or poses problems
- Elicits responses that uncover students' current knowledge
- Helps students make connections to previous work
- Posts learning outcomes and explicitly references them in the lesson
- Invites students to express what they think
- Invites students to raise their own questions

PHASE 2: EXPLORE

Once students have engaged in activities, they need time to explore ideas. Explore activities are designed so all students have common, concrete experiences which can be used later when formally introducing and discussing scientific and technological concepts and explanations. Students have time to investigate objects, events, or situations. As a result of their mental and physical involvement in these activities, students question events, observe patterns, identify and test variables, and establish causal relationships.

The teacher's role in the Explore phase is to facilitate learning. They initiate activities and allow time and opportunity for students to investigate objects, materials, and situations. The teacher coaches and guides students as they record and analyse observations or data and begin constructing models or initial explanations.

Teaching Strategies

- Provides or clarifies questions or problems
- Provides common experiences
- Observes and listens to students as they interact
- Acts as a consultant for students
- Encourages student-to-student interaction
- Asks probing questions to help students make sense of their experiences and redirect them when necessary
- Provides time for students to puzzle through problems

PHASE 3: EXPLAIN

The Explain phase consists of two parts. First, the teacher asks students to share their initial models and explanations from experiences in the Engage and Explore phases. Second, the teacher provides resources and information to support student learning and introduces scientific or technological concepts. Students use these resources and information, as well as ideas of other students, to construct or revise their evidence-based models and explanations. In engineering, students design solutions to problems based on established criteria.

Teaching Strategies

- Encourages students to explain concepts and definitions in their own words
- Asks for justification (evidence) and clarification from students
- Formally provides definitions, explanations, and information through mini-lecture, text, internet, or other resources
- Builds on student explanations
- Provides time for students to compare their ideas with others and if desired revise their ideas

PHASE 4: ELABORATE

Once students have constructed explanations of a phenomenon or design solutions for a problem, it is important to involve them in further experiences that apply, extend, or elaborate the concepts, processes, or skills they are learning. Some students may still have misconceptions, or they may only understand a concept in terms of the exploratory experience. Elaborate activities provide time for students to apply their understanding of concepts and skills. They might apply their understanding to similar phenomena or problems.

Teaching Strategies

- Expects students to use vocabulary, definitions, and explanations provided previously in new contexts
- Encourages students to apply the concepts and skills in new situations
- Provides additional evidence, explanations, or reasoning
- Reinforces students' use of scientific terms and descriptions previously introduced
- Asks questions that help students draw reasonable conclusions from evidence and data

PHASE 5: EVALUATE

It is important that students receive feedback on the quality of their explanations. Informally, this may happen throughout the learning sequence. Formally, the teacher can also administer a summative evaluation at the end of the learning sequence. The Evaluate phase encourages students to assess their understanding and abilities and allows teachers to evaluate individual student progress toward achieving learning goals and outcomes.

Teaching Strategies

- Asks open-ended questions such as, “Why do you think…?” “What evidence do you have?” “How would you answer the question?”
- Observes and records notes as students demonstrate individual understanding of concepts learned and performance of skills
- Uses a variety of assessments to gather evidence of student understanding
- Provides opportunities for students to assess their own progress

When this model is used in the lessons, learners interpret objects and phenomena they observe in their real-life experience and internalize those interpretations in terms of their current conceptual understanding.

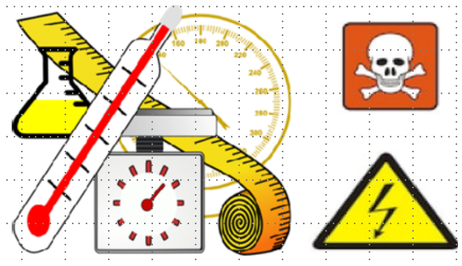
Scripted lesson is a structured lesson which is presented in a way that explains each step of the lesson in a direct instruction it shows what the teacher says what he/she does and indicates expected answers/findings of students in the whole process of lesson from the beginning to the end.

The following part contains examples of lessons selected from scripted lessons prepared in One Note. They will serve as reference of lessons with the structure of 5Es instructional model.

Sample Scripted Lessons For Senior One

LABORATORY SAFETY RULES AND MEASUREMENT OF PHYSICAL QUANTITIES

SUBJECT: PHYSICS	**GRADE:** S1	**DURATION:** 80 min
LESSON TITLE: Physics as science subject **LEARNING MATERIALS:** Reference books, computer, projector, chalkboard, chalks, …		

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS' READINESS** **(5 min)**	**Teacher:** Hello dear student! Welcome in today's lesson. **Carefully observe the picture.**  **What does this figure shows/tells you?**	**Display the picture** **Let learners themselves try to provide the answer and facilitate them to reach on the intended answer.**

	Student: Measuring instrument and Hazard symbol **Teacher:** Have you seen something similar to this before? **Student:** Yes/ Ruler, stopwatch, balance, Toxic symbol, Risk of electric shock **Teacher:** thank you, today we are going to study **The title of the unit:** Laboratory safety rules and measurements of physical quantities **The title of the lesson:** Physics as science subject **Learning Objectives:** By the end of this lesson the learner should be able to: • Explain the nature of physics and its applications. • Discuss importance of physics. • Discuss branches of physics and their benefits to mankind's development. • Relate physics to other subjects.	**Provide a pause time for students to think and say or write the ideas.**

2 **INTRODUCTION** **(5 min)**	**Observe the following picture and answer the question follow**  **Teacher:** Which subject needs science laboratory equipment? **Students:** Physics, Chemistry, and Biology	**Pictures or Handouts' texts have clear instructions.** **Encourage each learner to observe the picture and answers the questions**

3 **LESSON DEVELOPMENT** **(50 min)**	**Teacher: do the following activity** **Activity 1.1** **Observe the picture:** • Describe the activities that is being done. • What is the importance of the activity which is being done? 	**Ask learners to form a groups of 4 (this may depend on the class size)** **Remember gender and learners with special needs** **Emphasize new concepts.**

	Students: Observation using telescope and microscope. **Importance:** – to see around us – to observe very small object, to study – Testing or verification why peeled orange sink while unpeeled orange float. – To describe why object float – Measuring the mass object: – Checking the mass **Teacher: What do you think science is?** **Students:** Science Is the study that uses observation and experimentation to describe and explain natural phenomena. **Teacher: Could you suggest the branches of science?** **Students:** The branches of science are: **Natural sciences** (Physics, chemistry and biology): Examples: lightening, motion, earthquakes, etc.	**At each step, provide a pause time for students to think and say or write their ideas.**

	Formal science: study of natural phenomena which can be observed and tested, **Examples:** psychology and sociology • Deal with mathematical concepts and logics • Deal with the study of human behavior and society. **Teacher:** Very good! What is physics? **Students:** Physics is the study of matter and energy and their interaction. **Teacher:** Describe the branches of physics. **Students:** Branches of Physics are: **1) Electromagnetism** Is the study of the interaction of electrical and magnetic fields? **Application:** loudspeakers, electricity generators, telephone **2) Mechanics** Is the study of the action of forces on objects and motion. **Application:** vehicles, planes, ships, trains, etc. **3) Thermodynamics** Is the study of the relationship between heat, other forms of energy and work? **Applications:** thermos flask, refrigerators, car engine, radiators and air conditioners.	**Allow the learners to answer the questions.**

	4) Optics: Is the study of the behaviour and physical properties of light. **Applications:** Camera, eyeglasses, projectors, microscope, telescope, fiber optics, … **5) Acoustics:** Is the study of sound and sound waves. **Applications:** Musical instruments **6) Electronics:** Is the study of the flow of electrons, generally in a circuit. **Applications:** Television, radios, computers, amplifiers and mobile phones.	**Use learner's idea to formulate concepts clarification.** **Use different questions to probe learners to understand the content**
	Teacher: Suggest the importance of physics **d) Students:** **Importance of Physics** **1) Career in Physics** **Example:** laboratory, engineering, meteorology, electronics, geology, astronomy, medical physics, astro-physics, teacher, university lecturer or a researcher.	

	Foundation on which other sciences are built **Example:** Biology, chemistry, medicine, geography. **2) Development of instrument and equipment used in many areas of our daily lives.** **Example:** In agriculture, medicine, telecommunication, aviation, transport, land survey. **Application activity:** **Teacher:** Discuss the activities and appliance that apply knowledge in physics. **Answers:** **Activities:** walking, driving a car or using a phone, heating, lighting, and cooling for buildings .... **Appliances:** Telephone, kettle, radio, TV screen, projectors, lamp...... **Summary** **Teacher:** Briefly summarize what we have learnt in this lesson? **Students:**Physics refers to the study of matter and energy and their interaction.There are various branches of physics: mechanics, optics, electromagnetics etc.	**Allow learners to work in group.** **Invite each group to present their findings** **Use learner's ideas to formulate the lesson summary.**

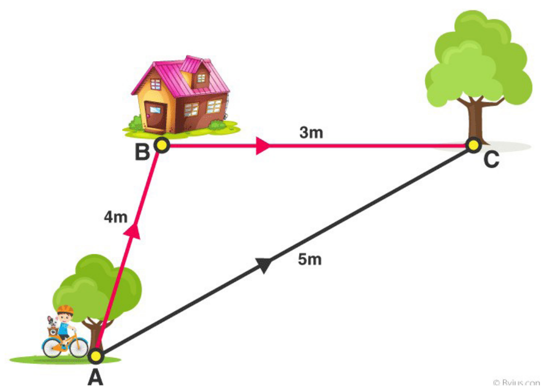
	Physics contributes to the technological infrastructure and provides trained personnel needed to take advantage of scientific advances and discoveries. Physics is an important element in the education of chemists, engineers and computer scientists, as well as practitioners of the other physical and biomedical sciences.	
4 **CONCLUSION** **(20 min)**	**Assessment** **Teacher:** take a paper/exercise notebook and do assessment 1. Define the term Physics 2. Name any six different branches of physics. 3. Write two reasons to study physics 4. Give two examples of use of physics principles in agriculture of Rwanda **Answers:** 1. Physics is a natural science that is concerned with the study of matter and natural forces. 2. Optics, acoustics, mechanics, astronomy, electronics, geophysics 3. Physics: – explains the fundamental laws of the universe	**Allow the learners to answers the questions.** **Allow the learners to work individually**

	– introduces important concepts that are essential for advanced study of chemistry, biology and all other branches of science. – is essential for understanding chemistry...... describing the motion, forces and energy 4. Irrigation using sprinkler Insecticide's sprayers. **Homework** 1. What is science? 2. Differentiate between natural and social sciences. 3. State some aspects of the natural sciences which you have learnt at the primary school level. 4. Name any four branches of natural sciences. 5. Define the term Physics. 6. Name six different branches of physics. ***Teacher: Thank you for your participation in this lesson.*** ***See you next time!***	**Provide pause time to think and say or write their ideas** **provide opportunities for corrective feedback to learners** **Students must get time to respond questions.**

QUALITATIVE ANALYSIS OF LINEAR MOTION

SUBJECT: **PHYSICS**	**GRADE:** **S1**	**Duration:** 40 min
LESSON TITLE: Distance and Displacement **LEARNING MATERIALS:** tape measure,, stopwatch, manila papers, chalk board		

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS' READINESS** **(5 min)**	**Teacher:** Hello dear student! Welcome in today's lesson. **Observe carefully this picture.**  **What does this figure shows/tells you?**	**Display the picture**

	Students: A person riding a bicycle/Racing bicycle **Teacher:** How do you call a trajectory moved by this cyclist? **Students:** This trajectory is called distance or displacement. **Teacher**: Very good! Could you **suggest** what we will learn in this lesson? **Teacher:** Thank you all. Today we are going to study **Learning objectives** By the end of this lesson, you should be able to differentiate distance and displacement	**Let learners themselves try to provide the answer and facilitate them to reach on the intended answer.**
2 INTRODUCTION **(5 min)**	**Teacher:** Observe this picture and answer the questions below  If the cyclist wants to move from point A to C, there are two paths to follow. What are they?	**Provide a pause time for students to think and say or write their ideas.**

	Students: red path (ABC) and black path (AC). **Teacher:** Very good! What is the shortest path among them and what is its specific name? **Students:** The shortest path is the black path. This is a displacement moved by the cyclist	
3 LESSON DEVELOPMENT (25 min)	**Teacher: Activity** • Mark points A and B in a classroom far away from each other. • Let one student move from point A, making full strides/steps towards point B in a straight line. • How many strides does he/she get? • Now let the student repeat the activity but this time he/she takes a curved path from point A to B. • Which one is longer between the straight and the curved paths? • Choose one student in your group to measure the total length from points A to B using a tape measure and find total length. What is the long path? • How do you call this long curved path? **Students:** The length of a curved path is longer than that in straight line. This long curved path is called a **distance.** **Teacher:** Well done my students, from your observation how could you define displacement? **Students:** Displacement is the shortest distance along a straight line between two points in the direction of motion. Its SI unit is meter	**Allow the learners to work in groups (remember gender balance and learners with special needs).**

Teacher: Good! What should be distance?

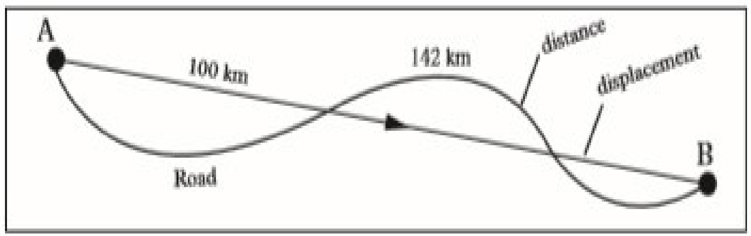
Students: Distance is the total length of the path followed by an object, regardless of the direction of motion. Its SI unit is meter

Teacher: As you remember, a scalar quantity is a quantity with only magnitude while vector quantity is a quantity with both magnitude and direction; where would you classify distance and displacement?

Students: Distance is a scalar quantity while displacement is a vector quantity.

Teacher: Excellent! The straight line path from location **A** to **B** is 100 km and the curved path from **A** to **B** is 142 km. Use the graph to differentiate distance and displacement from **A** to **B** .

Students:



In the diagram above, an arrowhead indicates the direction of motion.

Facilitate learners to do activity, make sure all learners participate.

Provide pause time to think and say or write their ideas.

	Teacher: Very good! What are the similarities between distance and displacement? **Students:** Distance and displacement have the same SI unit which is metre (m). Long distances and displacements may be measured in kilometres (km) while short distances and displacement may be in centimetres (cm) or millimetres (mm).	
	Application activity **Teacher:** What are some safety measures one should take before crossing a road? **Students:** Always cross the road where there is a zebra-crossing and cross it straight. Before crossing at a zebra-crossing, look right, left, then right again and if there are no oncoming vehicles then walk across. Do not run. Always remember it is better to be late but arrive safely. Do not make abrupt decision to cross a road. Always put all your concentration on the road when crossing it **Teacher:** Let together summarize some of the key points that we learnt. Describe distance and displacement.	**Asks learners to form groups of 4 students (the number may depend on the class size)** **Emphasize new concepts.**

	Students: • **Distance** is the total length of the path followed by an object, regardless of the direction of motion. It is a scalar quantity and measured in units of length. Its SI unit is meter. • **Displacement** is the object's overall change in position from the starting to the end point. It is the shortest distance along a straight line between two points in the direction of motion. The SI unit of both distance and displacement is the metre (m). **Teacher:** Good! Do you have any question? **Student:** yes teacher. If the car moves from Kigali to Huye by moving 142 km following the main road, is this a distance or displacement? **Teacher:** Very interesting question! This path followed by the car is a distance because the road from Kigali to Huye is not straight at all. It is curved path. **Assessment** **Teacher:** Take a paper/ exercises notebook and do the assessment. 1) Differentiate distance and displacement. 2) What is the SI unit of distance? What is that of displacement?	**Use different questions to probe students to summarize the lesson.** **Provide opportunities for corrective feedback or positive feedback to students.**

3) The distance between Anitha's home and the school is 2km. Calculate the distance and displacement that Anitha covers from home to school and back home.

4) Consider the figure below (AB = 150 m, BC = 200 m). Calculate the distance and displacement from point A to point C.

Allow the learners to work individually

Students: Solution

1) The difference between distance and displacement

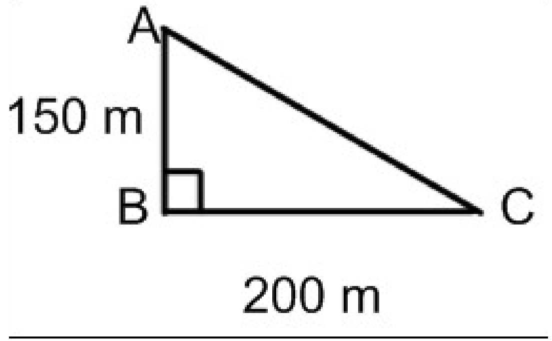
	Distance	Displacement
Definition	Distance is the total length of the path followed by an object, regardless of the direction of motion	Displacement is the shortest distance along a straight line between two points in the direction of motion
Quantity	Scalar	Vector

Provide opportunities for corrective feedback to learners

2) Distance and displacement have the same unity which is metre (m).

3) Distance from Anitha's home to school is 2km and from school to Anitha's home is 2km.

So, the distance that Anitha covers is 4km. The displacement that Anitha covers is 0 because the initial position is the final position as she returns back home.

4) 

- Distance AB =150m, BC=200m
- Distance AC =150m + 200m = 350m
- Displacement $AC = \sqrt{150^2 + 200^2} = 250m$

4 CONCLUSION (5 min)	Teacher: In conclusion, let me give you homework.	

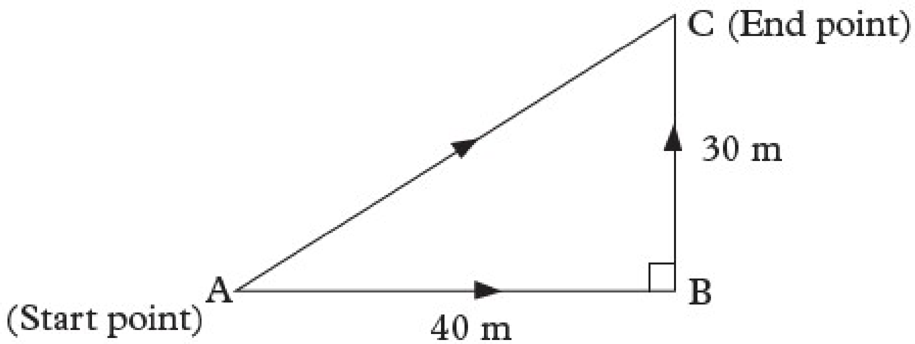
4
CONCLUSION

(5 min)

Teacher: In conclusion, let me give you homework.

Homework

Suppose a boat starts at point A moves 40m East to point B followed by 30m North to point C as shown in the figure below.



Determine the distance and the displacement covered by the boat.

Thank you for your participation in this lesson.

See you next time!

This homework will be done individually and will be corrected before starting a next lesson

FORCE

SUBJECT: PHYSICS	**GRADE:** S1	**DURATION:** 80 min
LESSON TITLE: Effects of forces **LEARNING MATERIALS**: Charts, Ball, springs, Ball, coins, rubber bands, kitchen sponge or eraser, balloon, clay, textbook.		

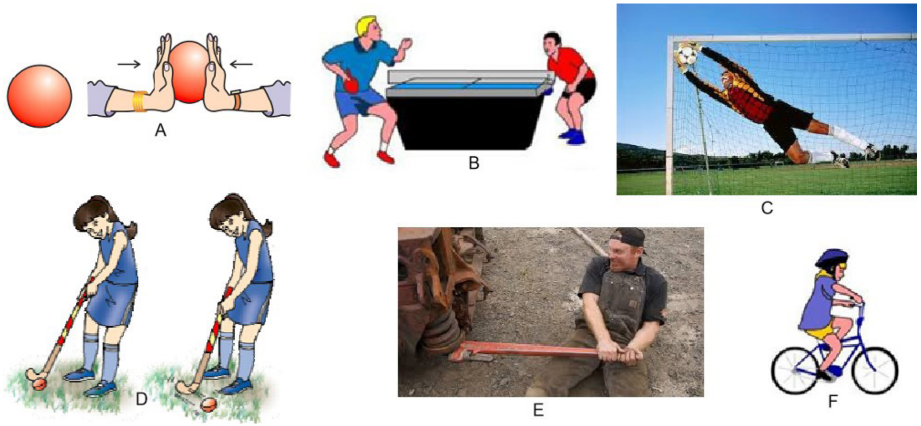
SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS' READINESS** **(5 min)**	**Teacher:** Hello dear S1 students! Welcome to this physics lesson! **Students:** Hello teacher, we like physics! **Teacher:** Do you remember what have learnt last time? **Student:** We learnt different forces **Teacher:** What causes an object to move or stop moving? **Students:** Forces	**If you don't have two successive periods halve the time for each activity and later you will come back to fix each.**

	Teacher: Could you suggest today's lesson? **Students:** Yes teacher, today's lesson may be the Effects of forces **Teacher:** Good! we are going to study Lesson 3 called "Effects of forces". **Lesson Objectives:** **By end of this lesson, you will be able to:** a) List effects of forces b) Demonstrate how force can change the state of motion and the shape of an object. c) Explore that greater the force, greater the change in the distance covered by the object. d) Demonstrate that some objects can return to their original shape after the release of force.	**Begin by paying the students 'attention and communicating the lesson objectives.**
2 **INTRODUCTION** **(10 min)**	**Teacher:** What are the types of forces? **Students:** Forces are in two categories namely contact and non-contacts forces. Contact forces include frictional force, tension, normal action reaction force, air resistance and up thrust. Non-contact forces include gravitational, electrostatic, and magnetic forces.	**Tell learners the materials needed and give them a small time to take them.**

3 LESSON DEVELOPMENT **(50 min)**	**Activity 1:** **Teacher:** Here there is a ball on the floor. How can we move this ball? **Students**: To move a ball we need to apply a significant force on it. **Teacher:** Could you please come and move the ball? **Student:** Yes, let me kick the ball. **Teacher:** Good! Could you push the ball harder? **Student:** Yes, let me kick it harder. **Teacher:** Good. What happens when you apply more force on the ball? Discuss. **Students:** Greater the force, greater the distance covered by the object. **Teacher:** This is rubber band, who can stretch it softly? Leaners, observe well what our classmate is doing. Does the shape of rubber band change when stretched? **Students:** Force changes rubber band's shape and once the force is removed the rubber regains its shape.	**Provide pause time to think and say or write their ideas**

Activity 2:

Teacher: Form groups each of four members and Carefully observe this picture:



Emphasize new concepts.

- Discuss in groups what is happening in each of the pictures
- What are effects of an applied force for each of images?

Students: **A**: force changes the shape,
B: Force change the direction,
C: Force stops motion
D: Force starts motion
E: force rotates objects
F: Force changes the speed of objects.

For each activity repeat it with different learners.

	Activity 3: **Teacher:** Here is the sponge. Let one Student in your group squeeze it. What happens when you squeeze it? What happens when you release it? What does it show? **Students:** when you squeeze it, it changes its shape by applying force; It regains its original shape if the applied force is removed; It shows that some objects regain their shapes when the applied force is removed **Teacher:** Repeat the experiment with a spring and discuss other objects that may have the same characteristics **Students:** Inflated balloon, sponge, and any other related plastic material. **Teacher:** In pairs, take clay and press it with hands inside a small container. What happens when you press the clay ball with their hands? Does it return to its original shape when hands are removed? Discuss. **Students:** Its shape changes, some objects do not regain their original shape after the removal of the applied force	**Once you miss the printed images, try out to draw them on manilla paper or you could use story telling technique.**

Teacher: Observe the following picture and discuss the effects of force shown in Fig (a) and (b).

(a) *Seesaw* **(b)** *A steering wheel*

Students: The effect of force at (a) and (b) is rotation or turning effects

Teacher: Compare and discuss the state and condition of the tyres shown in (a) and (b)

(a) **(b)**

Provide an opportunity where learners can ask questions.

	Students: Tyre (a) has its treads still in good condition. The tyre in (b) has its treads worn out. The tyres wear and sometimes tear because of friction between the road and the tyre when in use. This shows that, forces can cause wear and tear. **Teacher:** What effects of force did you learn today? Write a short note on what we have seen in this lesson. **Students:** Force can change the state of motion (increase/reduce the speed; can move or stop; change direction) for an object. The greater the force, the greater the distance covered by an object. Force can change the shape of an object. Some objects return to their original shape after the release of force and some not. Finally, the force can cause wear and tear as well rotating effects.	
4 **CONCLUSION** **(15 min)**	**Teacher:** Take a paper and do the following assessment: **Assessment:** **1) Which of the things could you change the shape of by applying force.** **a)** A plastic ball **b)** A metal toy **c)** A glass cup **2) What happens when you stretch the plastic bottle by your hand and release** **a)** It changes shape **b)** It breaks **c)** It regain its shape	**You can use oral during the assessment and don't miss to correct and give direct feedback.**

3) **When you apply greater force on the bicycle pedals**

a) It covers greater distance **b)** It slow down **c)** It stops

4) **How could you stop a toy car moving down a slope?**

a) Give it a push **b)** Put hands in its path

c) It is impossible to stop

5) **When a force is applied on a rubber band**

a) Its shape changes **b)** It stays the same **c)** It breaks

6) **Rwego needs …… to move in different directions**

a) A push or a pull **b)** A push only **c)** A pull only

d) a pull and push

7) **Effect of fore when we open and close the door is:**

a) Turning effect **b)** keeping the state of motion effect

c) changing the shape

Students:

1. **a)** A plastic ball
2. **c)** It regains its shape
3. **a)** It covers greater distance
4. **b)** Put hands in its path
5. **a)** Its shape changes
6. **a)** A push or a pull
7. **a)** Turning effect

Teacher: Good job! Before the end of this lesson, I would like to tell you that here is a simple homework. Don't miss to write it:

Homework:

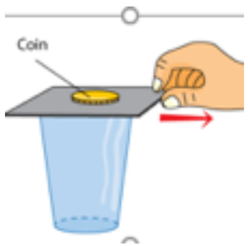
1) Discuss where pushes and pulls changes the shape of different objects in everyday life
2) Find three materials in which objects regain their original shape after the removal of applied force.
3) Find three materials in which objects change their shape on applying force but don't regain their original shape on removal of applied force. Draw their pictures.

Thank you very much for today achievements and participation.

NEWTON'S LAWS OF MOTION

SUBJECT: PHYSICS	**GRADE:** S1	**DURATION:** 40min
LESSON TITLE: Newton's first law of motion **LEARNING MATERIALS**: Coins, table, beaker, sheets of paper (or card board), manila paper and chalkboard		

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS' READINESS** **(2 min)**	**Teacher:** Hello students, how are you? **Students:** We are fine. **Teacher:** Welcome to this new unit Newton's laws of motion. Did you ever move by a car? **Students:** Yes, we did. **Teacher:** What happened when the car stopped suddenly? **Students:** When the car stopped suddenly, we had a tendency of moving forward.	**Begin by gaining student's attention**

	Teacher: Excellent! Now could you suggest today's lesson? **Students:** Today's lesson is **Newton's first law of motion** **Teacher:** Excellent! Now today's lesson is called **Newton's first law of motion** and we will see why it is so in the car. **Lesson Objectives/Instructional Outcomes:** By the end of this lesson, you should be able to: • Differentiate between mass and inertia • State the Newton's first law of motion.	**Welcoming them in the lesson and communicate the objective of the lesson**
2 INTRODUCTION **(4 min)**	**Teacher:** What did we study last time? **Students:** last time we studied the force, its types and the effects of force in nature. **Teacher:** Ok! Thanks, congratulation! Now, here we have materials which will help us to study well our new lesson: ***Coin, beaker, A smooth cardboard*** 	**The introduction is done by revising the previous lesson.** **Bring the materials and ask learners to observe and think.**

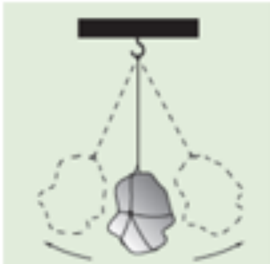
3 LESSON DEVELOPMENT **(20 min)**	Using those materials, you are going to do the experiment, and this will explain clearly our lesson **Steps:** 1. Place a coin on a smooth cardboard and place it over a beaker (figure above). 2. Pull the card away slowly and observe what happens to the coin. 3. Repeat the activity but this time pull the card away suddenly **Teacher:** Discuss with other learners the observations in steps 1, 2 and 3 and suggest a reason why the coin behaves differently in these steps. Why the coin does not move together with a paper for step 3? **Students:** There was the effect of the force on the coin. The coin resists to change its place. **Teacher:** Thanks a lot. What you have observed is the effects of force on the body either at rest or at uniform motion which is explained using Newton's first law of motion. Can you state the Newton's first law of motion according to what you observed in your experiment? **Student:** This law states that if a body is at rest or in uniform motion on a straight line, will continue to be in this state unless acted upon an external force. This law explains how the matter resists to the change of its state (motion or rest).	**Tell students the materials needed and give them a small time to take them.** **Students must be given time to think and note down their ideas.** **Emphasize new concepts (the term inertia).**

Teacher: Now let as do another small experiment

Materials: two stones of different masses, a string.

Steps:

1. Suspend the heavy stone using a string as shown below



(a) Heavy stone

(b) Light stone

2. Push the heavy stone towards one side. Release the stone to swing and then try to stop the stone from moving.
3. Repeat the activity with the light stone.

Let the learners think to the application of inertia in real life situation.

Which stone is easier to start moving and to stop moving? Suggest a reason.

Students: The lighter stone is easier to start moving and to stop moving. The heavier stone is more difficult to start or stop moving i.e, it requires a larger force to do so. This activity shows that the mass of a body is a measure of its resistance to move. A body with a large mass has a greater resistance and vice versa.

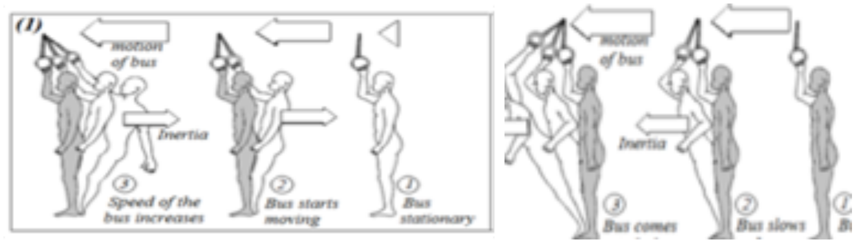
Use different questions to probe students to understand the content.

Teacher: What is the name of this resistance of bodies to move?

Answer: This resistance of bodies to change its state of rest or motion is called inertia.

Teacher: Can you tell me the application of inertia in real life situation?

Students: The example application of the inertia is the passengers moving in the car.



When a car stops suddenly, the passengers tend to move forward (they have a tendency of moving forward). And when a car starts to move forward from rest, passengers are jerked backwards because of inertia.

Application activity:

Explain why a stopped car must be pushed by many people?

Students: : A group of many people are able to push a stalled car to a high speed faster than one person or the small kids. An object of a big mass requires a big effort to displace it and an object of small mass requires less effort to displace it.

Provide opportunities for corrective feedback or positive feedback to students

	Teacher: Can you conclude our day's lesson? **Students:** Yes, we conclude that the Newton's first law of motion states that a body remains in its state of rest or uniform motion in a straight line unless acted upon by an external force. The resistance of the body to move or to remain at rest is called the inertia. And the mass of the body is one factor of it.	**Give an opportunity to students to ask questions depending on their special educational needs and ask them different questions leading to the summary of the lesson**
4 **CONCLUSION** **(12 min)**	**Teacher: Assessment** 1. Briefly explain why wearing safety belts in moving vehicles are very important. 2. Explain why the mass of a body and the force applied to the body are factors of inertia **Students: Answers:** 1. Wearing safety belts in moving cars is very important because they hold passengers onto the seat in case the vehicle comes to stop or decelerates suddenly, preventing them from lurching forward. This reduces any chances of serious injury in case of an accident **2. i) Mass:** the mass of body is a factor of inertia because a large mass requires a large force to produce a given acceleration or deceleration than a small mass, therefore a large mass has a greater inertia.	**Assessment is provided to check weather students understood the content.**

	ii) Force applied on the body: When the force applied to the body is increased, its tendency to remain at rest is reduced. This would result to movement of body from its state of rest.	
	Teacher: Homework: 1. The following are factors affecting inertia of bodies, which one is not? **a.** Acceleration of body **b.** Linear momentum **c.** Mass of body **d.** Friction force acting on body 2. Explain why Newton's first law is also called the law of inertia ***Thank you for your participation in this lesson.***	**Encourage learners to do the research while doing homework.**

CENTRE OF GRAVITY

SUBJECT: PHYSICS	**GRADE:** S1	**DURATION:** 80 min
LESSON TITLE: Centre of Gravity and Centre of mass of a body **LEARNING MATERIALS**: chair, a meter stick or any other stick of similar size, weight like a piece of clay, table, thin rectangular card, meter rule		

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS' READINESS** **(5 min)**	**Teacher:** Hello students! Welcome in today's physics lesson **Students:** Thank you teacher! **Teacher:** Why do you like to learn by sitting on a chair than standing up? **Students:** The lower we are to the ground, the less risk there is that we will tip over. **Teacher:** Excellent that is! Could you suggest today's lesson? **Students:** Today we think we are going to study the centre of gravity of a body.	**If your timetable doesn't have two successive periods, you can half number of repetitions allocated on activities.**

	Teacher: Good! We are going to study unit 5 'centre of gravity ' in its lesson 1(Centre of gravity and centre of mass of a body) Lesson objectives: By the end of this lesson, you should be able to: a) Differentiate between centre of mass and centre of gravity. b) Define centre of gravity and centre of mass.	
2 **INTRODUCTION** **(10 min)**	**Teacher:** Observe the figures below and answer the questions related on them Can the objects balance at any points?  **Student:** No! The objects balance at only one point **Teacher:** Lift a chair, raise one leg and pick up a quarter. What do you experience and think of the causes of it? **Students:** Not comfortable! The cause may be gravity and or additional mass.	**Tell students the materials needed and give them a small time to take them.** **Students must be given time to think and note down their ideas.**

3 LESSON DEVELOPMENT (55 min)	**Activity one:** **Teacher:** Balance meter rule and a squeegee horizontally using your finger. Repeat the activity two times more. What do you notice? Explain your notice and the causes. **Students:** The objects will be balanced at only one point. But for a ruler, it is balanced in its centre while for the squeegee, it is balanced nearby where there is too much weight. **Activity two:** **Teacher:** • Place a chair against the wall so that it cannot slide backward. • Sit in the chair with feet flat on the floor in front of you. (Feet may not be angled or slanted to the side.) • Have a partner gently place a thumb in the middle of forehead. • Now try to stand up without forcing partner's hand back. **What happened and why?** **Students:** It's so hard to stand up! This is because my center of mass is located over the seat of the chair rather than over my feet, which are in front of me.	**Emphasize new concepts.** **For each activity make sure that all learners are doing the task (individually, pairs, groups)** **At each step, provide a pause time for students to think and say or write their ideas.**

	Activity three: **Teacher:** • Place a chair sideways along a wall. • Stand next to the chair with feet_ beside the chair, not under the chair. • Bend over the chair by creating a 90-degree angle with the body. • Place head against the wall and hence lift the chair while keeping the head pressed against the wall. **What happened and why?** **Students:** It is so difficult for boys than girls. The center of mass for most girls is lower to the hips, while the center of mass in boys is much higher. Therefore, for most girls, the center of mass while bent over the chair is above their feet, while the center of mass for most boys is above the chair. **Teacher:** Very interesting but what is the physical meaning of the term "centre of mass"? **Students:** Center of mass is a term used by scientists to describe that point in an object where the object's mass or weight seems to be concentrated. This point could be a physical object, or it could be a point outside of the object. In a round/ spherical object, the equally distributed mass is the center of mass for the sphere. Finding the center of mass in an irregular object (such as the human body) takes a little more work to figure out.	**Don't forget to look for gender balance and different special educational needs.** **Use different questions to probe students to understand the content.**

	Activity four: **Teacher:** • Support the stick with both hands, resting the ends on just your index fingers. • Slowly slide your fingers together until they meet • Attach the weight or a piece of clay to some point on the stick. Again support the stick on two fingers, and then slide your fingers together to locate the new center of gravity. Move the weight or piece of clay to some new place on the stick. Explain your observation. **Students:** The stick's center of gravity is the place where I can balance the stick on just one finger. When I first support the stick with two fingers, one finger (the one that is closer to the center of gravity) will generally be holding a little more of the weight than the other. When I try to move my fingers closer together, the one that is carrying less weight will slide more easily. This finger will continue to slide more easily until it gets closer to the center of gravity than the other finger, at which point the situation will reverse and the other finger will begin to slide faster. My left and right fingers simply alternate moving until they meet at the center of gravity, where both fingers support equal weight. **Teacher:** What a good ideas! Is there any more questions please? **Student:** What is the physical meaning of the term centre of gravity?	**Provide an opportunity where learner can ask more questions.**

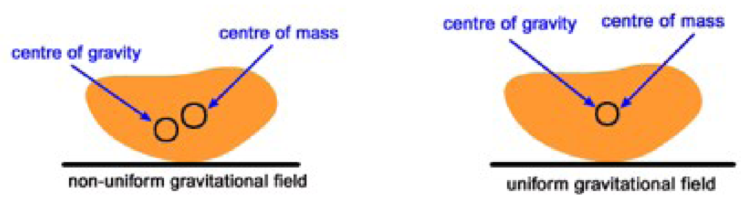
	Students/Teacher: Gravity is a term used by scientists to describe the force of gravitation given on an object or near the surface of a celestial body such as the Earth, the moon, or another terrestrial planet. This force pulls on all mass. The more mass an object has, the more gravitational force is exerted. **Student:** Which other situations in our real life where balancing objects is needed and helpful? **Teacher:** One person to carrying a long wooden block on shoulders; Riding a bicycle requires balancing; Walking on a string also requires balancing; carrying a jerrican full of a liquid	
	Summary: **Teacher:** Can you summarize what we learnt today? **Students:** • The centre of gravity of a body is the point from which the whole weight of the body appears to act. • Centre of mass of an object on the other hand is the point where all the mass of the object is concentrated. • The centre of gravity depends on gravitational field while the centre of mass doesn’t depend on gravitational field.	**Allow learners to provide their ideas to summarize the lesson(brainstorming)** **Use the learners' ideas to make a good summary.**

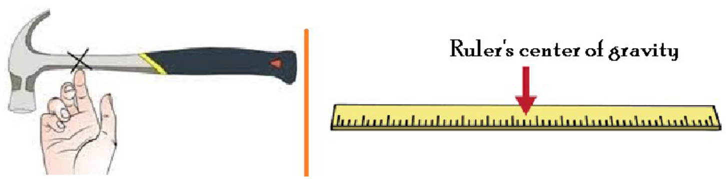
	• In addition, Centre of a mass of a system is such a point where an applied force causes the system to move without rotation" It is observed that the center of mass of a system moves as if its entire mass is confined at that point. A force applied at such a point in the body does not produce any torque in it i.e. the body moves in the direction of net force F without rotation.	
4 CONCLUSION **(10 min)**	**Teacher:** Take a paper and then do the following assessment **Assessment** 1. Why does a book balances at only one point? 2. The point through which the whole weight of the body acts is called **a)** Inertial point **b)** centroid **c)** center of gravity **d)** central point 3. Where does the Center of gravity is usually located? **a)** more weight is concentrated **b)** less weight is concentrated **c)** less mass is concentrated **d)** more mass is concentrated 4. In terms of definitions and location, differentiate between centre of mass and the centre of gravity. 5. With the use of a diagram, approximate where the centre of gravity of a hammer is located. Do the same for a ruler. Do they look alike in both cases? Explain.	**The assessment should done individually and will be marked.**

Students:

1. Because it is where its centre of gravity located
2. c) center of gravity
3. d) more mass is concentrated
4. By definition, Centre of gravity is the point from which the whole weight of the body appears to act while centre of mass the is the point where all the mass of the object is concentrated.

By location centre of gravity depend on gravitational field while centre of mass does not depend on gravitational field.





They do not look alike because for a hammer it is not in middle while for a ruler it is in middle. This is due that a hummer has irregular shape while a ruler has regular shape.

	Teacher: Now we are at the end of the lesson, your homework is to find the Centre of gravity of the following shapes: **1.** Rectangle **2.** Circle **3.** Square **4.** Triangle. **NB: Use different diagrams!** ***Thank you for your participation in this lesson.***	**Don't tell the leaners where they will search answers of a homework. Remember the homework is the opportunity for them to search from different resources.**

WORK, ENERGY AND POWER (I)

SUBJECT: PHYSICS	**GRADE:** S1	**DURATION:** 40min

LESSON TITLE: Work

LEARNING MATERIALS: books, timer or clock, piece of chalk, pen, chair, desk and a chart showing people doing different activities, a block of wood, a spring balance.

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS' READINESS** **(2 min)**	**Teacher:** Dear Students, Welcome to this Physics lesson! **Teacher:** Have you ever feel tired? What were the causes? **Students:** We get tired several times. For examples when teachers give us a lot of work (exams, exercises, sports,…). We think that tiredness is due to loss of energy. **Teacher:** Fantastic, today we are going to start our new unit 6(Work, energy, and power); lesson 1 is only for work.	**Begin by gaining student's attention (Welcoming them in the lesson and communicate the objective of the lesson)**

	Teacher: Dear students by the end of this lesson, you should be able to: a) define the term work, b) identify its units c) Calculate work, force, and distance, using the formula Work=Force X Distance moved direction on direction of force.	
2 **INTRODUCTION** **(5 min)**	**Teacher:** • You are provided with a piece of stone and a piece of chalk. • Drop a stone from different heights on to a piece of chalks • What is your observation related to the height from which a stone is dropped? What physical quantity that combines weight of stone and its displacement? **Students:** As the height increases the chalk more pain. The physical quantity that relates weight of stone and its displacement is called mechanical work.	**Tell students the materials needed and give them a small time to take them.**

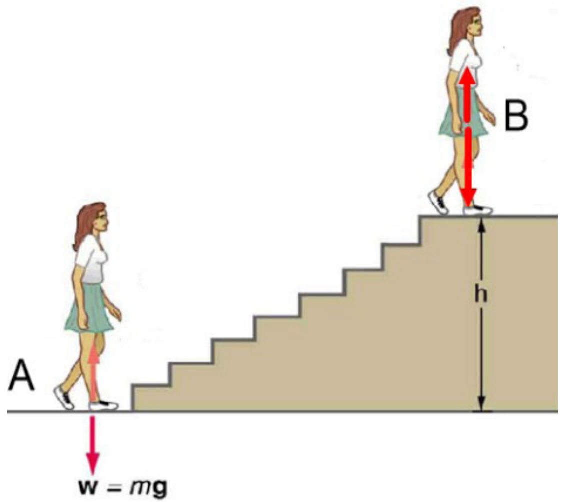
3

LESSON DEVELOPMENT

(25 min)

Activity one:

Teacher: In your group, observe this picture and discuss what is done from position A to position B and what would happen when this person moves slowly or quickly.



Student: What is done from A to B is work

If the person moves slowly, will use much time than when moves quickly and the power will not be the same on both situations.

work = force x distance. It is measured in joules (J)

At each step, provide a pause time for students to think and say or write their ideas.

	Activity two: **Teacher:** • In your group, let one student holds the book steady out in front of her/him and parallel to the floor. • On another hand, let the student carries the heavy chair from one location to another. • Who does a work? **Discuss.** **Students:**The student holding the book at a constant position is doing zero work, while the one who carries the heavy chair does a work. This is because the work depends on the force that moves an object in a certain distance. **Activity three:** **Teacher:** Give the real examples of tasks where the work is done on or by. **Students:** work is done on ball once shooted, the work is done by a player while shooting the ball, the work is done by the Earth to drop down an apple from its stem, the work is done on lift from the ground to nth floor,…	**Facilitate learners in their groups while are working on given example.** **Show them the correct answer to the example given** **Allow students to discuss in their groups and present their finds to others**

	Teacher: Very good, now can you explain the scientific meaning of "**work**" and its SI unit ***joule*** **Students:** Work is defined as the product of force and distance moved in the direction of the force. i.e **Work** = force × distance moved in the direction of the force. A **joule** is the work done when a force of one newton moves a body through a distance of one metre in the direction of applied force **Teacher: Example 1:** Find the work done in lifting a mass of 2 kg vertically upwards through 10 m. (g = 10 m/s2) **Students:** Applied force = weight = mg = 2kg × 10N/kg = 20 N Work done = F × d = 20 N × 10 m= 200 Nm = 200 J **Teacher:** What do you notice from example one? **Students:** To lift the mass upwards against gravity, a force equal to its own weight is exerted. **Teacher: Example 2:** A horizontal pulling force of 60 N is applied through a spring to a block on a frictionless table, causing the block to move by a distance of 3 m in the direction of the force. Find the work done by the force. **Students:** The work done = F × d = 60 N × 3 m = 180 Nm = 180 J	**Provide opportunities for corrective feedback or positive feedback to students.** **Use different questions to probe students to understand the content.**

Activity four:

Teacher: In your group, discuss the reason why you sweat when you move a distance while running but when you walk normally you don't sweat.

Students: Because when you are running the work is done in short time. This means that you are using a lot of power.

Teacher: Explain why in trying to push a rigid wall, a person is said to be doing no work.

Students: Its because there is no distance moved in the direction of force.

Teacher: Place the block of wood on a smooth horizontal surface; Attach the spring balance on the block and pull it slowly. What do you observe? Record the force needed to pull the block of wood. Measure the distance through which the block of wood has moved from the beginning to the end (d) in metres using a tape measure/metre ruler. Calculate the work done in pulling the block. What assumption did you make? **Explain**

Students: When the block of wood was being pulled, the spring balance registered the force applied. Since the block was on a smooth surface, we assume that friction force is negligible hence the force applied is constant along the distance of motion, d. Work done in moving the block is given by: Work = force × distance.

Teacher: Excellent! Dear students before we move forward, Is there any more question?

Student: How can I distinguish between work and energy?

Teacher: Good question, class can we work together and compare two terms please?

WORK	ENERGY
The action did on the object causing some displacement	**It is described as a property of a system or the ability to do work**
Work = force X distance	**There are various equations depending upon the types of energy**
The components of the force are parallel to the displacement	**Energy is the result of the work performed**
If the applied force is in the same direction of the displacement than work is positive. It the applied force is in the opposite direction of the displacement that work is negative	**The is no direction component here as it is a scalar quantity**

Summary:

Teacher: What have we learnt in this lesson?

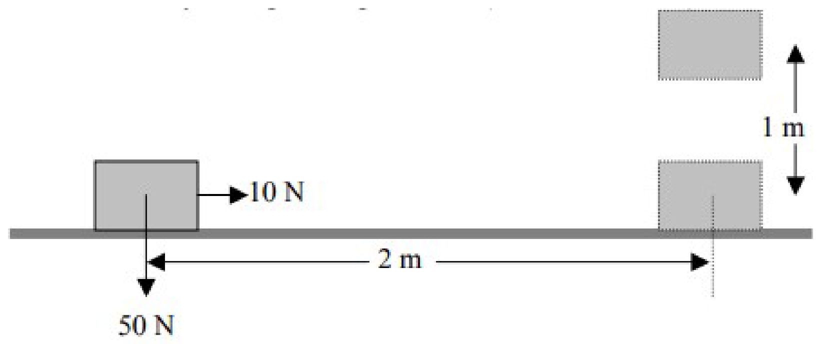
Students: Work is the product of force and distance moved in the direction of the force.

Use learners ideas to formulate the lesson summary

	A joule is the work done when a force of one newton acts on a body and makes it to move a distance of one metre in the direction of the force. When work is done on an object, energy is transferred. Work is said to be done if a force acts on a body and makes it move (get displaced) in the direction of the force, Energy is the ability to do work.	
4 **CONCLUSION** **(8 min)**	**Assessment:** **Teacher:** 1) Write mathematical definition of joule. 2) What happens to work when distance equals zero? 3) What happened to the amount of work done after you climbed the stairs twice, each time at a different speed? 4) How much work is done on a 50N package you carry horizontally for a distance of 10m? 5) How much work is done on a 625N rock that you lift 0.5m? **Students:** 1) 1J=1N m 2) There is no work because any number times zero is zero 3) The amount of work stays the same, or did not change 4) 0J because the force applied to package is perpendicular to the moved distance 5) W=F*d= 625N*0.5m= 312.5N m	**Allow the learners to work individually** **Make sure that you have marked learner's work.** **Analyse the class performance and encourage them to look from different resources so that the new unit will be most enjoyable and helpful.**

Teacher: Here is the homework:

A box of weight 50 N is pulled 2 m along a horizontal floor by a force of 10 N and then the box is lifted vertically through a height of 1 m (see sketch below)



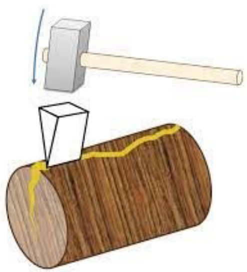
What is the total work done on the box? a) 35J b) 55J c) 70J d) 110J e)180J . **Explain.**

Thank you for your participation in this lesson.

SIMPLE MACHINES (I)

SUBJECT: PHYSICS	GRADE: S1	DURATION: 40min
LESSON TITLE: Introduction to simple machine.		

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 STUDENTS READINESS (5 min)	**Teacher:** Hello dear students. I hope you are doing well right! **Observe carefully this picture.**  **Teacher:** What does this figure shows/tells you? **Student:** Figure show man and woman who are doing work	Begin by gaining student's attention (Welcoming them in the lesson andcommunicate the objective of the lesson)

	Teacher: Who will do the work in easy way between man and woman? Why? **Students:** She is a woman because she is using a tool to simply that activity while a man uses his only force **Teacher:** How can we call that tool a woman used? **Students:** The tool is called a simple machine **Teacher:** Very good! Could you suggest what we will learn in this lesson? **Students:** We will learn simple machine **Teacher:** Thank you all. Today we are going to study unit 7: Simple machine. Today's lesson is Introduction to simple machine. **Learning objectives:** By the end of this lesson, the learner should be able to: explain the term simple machine and give examples of simple machines	**Let learners themselves try to provide the answer and facilitate them to reach on the intended answer.**
2 INTRODUCTION (8 min)	Observe the figures below and answer questions related on them.   	**Display the picture**

Teacher: Name the tools showed on the folowing figure.

Student: hummering nail,wood, bottles, opener, man pushing object on an oblique wood and spade.

Teacher: Good! What tools do we use to work easily?

Students: Hummer, Spade, opener and inclined plane .

Teacher: Very good ! How do we call tools we use to work easily ? Remember you learnt them in SET in primary

Students: Those tools are called simple machines

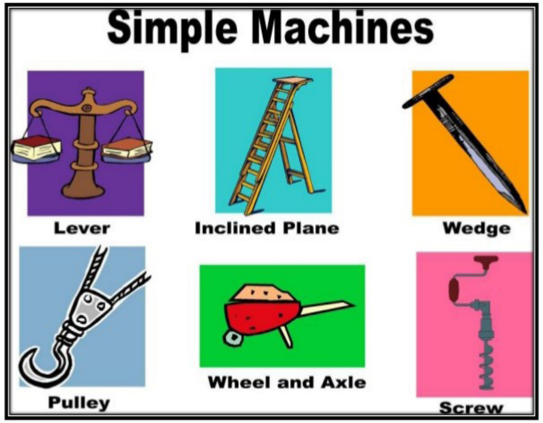
Student: Teacher, isn't possible to slide object at vertical wood?

Teacher: very interesting question! It is possible but we can use much effort than using an oblique wood

Form groups of 4 (depending on your class size), help learners to discuss

Ask learners to discuss in groups what does each of the pictures show

3 LESSON DEVELOPMENT (22 min)	**Teacher:** What is a machine in physics? Give an example. **Students:** A machine in physics is essentially a device or a tool which allows a force(effort) applied at one point to overcome a resisting force (Load) at another point. E.g.: a car, airplane, motors, etc **Teacher:** Good! What is the use of machine? **Students:** A machine is used for doing work more easily and conveniently that it could be done without it. **Teacher**: Good! we get meaning of machine. Then What is a Simple machine we mention above? **Students**: A Simple machine is a machine that is made up of only one type of machine and that is used to make work easier. **Teacher:** very good! What is the name of machine made up with more than simple machine? **Students**: Is a compound machine **Teacher:** very good! suggest the role of simple machines and examples. **Students:** Simple machines plays a role of allowing you to do all of these things without the assistance of any source of power other than your own.	**Encouraging learners to ask questions** **Students must be given time to think and provide good feedback**

	Examples Split a wood into piece Lift yourself up to a great height Pull a nail out of solid wood Raising heavy objects Fixing a nail into a wood **Teacher:** observe the picture below.  **What are the types of simple machine?** **Students:** Lever, inclined, wedge, pulley, wheel and axle and screw	**Learners observe the picture which contain the different types of simple machine and discuss**

	Application **Teacher:** Describe the simple machines that are used at home **Students:** a panga, scissors, knife, wheelbarrow, spoon, spade, ladder, hammer, bottle opener, bicycle **Teacher:** we are going to the end of the lesson. With examples, differentiate between machine and simple machine **Students:** A simple machine is a tool with few or no moving parts that is used to make work easy **Examples:** a lever, a wedge, wheel and axle, lever, inclined plane, screw, or pulley. A compound machine is a machine made up of two or more machines. Examples: car, bicycle, …	**In pairs allow the learners to discuss about the application where they use simple machine at home.** **Allow learners to provide their ideas to summarize the lesson**

4 CONCLUSION **(5 min)**	**Teacher: Assessment** 1) A machine made up of more than one simple machine is called A. A convex lens B. A compound machines 2) Which is not a type of a simple machine? A. Wedge B. Pulley C. Spring D. Screw 3) Which is a characteristic of simple machine? A. They run on electricity B. They take a long time to make C. They have few or no moving parts D. They are note very large 4) All of the following are considered to be simple machine except A. Scissors B. A bicycle C. A jackknife D. A Wheelbarrow	**Learners work individual the assessment and providing a good feedback**

5) With aids of examples, what is the difference between simple machine and compound machine?

6) What are three simple machines can you find in

A) a wheelbarrow b) a Bicycle

Students: Answers

1) B
2) C
3) C
4) B
5) Simple machine are used to make work easier and they are used in various places and times in our lives and do not contain an energy source so that can perform more work than is applied to them in their use

	Examples: a bottle opener, a ladder, wheelbarrow, a hammer, ... Compound machine is made of two or more simple machines working together. **Examples:** a bicycle, a car, corkscrew 6) a. Lever, wheel and axle, inclined plane b. Pulley, wheel and axle, Lever and inclined plane **Students: Homework** Discuss the importance of simple machines in our daily life. Support your argument with examples ***Thank you for your participation in this lesson.*** ***See you next time!***	**Tell learners to write this homework in their exercise's notebook** **Tell them that it will be submitted before the next lesson**

KINETIC THEORY AND STATE OF MATTER

SUBJECT: PHYSICS	**GRADE:** S1	**DURATION:** 40min

LESSON TITLE: Matter and its physical properties
LEARNING MATERIALS: Small stone, cup, water, balloon full of air

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 STUDENTS' READINESS **(2 min)**	**Teacher:** Good morning class! Welcome everybody to this lesson. Observe carefully the picture below 	**Begin by gaining student's attention.**

	Teacher: What does this figure shows you? **Students:** Ice, water and steam **Teacher:** What are the states of matter you know? **Students:** Solid, liquid and gas **Teacher:** What do you think we will learn in this unit? **Students:** Kinetic theory and states of matter **Teacher:** Thank you all! Today we are going to learn unit 8: Kinetic theory and states of matter, the lesson for today is "matter and its physical properties" **Lesson Objectives** By the end of this lesson, you should be able to: • Define the matter • Enumerate the components of matter • Differentiate between intensive and extensive physical properties of matter	**Communicate the objectives of the lesson.**

2 INTRODUCTION **(8 min)**	**Teacher:** To start our lesson. Let us make a simple experiment. **Materials:** Piece of chalk **Procedure:** 1) One member of each group take a piece of chalk and breaks it into halves. 2) He/she continue breaking until when the breaking can't continue any further. From this experiment, what do you notice the initial piece of chalk and the final particle in terms of size **Students:** The final particle is smaller than the initial piece of chalk. **Teacher:** Basing on the observation of the experiment, how can you define matter? What is matter is made up of?	**Students must be given time to think and note down their ideas.**
3 LESSON DEVELOPMENT **(20 min)**	**Teacher:** Can you define the matter? **Students:** The matter is anything that has mass and occupies space. Anything around us is matter. **Teacher:** From definition of matter, give examples of matter. **Students:** Cup, book, water, air, chalk, wall, banana, pencil, table, desk, tree … **Teacher:** After the experiment done in your group, what is matter made up of?	**Make a group of 4. Grouping students and gender must be respected in groups.** **Emphasize on new concepts**

Students: We observe that matter is made of tiny particles. The smallest particle of matter that can't be broken down further is called an atom.

Teacher: From the experiment, differentiate between element and an element and a compound.

Students: An element is a substance which cannot be split into a simpler substance. (eg Carbon) while a compound is a substance made of two or more elements combined together in a fixed proportion. E.g. water is made up of oxygen and hydrogen

Teacher: We have that an atom is the smallest particle that can't be broken. What are components of the atom?

Students: Atom is composed by electrons, protons and neutrons.

Teacher: Hello students, observe the image below.

Use different questions to probe students to understand the content.

Provide opportunities for corrective feedback or positive feedback to students.

	After your observations, which states of matter can be classified these different substances? **Students:** There are three states: solid, liquid and gas **Teacher:** After breaking the chalk the composition of chalk does it change? How can you call this property? **Students:** Each particle has the same composition as the all piece of chalk. This property is a physical property of matter. **Teacher:** What is a physical property of matter? **Students:** A physical property is a characteristic that can be observed or measured without changing the composition of the matter. **Teacher:** Now, how can call a property that changes the composition of matter? **Students:** It is a chemical property. **Teacher**: Some physical properties change with the change of the size of body others do not change. Give one example of property which changes with the size of body and one example which doesn't change with the size of body.	**Provide the time for students to think, say or write their ideas.**

Students: Examples:

1) Mass of body change with the size of body
2) Density of body do not depend on the size of body, it is constant.

Teacher: The property of body that does not depend on the size of matter is called intensive property while that depends on the amount of matter is called extensive property.

After understanding physical properties, give and define five examples of physical properties.

Students: Examples:

Mass: is the amount of matter in an object. It is measured in g or kg.

Weight: is a measurement of the gravitational force of attraction of the earth acting on an object. It is measured in newton (N).

Solubility: is the amount of substance that will dissolve in a given amount of solvent.

Volume: is the measurement of the amount of space a substance occupies.

Malleability: is the ability of a substance to be beaten into thin sheets (by hammering or rolling of matter

	Teacher: Thank you! Physical properties are so many. In your groups discuss the physical properties of materials encountered in your home place After your discussion, can summarize the today's lesson? **Students:** We can conclude that: Matter is anything that has mass and occupies space. Composition of matter (**atoms, elements, compounds and mixtures)** Physical properties (density, mass, volume malleability, hardness...) A physical property is a property that does not change the composition of matter but a chemical property change completely the composition of matter	
4 CONCLUSION **(10 min)**	**Teacher:** To conclude the today's lesson do the assessment below. **Assessment.** 1) What is matter? 2) What is the meaning of the term an element 3) Which are compounds? You may pick more than one response **A**. Gold **B**. Water **C**. Mercury **D**. Salt	**The assessment is done individually**

4) Define the term malleability and give one example of an element which is malleable

5) Differentiate between intensive and extensive properties of matter.

Students: Answers

1) Matter is anything that has mass and occupies space.

2) An element is matter composed by the same kind of particles

3) B and D

4) Malleability is the ability of substance to be beaten into thin sheets.

Example: Gold

5) Intensive property that does not depend on the amount of matter while extensive property changes with the amount of matter.

Teacher: Now I want to give you a homework assignment so that you try to apply some of what we have learned today at your own.

Homework:

1) What is matter?
2) What is matter made up of?
3) Define the following terms:

   a) an element   **b)** a compound

4) All bodies are they in the same state? Explain.
5) Differentiate between intensive property and extensive property of matter.

Thank you for your participation in this lesson.

HEAT AND TEMPERATURE

SUBJECT: PHYSICS	**GRADE: S1**	**DURATION:** 40min

LESSON TITLE: Difference between heat and temperature
LEARNING MATERIALS: Charts, manila papers, chalk board, thermometers, beakers, test tubes, stirrer

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 STUDENTS' READINESS (2 min)	**Teacher:** Hello students! How are you? **Students:** Hello teacher, we are ok! **Teacher:** Welcome to this lesson. Were you ever suffered from, Malaria in your life? **Students:** Yes, sir **Teacher:** How was your temperature? **Students:** Our temperature was very high.	**Begin by gaining students attention and communicate objective of the lesson (welcoming them in the lesson).**

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Teacher: Have you ever touched on a metal into fire? How did you fill?

Students: yes teacher we have tried. The metal was very hot.

Teacher: Could you suggest today's lesson?

Students: It should be heat and temperature.

Teacher: Thank you very match. Now, today's lesson is the **difference between heat and temperature** and let me give you the objectives of the lesson.

Lesson Objectives / Instructional Outcomes:

By the end of this lesson, you should be able to:

i. Describe the heat as a form of energy.

ii. Explain the difference between heat and temperature.

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2
INTRODUCTION

(4 min)

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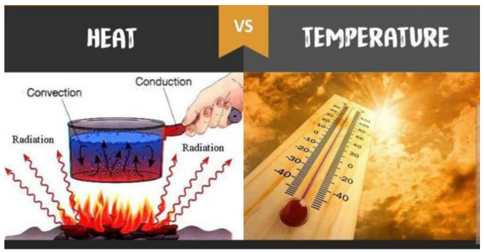
Teacher: Observe the picture and try to answer the questions



Is a heat temperature or not?

Students: The heat is different from temperature.

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Display the picture in the activity to the learners in groups.

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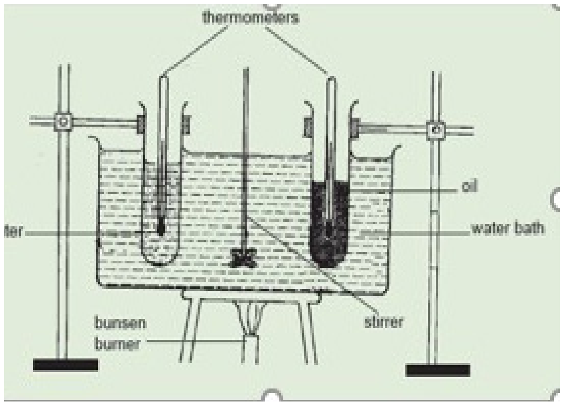
3 LESSON DEVELOPMENT **(20 min)**	**Teacher:** Now, we are going to do the activity and after you will analyze the difference between heat and temperature. **Materials:** Cooking oil, two identical test tubes, two identical thermometers, a beaker and a stirrer. **Steps:** 1) Take equivalent masses of water and cooking oil in two identical test tubes fitted with two identical thermometers. 2) Place these test tubes in a large beaker containing water (see the figure below). 3) Note the initial temperature of both water and oil in the tubes. Heat the water in the beaker and make sure that the heat is distributed uniformly by stirring the water. 4) After some time, note the temperature of water and oil in the test tubes. Are the two temperatures the same? **Explain**. 	**Tell students the materials needed and give them a small time to take them.** **Organize the learners into groups depending on the available set up.** **Ask students to do activity given.** **Through probing questions, let the learners describe the various parts of the set-up.**

	Students: After doing this experiment, we observed that the temperature of water is lower than the temperature of the oil. **Teacher:** Can another group add something? **Students:** When the tubes are heated for the same time, i.e. the same heat energy passes from the burner to the tubes, both oil and water gain equal amount of heat energy but at different temperatures. Therefore, two substances can have equal amount of heat energy supplied but be at different temperatures. **Teacher:** Very nice! So can you define clearly **heat** and **temperature**? **Students:** Yes, the **heat** is an amount of energy which passes from a hot body to the cold body. And the SI unit of heat is the Joule and is measured by an instrument called **calorimeter.**	**Let the learners record the temperature after heating the water and oil in the test tube.** **Ask the learners the use of water bath.** **Let them discuss their findings from the activity.** **Summarize their findings by pointing out that substances can gain equal amount of heat but are in different temperature.** **If calorimeters are available show them the learners.**

The **temperature** is the degree of hotness and coldness of the body or place. Its unit in SI is the Kelvin(K), and is measured using an instrument called **thermometer**.

HEAT	TEMPERATURE
It is energy transferred from hot body to the cold body	It is a degree of hotness of a place or of a body
Its SI is Joule (J)	Its S.I Unit is Kelvin(K)
It is measured by calorimeter	It is measured by thermometer

Emphasize new concepts.

Application activities:

When a malaria sick person goes to the hospital, do they check the heat or the temperature of his or her body? Explain your answer.

Students: They check his or her temperature because they use Thermometer, and it is used to measure temperature.

Teacher: Can someone conclude today's lesson?

Students: Yes, to conclude this lesson, we can say that:

- Heat is a form of energy which passes from a hot body to a cold body.
- The SI unit of heat is joule (J).
- Calorimeter is the instrument used to measure heat

At each step, provide a pause time for students to think and say or write their ideas.

	– Temperature is the degree of hotness or coldness of a body. It is also defined the average kinetic energy of the molecules of a substance. – The SI unit of temperature is kelvin (K) and is measured by an instrument called thermometer.	**The assessment is done individually**
CONCLUSION **(14 min)**	**Teacher: Assessment** 1) What do you mean by the term temperature? 2) What do you mean by the term heat? 3) Differentiate heat from temperature 4) What is the relationship between heat and temperature? **Students answers:** 1) The temperature is the degree of hotness and coldness of body 2) The heat is an amount of energy which passes from a hot body to the cold body 3) Heat is a form of energy which passes from a hot body to a cold body. The SI unit of heat is joule (J) Calorimeter is the instrument used to measure heat	

Temperature is the degree of hotness or coldness of a body. It is also defined the average kinetic energy of the molecules of a substance.

The SI unit of temperature is kelvin (K).

A thermometer is an instrument used to measure the temperature of a body

4) **Heat transfer** increases or decreases because of a difference in temperature between molecules.

This implies that when the difference in temperature **increases/decreases it increases/decreases** the amount of the heat flow

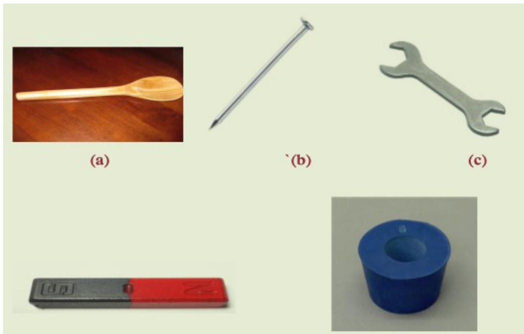
Teacher: Homework

Search on the internet about **the temperature scales.**

Thank you for your participation in this lesson.

MAGNETISM

SUBJECT: **PHYSICS**	**GRADE:** **S1**	**DURATION:** 80min
LESSON TITLE: Difference between heat and temperature **LEARNING MATERIALS:** Charts, projector slides, magnet, bottle openers, needle , glass ,wood , pair-scissors ,button ,paper clip, leaf ,stool, ,eraser ,and nut … :		

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS' READINESS** **(5 min)**	**Teacher:** Hello dear students! welcome in today's lesson .Observe carefully this figure  	**Begin by gaining student's attention.** **Display the pictures**

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Teacher: What does the figure shows?
Students: The figure shows different object such as magnet, cork, spanner, nail and the spoon made in wood.
Teacher: Good! Which materials can be attracted or cannot be attracted by the magnet?
Students: spanner and nail can be attracted by a magnet, but cork and the spoon made in wood cannot be attracted by the magnet.
Teacher: Thank you! How does the magnet work?
Students: The magnet attracts the metals but not all.
Teacher: Very nice! Could you guess what we will learn in this lesson?
Students: Magnetism
Teacher: Good! Today's lesson is Magnetic and non-magnetic materials
Learning objectives:

Define magnetic materials and give examples
Define non-magnetic materials and give examples

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<td>Communicate the objectives of the lesson</td>
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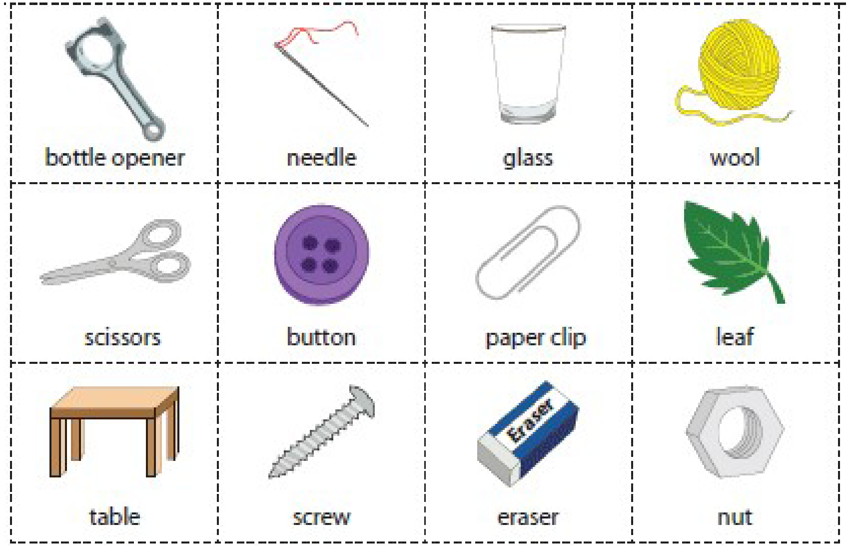
2 **INTRODUCTION** **(10 min)**	**Teacher:** observe the picture and answer questions below  Which do you think are magnetic materials and non-magnetic materials? **Students:** magnetic materials are bottle opener, needle, scissors, paper clip, screw and nut. non-magnetic materials are glass, wool, button, leaf, table and eraser. **Teacher:** Why do you select the materials in such way? **Students:** This is because magnetic materials are attracted by a magnet, but non- magnetic materials are not.	**Display the pictures to the learners in groups**

3

LESSON DEVELOPMENT

(55 min)

Teacher: Activity

Materials: Iron and steel nails, bar magnet, copper metal, cobalt, wood, zinc, glass rods

Steps

- Bring a bar magnet close to the iron nails, steel nails, bar magnet, copper metal, cobalt, wood, glass rods and observe what happens.
- Record your observations in tabular form as shown below

SUBSTANCES THAT ARE ATTRACTED BY A BAR MAGNET	SUBSTANCES THAT ARE NOT ATTRACTED BY A BAR MAGNET
1.	1.
2.	2.
3.	3.

Discuss your observations in step 2 and suggest the name given to substances that are attracted by a magnet and those that are not.

Group learners into appropriate group and provide them the needed materials.

Student :

SUBSTANCES THAT ARE ATTRACTED BY A BAR MAGNET	SUBSTANCES THAT ARE NOT ATTRACTED BY A BAR MAGNET
Iron nail	Copper
Steel nail	Wood
Cobalt	Grass rod

The materials which can be attracted by a magnet are **magnetic materials.**

Eg: Nickel, cobalt, iron and cobalt.

The materials which cannot be attracted by a magnet are called **non-magnetic materials.**

Eg: Copper, brass, aluminum, woods, plastics…

Teacher: What is an alloy?

Student: When metals are mixed together, they form alloys. Some alloys are ferromagnetic materials. An example is Al-ni-co which composed of aluminum (Al), nickel (Ni) and cobalt (Co) hence the name Al-ni-co.

Another example of alloys which are those composed of nickel, iron, copper, chromium or titanium; they are also ferromagnetic

At each step, provide a pause time for students to think and say or write their ideas.

	Teacher: We are reaching the end of the lesson, who can summarize what we learnt **Student:** The materials which are attracted by a magnet are called **magnetic materials** Materials which are not attracted by a magnet are called non-magnetic materials. The magnetic materials which are strongly attracted by a magnet are called **ferromagnetic materials.** When metals are mixed together, they form alloys. Some alloys are ferromagnetic materials.	**Use learners answers to summarize the lesson**
4 CONCLUSION (10 min)	**Teacher: Assessment** 1. With examples differentiate magnetic from non-magnetic materials 2. a) What do you understand by the term ferromagnetic material? b) State any 4 examples of ferromagnetic materials. 3. Tell way you can use to test if a given material is a magnetic material or nonmagnetic material **Expected answers:** 1. Magnetic materials are material which can be attracted by a magnet eg : Nickel ,cobalt, nail , iron	**The assessment is done individually.**

Teacher: Homework

1. a) What is an alloy?
   b) List any 3 examples of alloys
   c) Is zinc a magnetic substance? Explain your answer.

2. Differentiate the following materials according to their magnetic properties: steel needle, wooden block, a pencil, steel nail, iron feelings, plastic plate, cobalt, copper, a notebook, Al-ni-co

Thank you for your participation in this lesson

ELECTROSTATICS

SUBJECT: PHYSICS	**GRADE:** S1	**DURATION:** 40min
LESSON TITLE: Origins and types of electrostatic charges. **LEARNING MATERIALS:** pens, small pieces of paper		

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 STUDENTS READINESS (2 min)	**Teacher:** Good morning, everybody! Welcome to this lesson. Today, we have a new lesson. The lesson for today is: The origins and types of electrostatic charges. **Lesson Objectives / Instructional Outcomes** By the end of the lesson, you should be able to: • Describe the atomic structure • Describe the origin of charges • Identify types of charges • Explain what electrostatics	**Organizes the learners and give them the order to respect during the lesson.** **Announce the lesson title.** **Communicate the lesson objectives**

2 **INTRODUCTION** **(8 min)**	**Teacher:** Let us begin by reviewing the previous lesson by mentioning the components of matter. What is matter? **Students:** Matter is anything that has mass and occupies space. **Teacher:** What is matter made up of? **Students**: Matter is made of tiny particles (atoms).	**Give students the time to think and note down their ideas.**
3 **LESSON DEVELOPMENT** **(25 min)**	**Teacher:** Let us make a simple experiment **Materials:** Pen, small pieces of paper **Procedure** 1) Take a pen and a small piece of paper 2) Rub the pen in the hair 3) Place the pen nearest the small piece of paper **Teacher:** What is your observation? **Students:** The rubbed pen in the hair attracts the small pieces of paper. We say that the pen is charged by friction. By rubbing the pen gains the charge and becomes charged. There are the charges formed on the pen. The charges developed on the materials are at rest and cannot move. We therefore, call them static charges.	**Tell students the materials needed and give them a small time to take them**

Teacher: What is electrostatics?

Students: Electrostatics is the study of static charges.

Teacher: What is the composition of matter?

Students: The matter is composed by the tiny particles called atoms. Each atom is composed by **protons, electrons and neutrons**

Teacher: Compare the protons, neutrons and electrons in the atom.

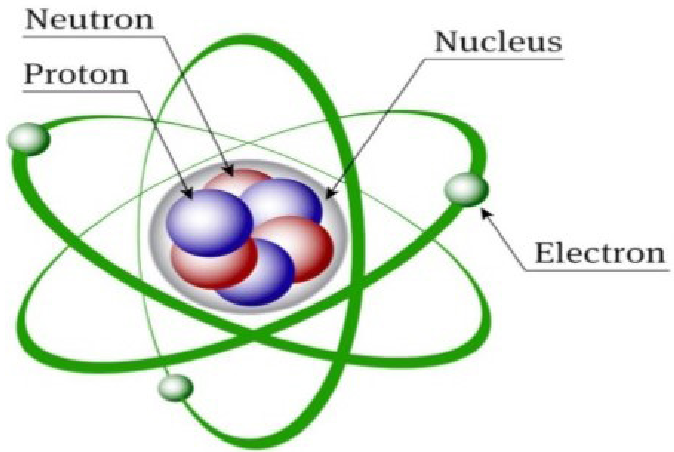
Students: Comparison between protons, electrons and neutrons

	PROTONS	NEUTRONS	ELECTRONS
Charge	Positively charged	Neutral (no charge)	Negatively charged
Location	In nucleus	In nucleus	Orbiting around a nucleus
Heaviness	heave	Heavier than proton	light
Symbol	p	n	e

Teacher: Draw a figure to represent the structure of an atom. Show position of the components of the atom.

Use different questions to probe students to understand the content and provides positive feedback to students.

Students:



Teacher: When do we say that an atom is electrically neutral?

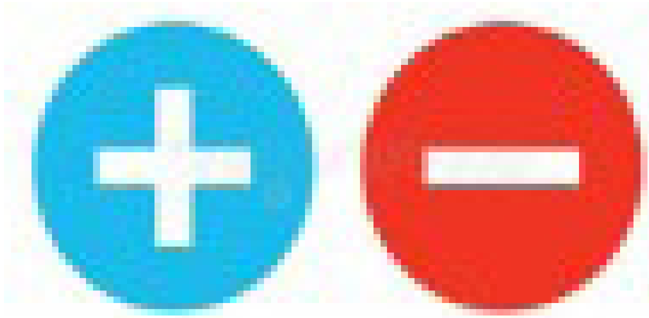
Students: An atom is electrically neutral when the number of protons and electrons in an atom are equal.

Teacher: What are types of charges?

Students: There are two types of static charges: positive charges and negative charges (commonly carried by protons and electrons respectively

Teacher: How do we represent the positive and a negative charge?

Students: Symbols of charges



positive charges (proton)

negative charges (ele Define the term electrostatics Define the term electrostaticsctron)

Give the pause time to student to think, say or write down their ideas.

Teacher: Let's together summarize what we have learnt.

Briefly explain the components of an atom.

Students: An atom is made up of nucleus and electrons.

- The nucleus contains protons and neutrons.
- The electrons have a negative charge; protons have a positive charge while neutrons have no charge.
- The number of protons and electrons in an atom are equal and hence an atom is electrically neutral.

Guide learners to give the expected answer.

	Teacher: What is SI unit of quantity of charge? **Students:** The SI unit of quantity of charge is the coulomb (C) **Teacher:** What is electrostatics **Students:** Electrostatics is a study of static charges. **Teacher:** Static charges are charges at rest. List the types of static charges. **Students:** There are two types of static charges: positive charges and negative charges.	
4 **CONCLUSION** **(5 min)**	**Teacher: Assessment:** Discuss on the following questions then answer them. 1) What is the SI unit of quantity of charge? 2) What does an atom made up of? 3) What are the types of changes? 4) Define the term electrostatics **Students: Answers** 1) The SI unit of quantity of charge is coulomb 2) An atom is made up of neutrons, protons and electrons 3) There are positive charge and negative charge 4) Electrostatics is the study of static charges	**The assessment may be done in pairs.**

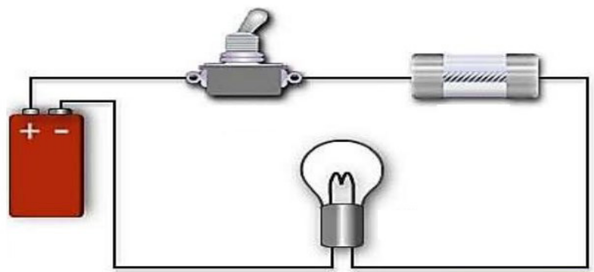
	Now I want to give you a homework assignment so that you try to apply some of what we have learned today at your own. **Teacher: Homework.** 1) Explain the origins of charge on body. 2) Give other methods can be used to create electric charges ***Thank you for your participation in this lesson.***	

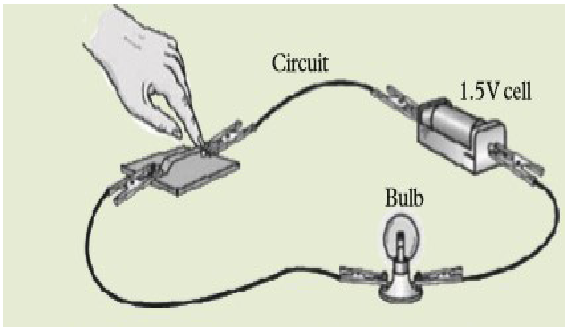
CURRENT ELECTRICITY (I)

SUBJECT: **PHYSICS**	**GRADE:** **S1**	**DURATION:** 40min

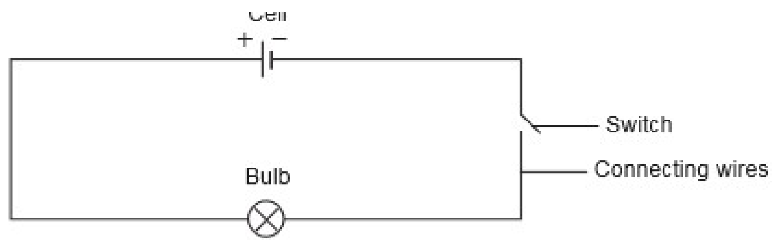
LESSON TITLE: Magnetic and non-magnetic materials
LEARNING MATERIALS: Switches, cell holder, dry cells, connecting wires, bulbs in bulb holders

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS' READINESS** **(5 min)**	**Teacher:** Hi dear students! You are welcome in today's lesson. Observe carefully this picture. 	**Begin by gaining students attention and communicate objective of the lesson (welcoming them in the lesson).**

	Teacher: What does the picture shows? **Students:** The picture shows electricity. **Teacher:** Thank you! Could you tell me the use of electricity? **Students:** Oh! Yes, electricity is use at home to light our rooms **Teacher:** Many flowers! Could you guess what we will learn in this lesson? **Students:** Electricity. **Teacher:** Thank you all you! Today we are going to study unit 12 'Current Electricity I. Today's Lesson is 'Simple electric Circuit and its components. **Learning objective:** By the end of the lesson, you should be able to design and describe the components of simple electric circuit.	
2 **INTRODUCTION** **(5 min)**	**Teacher:** Observe and answer the questions related to you observation  What does the diagram represent?	**Group learners into appropriate group** **Help learners to design simple electric circuit**

	Students: It represents electric circuit. **Teacher:** Define electric circuit. **Students:** The electric circuit is a complete path along which the charges flow.	
LESSON DEVELOPMENT **(25 min)**	**Teacher:** Let us do the following activity: Use the simulation below and design a simple circuit with the following **Set up a simple electric circuit** • Place a dry cell in a cell holder • Connect one end of the connecting wire to one of the terminals of the cell holder. Screw the bulb in the bulb holder. • Connect the other free end of the wire from the dry cell to the bulb holder • Use the second wire to connect the other end of the dry cell to the bulb through as switch  Close and open the switch in turn. What happens to the bulb?	

	Close and open the switch in turn. What happens to the bulb? **Students:** When the switch is closed, the bulb lights. When switch is open, the bulb does not light **Teacher:** What do you understand by terms "electric circuit **Students:** Electric circuit is a path or line through which an electrical current flow. **Teacher:** State the components of electric circuit and their role. **Students:** The components of electric circuit and their role are cell or battery (source of voltage), wires (conductive path), switch and the bulb. **Teacher:** As you know the electricity is dangerous in some way. How could you control it? **Student:** Avoid touching uninsulated wire. **Teacher:** Tell the main points of the lesson and explain them clearly. **Students:** The main components of simple electric circuit are **source of current , conducting wire ,receptors (resistor, bulb)**	**Emphasis on open and closed circuit** **Use learners answers to summarize the lesson**

4 **CONCLUSION** **(5 min)**	**Teacher: quiz** 1) Draw a diagram for a simple circuit. 2) What is an open circuit? **Students: answers** 1.  2. An open circuit does not allow current to pass through the circuit ***Thank you for your participation in this lesson.***	**The quiz must be done individually**

RECTILINEAR PROPAGATION OF LIGHT.

SUBJECT: **PHYSICS**	**GRADE:** **S1**	**DURATION:** 40min
LESSON TITLE: Nature of light. **LEARNING MATERIALS:** Charts, Phone torch, candle, match box		

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS' READINESS** **(2 min)**	**Teacher:** Hello students! I hope you are fine. **We are in which period of the day? Daylight or night?** **Students:** We are in daylight. **Teacher:** Which main difference between day and night? **Student:** The main element that differentiates day and night is light. At day we see sunlight at night non-sunlight. **Teacher:** Good! Could you suggest what are we going to study in this lesson?	**Begin by gaining students' attention, revisiting pertinent skills and prior knowledge and communicate objective of the lesson**

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Students: Light

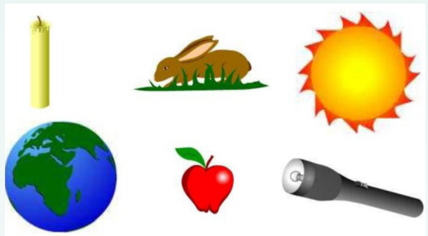
Teacher: Excellent! The lesson of today is nature of light.

Lesson Objectives / Instructional Outcomes:

By the end of this lesson, you should be able to:

- define light
- Identify different sources of light.

Teacher: Observe the following pictures.



What do you observe from the picture?

Students: From the pictures we observe different source of light.

Teacher: What are different types of sources of light you observed?

Students: Luminous source of light and non-luminous source of light

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Display the picture to the learners in groups

Teacher may also use real object materials such as phone torch, candle,

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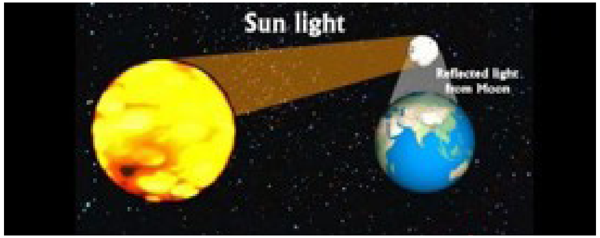
3 **LESSON DEVELOPMENT** **(25 min)**	**Teacher:** Who can suggest the definition of light? **Students:** Light is a form of energy that enables us to see the surrounding objects. Light itself is not visible but its effect is felt by the eye. For example, the track of light entering a room cannot be seen; but the track becomes visible, if some dust particles are present in the room. Light is actually a form of energy in a wave form. It travels at a speed of approximately 300 000 000 m/s or 3 × 108 m/s. **Teacher:** Who can suggest the meaning of luminous sources of light? **Students:** Luminous sources of light are sources (objects) that emit (give out) their own light. **Teacher:** What are the examples of luminous sources of light? **Students:** Examples of non-living luminous objects are sun, stars, fire, candle flame and electric bulb. Examples of living things that are luminous objects are fireflies and glow **Teacher:** Then what are non-luminous sources of light? **Students:** Non-luminous sources of light are objects that do not emit (give out) their own light. We get to see these objects when they reflect the light falling on them from luminous source onto our eyes. The moon is a good example of a non-living thing that is non-luminous source of light. Others are a wall and a car.	**Use different questions to probe students to understand the content.** **Provide opportunities for corrective feedback or positive feedback to students.**



Present a chart that show reflection of light from sun to the earth through the moon.

Application activity

Teacher: In group of two discuss about the sources of light you use at home

Students: Possible sources: Electric bulb, candle, kerosene lamp, fire wood, moon, sun, torch..

Teacher: By summarizing this lesson, what we learnt in this lesson?

Or draw the figure on chalk board.

Students: During this lesson we learnt that:

Light is a form of energy. It enables us to see the surrounding objects.

Luminous sources of light these are sources (objects) that emit (give out) their own light.

Non-luminous sources of light These are objects that do not emit (give out) their own light.

Use learners' ideas to formulate the lesson summary.

4 CONCLUSION **(5 min)**	**Teacher:** As we learned different things about light, let us answer to the following questions 1) What is light? Light is a form of energy that enables us to see surrounding object. 2) Explain (a) Why is the sun called a luminous object? (b) Why is moon non- luminous? **Students: Answer**: a) Because it emits its own light. b) because it doesn't produce its own light but it reflects light from sun ***Thanks for your attention in the lesson!***	**Allow the learners to answer the questions. Brainstorming** **provide opportunities for corrective feedback to learners** **Allow the learners to work individually** **Make sure that you mark learner's work.**

Sample Scripted Lessons For Senior Two

SOURCES OF ERRORS IN MEASUREMENT OF PHYSICAL QUANTITIES

SUBJECT: PHYSICS	**GRADE:** S2	**DURATION:** 80 min

LESSON TITLE: Dimensions of physical quantities

Learning materials: Pictures of Measurement Instruments

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS' READINESS** **(2 min)**	**Teacher:** Hello students, welcome for today's lesson. **Observe the following picture.** 	**Let learners observe the picture.** **Bring different measuring instruments in class.**

	What does this figure shows/tells you? **Students:** Measuring instrument **Teacher:** Have you seen something similar to this? **Students :** Yes/ Micrometer screw gauge, tape measure, vernier calliper **Teacher:** What do you think we will learn in this unit? **Students:** Measurement **Teacher:** Thank you all! Today we are going to learn unit 1: Sources of error in measurement of physical quantities, the lesson is dimensions of physical quantities. **<u>Lesson Objectives</u>** **By the end of the lesson, you should be able to:** • identify appropriate measuring instruments • State the fundamental and the derived quantities and determine their dimensions. • Use dimension analysis to verify equations in physics.	**Allow learners to observe and ask questions.** **At each step, provide a pause time for students to think and say or write their ideas.**

2

INTRODUCTION

(8 min)

Teacher: Observe the following instruments and answer the question related to your observation

Teacher: Name the instrument using to measure the length and width of classroom.

Students: Meter rule

Teacher: Name the instrument used to measure the thickness of paper

Students: Micrometer screw gauge

Teacher: Name the instrument used to measure the diameter of a wire.

Students: Micrometer screw gauge

Teacher: Name the instrument used to measure the length of a football pitch.

Students: Tape measure

	Teacher: Name the instrument used to measure the mass of a stone **Students:** Beam balance **Teacher:** Name the instrument used to measure the mass of a feather **Students:** Electronic balance	**Provide opportunities to ask the questions.**
3 **LESSON DEVELOPMENT** **(60 min)**	**Teacher:** All these instruments are used to measure. What does it mean measurement of a physical quantity? **Students:** Measurement is the process of obtaining the magnitude of a physical quantity, such as length or mass ... **Teacher:** A physical quantity can be measured by different instruments. How can you choose an instrument better than another? **Students:** We must always choose one which is most suitable for measuring the quantity depending on the sensitivity required for the measurement and on the order of size of the required measurement **Teacher:** In physics S1, we have seen that there are different physical quantities. State those physical quantities. **Students:** There are fundamental quantities and derived quantities	**Emphasize on new concepts.** **Use different questions to probe students to understand the content.** **Provide opportunities for corrective feedback or positive feedback to students.**

Teacher: Can you enumerate different fundamental quantities?

Students: Length, mass, time, electric current, temperature, amount of substance and luminous intensity.

Teacher: Each of the seven base quantities used in the SI is regarded as having its own dimension, which is symbolically represented by a single capital letter. The dimensions of fundamental physical quantities mentioned above are symbolized by L, M, T, I, T, N, L.

Students: Are there the relationship between dimensions of basic physical quantities and derived physical quantities?

Teacher: The dimensions of derived quantities from the combination of dimensions of basic quantities which constitute the derived quantities.

For example: Area (A) is obtained from length times length. Then, the dimension of area A will be written as: $\mathbf{A = L \times L = L^2}$

Students: Good! How can we generalize the way to reach on dimensions of different derived physical quantities?

	Teacher: In general the dimension of any quantity Q is written in the form of a dimensional product, dim Q = LaMbTcIdKeNfJg where the exponents a, b, c, d, e, and g, which are generally small integers that can be positive, negative or zero, are called the dimensional exponents. **Students:** To obtain the dimension of a derived physical quantity it is very important to know the formula that gives this quantity. **Teacher:** Very good! Now, find the dimension of volume. **Students:** The dimension of volume is obtained as follow: Volume v = length (l) x length (l) x length (l) Then, dimension of volume is L x L x L= L^3 **Teacher:** Very good! Thank you. Can you find the dimension of density? Find it. **Students:** Density = Mass/volume Dimension of density is written as: M/ L x L x L= M/L^3= M x L^{-3} **Teacher:** We have seen that the measuring is very important. Now, why should we choose the most suitable instrument before measuring? **Students:** Because each quantity has its specific instrument and instruments differ in sensitivity and accuracy	**Grouping the students and gender must be respected**

	Teacher: What have we learnt in this lesson? **Students:** In science, measurement is the process of obtaining the magnitude of a quantity, such as length or mass, relative to a unit of measurement, such as a meter or a kilogram. Measurement is done using measuring instruments which differ in their sensitivity, that's why we must choose the most suitable instrument for the measurement of each quantity. Physical quantities are classified into derived and fundamental physical quantities. Quantities have different dimensions and units.	**Help learners to formulate the summary of the lesson**
4 **CONCLUSION** **(10 min)**	**Teacher:** In your groups try to answer the following questions **Assessment:** In the following questions you choose the correct answer for each question. **1. A micrometer screw gauge is used to measure** **A.** Length of the road **B.** Width of the measuring cylinder **C.** Area of a tennis pitch **D.** Width of a small electric wire **2. The tape measure is most suitable in measuring** **A.** The length of the football pitch **B.** The volume of water in a cup	

C. The size of marble **D.** None of them

3. The vernier caliper is most suitable in measuring

A. Volume of water in a tank **B.** Length of a book
C. Width of marble **D.** Area of a field

4. One of the instruments below is used to measure volume of juice. choose the correct instrument.

A. Beam balance **B.** Measuring cylinder
C. Electronic balance **D.** Ruler

5. The dimension of area is represented by

A. L x L **B.** L/T
C. M **D.** M x M

Students:

1. **D** 2. **A** 3. **C** 4. **B** 5. **A**

Now I want to give you a homework assignment so that you try to apply some of what we have learned to day at your own.

Homework: Find the dimensions of the following physical quantities:

a) Density b) Weight
c) Pressure d) Kinetic energy

Thank you for your participation in this lesson.

QUALITATIVE ANALYSIS OF LINEAR MOTION

SUBJECT: PHYSICS	**GRADE:** S2	**DURATION:** 40 min

LESSON TITLE: DEFINITION AND TYPES OF LINEAR MOTION
LEARNING MATERIALS: ila paper, markers, notebooks, pictures…

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS' READINESS** **(5 min)**	**Teacher:** Good morning, dear students? How are you? **Students:** Good morning teacher. We are very nice **Teacher:** Observe the picture in front and comment on it. What do you see? 	**Begin by gaining students' attention and communicate objective of the lesson.**

	Students: We see a car **Teacher:** What is the car doing? **Students:** The car is moving or at rest. **Teacher:** Could you suggest what are we going to study? **Students:** The motion of objects **Teacher:** Thank you very much, Now, we are going to study Unit 2: Quantitative analysis of linear motion, lesson 1: definition and types of linear motion. **Lesson Objectives /Instructional Outcomes:** By the end of this lesson, you should be able to: - Define linear motion - Identify the types of linear motion.	
2 **INTRODUCTION** **(5 min)**	**Teacher:** Observe the picture bellow and comment on it. What do you see?  **Students:** A car is moving on the straight line.	

<table>
<tr><td></td><td>Teacher: Very god! You are right. Can you think about the name of our lesson today?
Students: We are going to sutdy the motion
Teacher: Excellent!</td><td></td></tr>
<tr><td>3
LESSON DEVELOPMENT

(20 min)</td><td>Teacher: Now, on the picture bellow, each girl is moving on a straight line. Can you tell me the name of the motion in which the body moves on the straight line?

Students: the motion which follows a straight line is called linear motion
Teacher: Ok, thanks, can you define clearly the linear motion?
Students: Yes, an object is said to make a linear motion when it follows a straight path.
Teacher: Great! What are the types of linear motion?
Students: The types of linear motion are uniform linear motion and non-uniform linear motion.</td><td>Show the picture and ask learners questions which help them to formulate a key question.</td></tr>
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Teacher: What is the difference between them?

Students: Uniform linear motion is the motion in which the body moves at constant velocity, While the non-uniform linear motion is which the body moves at variable velocity.

A linear motion is a kind of motion described or analyzed in one dimension.

Teacher: What are the types of non-uniform linear motion?

Students: When the velocity increases uniformly, the motion is called a uniformly accelerated linear motion, and when the velocity decreases uniformly the motion is called a uniformly decelerated linear motion.

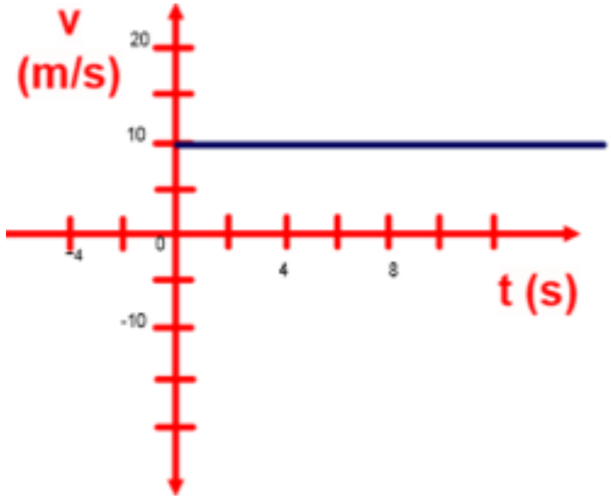
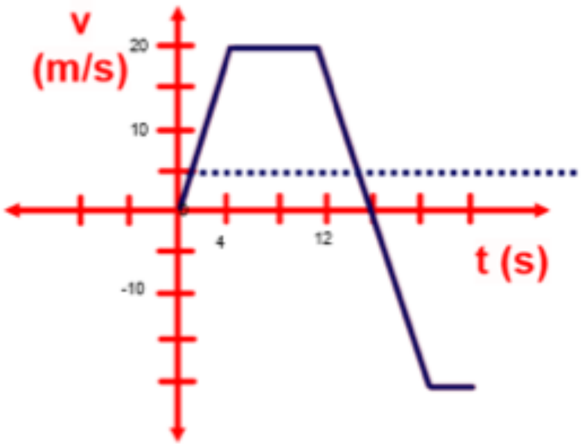
Teacher: What are the examples of non-uniformly linear motion in real life situation?

Students: The free fall motion of body and the body thrown upwards are examples of a uniformly accelerated and decelerated linear motion respectively in a vertical direction.

Teacher: Thanks a lot, now let me give you some exercises of application

Activity of application:

Look at the velocity-time graphs bellow carefully and state which kind of linear motion are they standing for.

	a.  b.  	**The teacher facilitates the learners to explain the key concepts.**

Students answer:

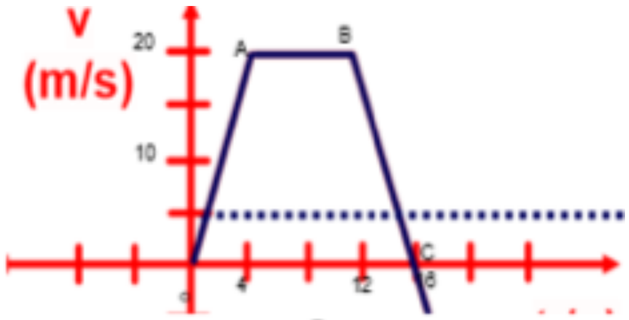
From the graph **(a),** the velocity -time graph stands for a uniform linear motion with a constant velocity of 10m/s.

From the graph **(b)**, the velocity-time graph stands for a non-uniform linear motion, where the velocity changes from 0m/s to 20m/s in the first 4s, remains constant in the next 8s then decreases from 20m/s to 0m/s in 4s.

The teacher ask questions by respecting gender and learners with special needs are considered.

Application 2:

The graph below describes how the velocity of path's car changes with time through its trip. State the types of linear motion between i. A and B, ii. B and C and iii. O and A.



Students must be given time to think and note down their ideas.

Answer:

i. At A and B, the velocity remains at constant velocity of 20m/s during 8 seconds. This is the uniform linear motion.

	ii. At B and C there is a decreasing in velocity from 20m/s to 0m/s during 4seconds, this is the non- uniform decelerated motion. **iii.** From O and A, the body accelerates from 0m/s to 20m/s during 4 seconds, the motion is non- uniform accelerated motion.	**Emphasize new concepts.**
	Teacher: Now, there are many examples of linear motions in real life situation **Can you tell me some of them?** **Students:** - Cars moving in straight road - Elevator in house construction on a straight line - Free fall of the body in vacuum. **Teacher:** Let together summarize our today's lesson. What did you learn in this lesson? **Students:** In summary, we studied that - The linear motion is which of body moving on a straight line. It has two types: uniform (constant velocity) and non-uniform motion (variable velocity). - A linear motion is defined as one dimensional motion. - The free fall motion of bodies and running races on horizontal grounds are examples of linear motion.	**Learners relates the lesson to real life situation.** **The teacher helps learners to summarize the lesson** **Give a time pause to learners to think and write the ideas.**

	- There are two types of linear motion, uniform linear motion and non-uniform linear. - For uniform linear motion the velocity is constant throughout the journey, while for non-uniform linear motion the velocity is changing either by decreasing or increasing.	
4 **CONCLUSION** **(10 min)**	**Assessment:** **Teacher:** Now, we are going to do an evaluation to see if you have understood the lesson. 1. The body is executing a linear motion if a path followed is: **a**. circular motion, **b**. straight line, **c**. zigzag line. ***What is the best answer?*** 2. A body is moving with a velocity of 10m/s. If the motion is uniform, what will be the velocity after 10 seconds? 3. Can a body have a constant speed but a variable velocity? 4. The following are examples of linear motion except: a. Mango dropped from the tree b. A ball kicked and moves on the horizontal football ground from one side to the opposite side c. A point on a rotating tyre of a bicycle.	

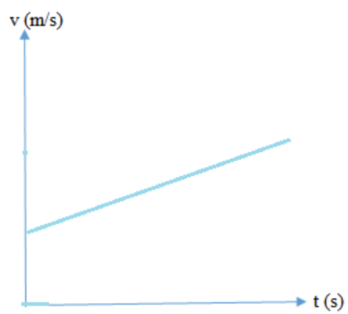
Students: Solutions

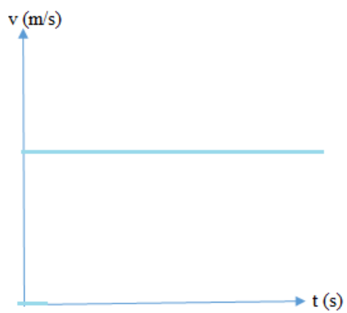
1. The best answer is **b**
2. Because the uniform motion implies the zero acceleration, then from the equation v= u + at (studied in S1), a=0, this means v=u. After 10 seconds the velocity of an object will be the same as the initial velocity. V=10m/s
3. Yess a body can have a constant speed and a variable velocity, whenever the direction changes, the velocity changes because it is a vector quantity.
4. **c)** The point on a rotating tyre from the tyre of a bycle.

Teacher: Let me give you homework.

Homework:

1. Which type of the motion on figures bellow





Provide opportunities to corrective feedback or positive feedback to students.

	2. A car changes its velocity from 10m/s to 25m/s, this motion is: **a**. uniform motion **b**. non uniform decelerated motion **c**. non uniform accelerated motion **d**. circular motion. ***What is the best answer?*** **Teacher:** Thank you for your participation in this lesson. See you next time.	**The learners are encouraged to do the research while doing the homework given**

FRICTIONAL FORCE

SUBJECT: PHYSICS	**GRADE:** S2	**DURATION:** 40 min

LESSON TITLE: Nature and types of friction forces

Learning materials: flat piece of plywood, a kitchen cutting board or even a large book, boxes, cylindrical objects or related objects, charts or photos.

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS' READINESS.** **(2 min)**	**Teacher:** Dear students welcome to this physics lesson!!! Let all of us stand up!!! Good why are you standing? Use physics to explain. **Students:** There are forces the act on us and they keep us standing! **Teacher:** Right! Forces are there to keep us at rest or move. What do you think are we going to study? **Students:** Friction force	**Begin by gaining students' attention and communicate objective of the lesson.**

	Teacher: Great! We are going to start a new unit 3: Frictional forces; Today 's lesson is Nature and types of friction force. **Lesson Objectives:** By the end of this lesson, you should be able to: • State and explain the nature of frictional force. • Describe types of frictional forces.	**Let the learners discover the concepts themselves by answering the questions.**
2 **INTRODUCTION** **(5 min)**	**Teacher:** observe the picture then ask questions related to your observation  What cause the block not to move easily as the boy pulls on it? **Students:** Friction is the force that opposes the motion of an object as it moves across a surface or as it makes an effort to move across it.	**If there is a pictures , give students a chance to visualize it (once there is no printed picture you can draw it on manilla paper or you use a story telling or demonstration)**

3 **LESSON DEVELOPMENT** **(25 min)**	**Teacher:** Join your groups and do the following activities **Activity 1:** • Make an inclined plane at a shallow angle using a flat piece of plywood, a kitchen cutting board or even a large book. • Place two coffee cups on the board, one cup on its rough, unglazed bottom; the other on its smooth, glazed side. • Predict what will happen when you slowly raise the plane to a steeper angle.  • Can you explain what makes the cup on its side slide down while the cup on its bottom does not (until you increase the plane to a steeper angle). **Students:** The force of gravity must be great enough to overcome another force, the force of friction, in order for the cups to move. Friction is a force that occurs between two surfaces, and it acts to impede motion.	**Students must be given time to think and note down their ideas.**

Teacher: What do you think will happen if you change the bottom of the cup by gluing sandpaper to it?

Will the cup slide more or less freely down the inclined plane?

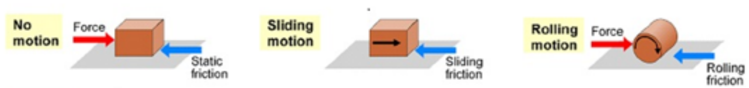
Students: The cup will slide less freely.

Teacher:

Activity 2:

- In your group, provide two boxes and (or cylinders such as piece of chalk) one full of items, another empty! Push or slide each with a small force.
- Discuss the results! Doesn't each applied force cause the motion? Why?

Students: Not all applied forces cause the motion. The resistance to motion that must be overcome in order to allow one surface to begin sliding against another surface(Static friction).The resistance to motion that occurs once one surface is in motion, sliding against another surface(kinetic friction). Kinetic friction can either be sliding or rolling.



Activity 3:

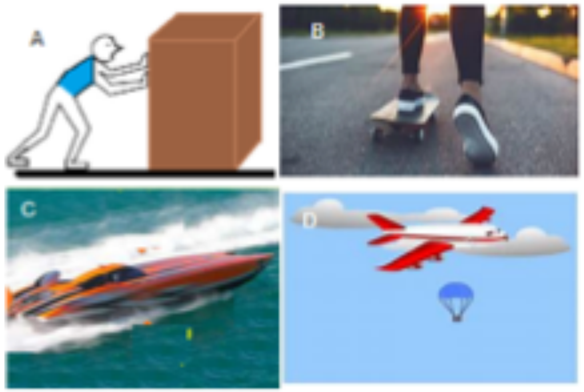
Teacher: Give at least two real life examples of application for sliding of friction.

Emphasize new concepts.
At each step, provide a pause time for students to think and say or write their ideas.

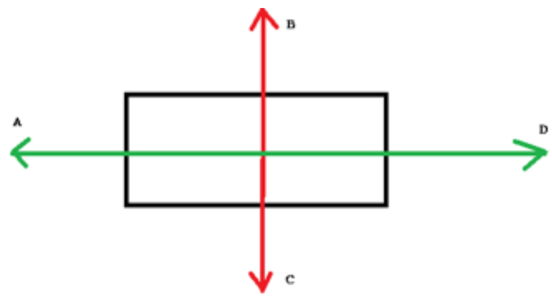
	Students: Rubbing both hands together to create heat, A sled sliding across snow or ice, Skis sliding against snow person sliding down, box sliding against a table, washing machine pushed along a floor, iron being pushed across material, frame and the edge of door sliding against one another, bottom of a trashcan sliding against the concrete, block being slid across the floor, two cement blocks being slid into place next to each other, two cards in a deck sliding against each other, bottom of a glass being pushed across a table, couch sliding against the steps when being moved, dresser's legs on the carpet when being slid to another part of the room, rope and the pulley on a set of blinds, friction between two books when sliding one into place on a bookshelf, friction between the bottom of a book and the shelf when being slid into place vegetable drawer sliding against the holder in the fridge, check being slid across the counter at the bank, paper sliding against the paper holder once emitted from a copy machine, paper on the roller as it slides through a printer, bottom of a chair leg and the floor when a chair is moved out, bottom of the coffee pot when slid out from the maker.	**Make groups of 4 learners each and let them discuss, From the answers they got, show them provided answer to complement.**

	Teacher: Very good, Is there any more questions please? **Student:** When a, birds, fishes and boats are moving through gases or water, I see some resistances. Are they also the friction forces? **Teacher:** Good question! When a, birds, fishes and boats are moving through the fluids (gases or liquids); They face a resistance that reduce their speed. These resistances or drags are called fluid friction. **Student:** What are some factors that affect fluid friction? **Teacher:** More the speed of object more drags, more streamlined object less drags, bigger the object bigger the drags, more viscous fluid more drags. **Teacher:** In summary; what have we learnt in this lesson? **Students:** • There is usually less friction when two smooth surfaces slide past each other than when one (or both) of the surfaces is rough. • The rough surfaces are bumpy and the bumps on the two surfaces hit each other and make it harder for one surface to slide past the other. • F friction: A resistance to motion that occurs when two surfaces are in contact with each other.	**In the group discussion remember gender and students with special needs.**

	• Kinetic friction: The resistance to motion that occurs once one surface is in motion, sliding against another surface. • Static friction: The resistance to motion that must be overcome in order to allow one surface to begin sliding against another surface. • Fluid friction is the force that resists motion either within the fluid itself or of another medium moving through the fluid. There is internal friction, which is a result of the interactions between molecules of the fluid, and there is external friction, which refers to how a fluid interacts with other matter. Example of fluid friction is air/water resistances. • More the speed of object more drags, more streamline object less drags, bigger the object bigger the drags, more viscous fluid more drags.	**Allow the students to make their own summary**
4 **CONCLUSION** **(8 min)**	**Teacher:** Take your exercise notebook and do the following assessment. **Assessment** 1. What is friction? 2. Look carefully the picture and then say the type of friction from A to D.	**Provide opportunities for corrective feedback or positive feedback to students.**



3. Give three examples of friction in our daily life.
4. Kiza pushes a box rightward, but it resists to the motion one 100%. Name all forces on this free body diagram.



Students:

1. Friction is the force that opposes the motion
2. **A**: Static Friction **B**: Kinetic Friction

   C: Water resistance **D**: Air resistance.

3. Skis sliding against snow person sliding down, box sliding against a table, bottom of a chair leg and the floor when a chair is moved out.

4. **A:** is friction force, **B:** is normal force.

   C: is the weight, **D:** is applied force,

Teacher: We are at end of today's session but here is an individual homework

Homework:

1. Apart from what we have seen, discuss at least 4 examples where the friction can be observed.
2. Why airplanes move faster than chips?

Thank you for your participation in this lesson.

DENSITY AND PRESSURE IN SOLIDS AND FLUIDS

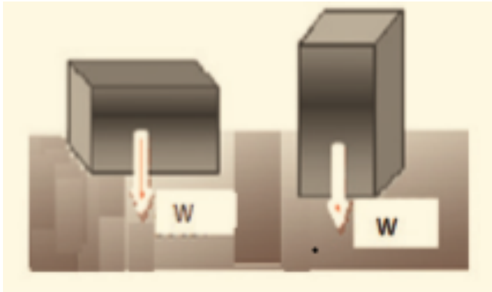
SUBJECT: **PHYSICS** **GRADE:S2**

LESSON TITLE: Force exerted by solid on area surface

Learning materials: computer, projector, bricks, ruler, Balance, basket full of sand, a long beam of wood, chalk board, chalks, physics learner's book S2.. **DURATION:** 40 min

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS READINESS** **(5 min)**	**Teacher**: Hello dear student! Welcome in today's lesson. Carefully observe this picture. 	Display the picture

	What does this figure shows/tells you? **Students:** A solid body in a fluid. **Have you seen something similar to this?** **Students:** yes, most of time we do that for example putting stone in a water. **What do you think we will learn in this unit?** **Answer:** forces applied by solid objects in fluid **Teacher:** Thank you all. Today we are going to study **Unit 4:** Density and Pressure in solids and fluids.	**The teacher shares with learners the expected learning outcomes**
	Lesson1: Force exerted by solid on area surface. **Learning Objectives:** By the end of this lesson, learner should be able to: • Identify factors on which pressure in solids depends. • Explain how pressure varies with force and the area of contact.	

2 **INTRODUCTION** **(5 min)**	Observe the photo  **Figure: Two sinking objects** **Teacher:** Among objects **A** and **B** which sink more? Explain why? **Students:** An object A is least sink due to large area, low pressure while an object B sinks more due to large area, high pressure.	**Learners observe the photo and answer the questions.**
3 **LESSON DEVELOPMENT** **(20 min)**	**Teacher:** **Activity1:** Give and explain examples which illustrates the variation of pressure **Students:** The examples of varying pressure 1. A finger can be pressed against a wall without making any lasting impression; however, the same finger pushing a thumbtack can easily penetrate the wall. Although the force applied to the surface is the same, the thumbtack applies more pressure because the point concentrates that force into a smaller area.	

2. A bus or truck is heavy. It may have large tires, so that its weight is spread over a large area. This means that the pressure on the ground is reduced;

so it is less likely to sink in soft ground. This is one example of a practical application of pressure.

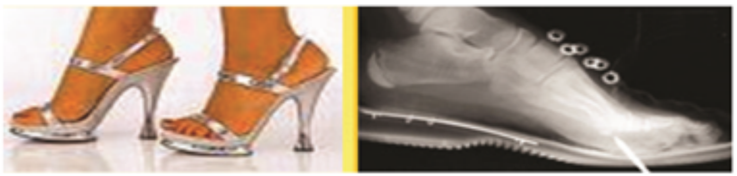
Fig 4.1.3: Lorry with many tires

3. If we try and cut a fruit with the flat side of the knife it obviously won't cut. But if we take the sharp side, it will cut smoothly. The reason is, the flat side has a greater surface area (less pressure) and so it does not cut the fruit. When we take the thin side, the surface area is very small and so it cuts the fruit easily and quickly.

Students must be given time to think and note down their answers.

	Activities for application **Teacher: Activity 2:** Investigating pressure in solid **Materials:** One brick, ruler, Balance, basket full of sand, a long beam of wood. **Procedures:** – Measure the mass (m) of the brick and calculate its weight (w = mg). – Pour two bucket full of sand outside your laboratory such that it forms a pile as shown in figure below  **Figure: Sand pile** – Use the long wooden beam to spread the sand such that you have a fairly large plain surface on top of the sand pile, as shown in figure below.  **Figure: Levelled sand pile,** – Take measurement of dimensions of one of the large surface side and calculate its area A1.	**Use learners' ideas to formulate the concept clarification.**

	– Take measurement of the dimensions of the small side and calculate its area A2. – Gently place the brick in the sand on its big side and let it rest on the sand for 15s. Carefully remove the brick from the sand. Note the depression formed on the sand and carefully measure its depth. – Measure the depth at four different places and determine the average depth of the depression on the sand left by the brick – Calculate pressure exerted by the brick using $P_1 = \frac{W}{A_1}$ $P_2 = \frac{W}{A_2}$ **Compare and discuss about the results obtained** **Students' Conclusion:** If the force is concentrated on a small area, it will exert higher pressure than if the same force is distributed over a larger surface area. **Summary** **Teacher:** Let together summarize some of the key points that we learnt.	**Emphasize to new concepts** **Use learners' ideas to formulate the lesson summary.**

4 **CONCLUSION** **(10 min)**	**Assessment** 1. Pressure on solid depends on A. cross section area B. density C. total volume 2. Why do bikes for riding on the beach have wide tires? Discuss.  3. Which of the shoes shown below causes most damage, and explain why? 	**Allow the learners to work individually** **Provide pause time to think and say or write their ideas.**

	Answers: 1. A 2. The bikes for riding on the beach have wide tires because of redaction of pressure on the sand. Means a greater the surface causes the small pressure 3. It is the heeled shoes. Means a small the surface area causes the big pressure. **Teacher: Homework** 1. A substance has mass of 3kg submitted by acceleration of $9m/S^2$. Find the force in Newton. 2. Define force and state its SI Unit. 3. Copy and fill in the blanks the missing words: **P** Pressure tells us how concentrated a ------------ is. It is measured in ------------- or ------------, and is calculated using the equation: p = -----------. A force of 12N acting over an area of 2m2 causes a pressure of ------------. If the area were less, the pressure would be --------------------. The dimensions of velocity are ------------. The dimensions of pressure are ------------.	**Provide opportunities for corrective feedback or positive feedback to learners.**

MEASURING LIQUID PRESSURE WITH MANOMETER

SUBJECT: PHYSICS	GRADE: S2	DURATION: 40 min

LESSON TITLE: Pressure in liquids in equilibrium
Learning materials: Charts, plastic bottle, manila papers, chalk board, needle

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS' READINESS** **(5 min)**	**Teacher:** Hello students! Welcome again in physics lesson. **Teacher:** Observe the picture below  **Teacher:** What is the name of this object? Remember we have seen it in senior one. **Students:** It is a manometer	**Display the picture**

	Teacher: Good student! you never forget I see. What is the use of this manometer? **Students:** *Manometer is used to measure the pressure in fluid.* **Teacher:** Very good! Can you suggest what we will learn in this lesson? **Students:** Pressure in fluid **Teacher:** Thank you for your supporting ideas, today we are going to study UNIT 5: **Measuring liquid Pressure with Manometer** and Today's lesson is **pressure in liquids in equilibrium** At the end of this lesson, you should be able to: explain why water jets are at different levels and explain the conditions of liquids in equilibrium	**Let learners themselves try to provide the answer and facilitate them to reach on the intended answer.**
2 **INTRODUCTION** **(10 min)**	**Teacher:** Previously in UNIT 4, we learnt about static fluid pressure and atmospheric pressure. What does the factor that affect static fluid pressure depends on? **Students:** At any given depth, pressure depends on the distance below the surface.	**Allow learners to work individual and provide good feedback on previous unit**

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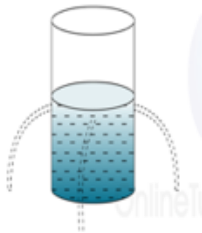
Teacher: Very good! Observe the images below and try to discuss on questions below.



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<td>**Display the picture**</td>
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Teacher: Why water streamed out at the same way for the first figure?

Students: water streamed out from the same level

Teacher: Good! Why is the lower jet more powerful than the upper one out for the second figure?

Student: it is because above of lower jet there is a lot of weight of water.

Teacher: Thanks a lot students, let us use an experiment to investigate well pressure in equilibrium.

</td>
<td>**Provide a pause time for students to think and say or write their ideas.**</td>
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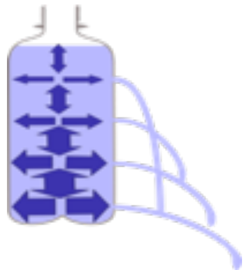
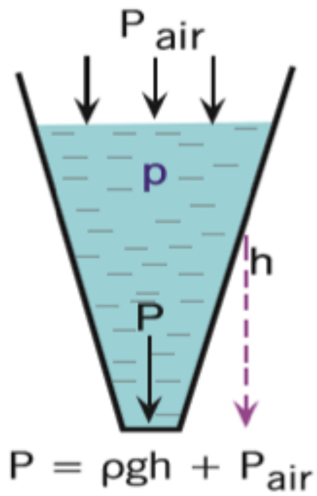
3 **LESSON DEVELOPMENT** **STEP 1** **(20 min)**	**Teacher: Activity: Investigating pressure in liquids** **Materials:** plastic bottle, Water, Hammer and nail, Ruler **Procedure: 1.** Punch 5 holes in the sides of the container, one below the other at 4cm intervals. **2.** Fill the container with water. **3.** Measure the distance from the bottom of the container to the point that the water squirts on the ground from each hole  **Teacher:** What is pushing water to squirt out from the container? **Students:** Atmospheric pressure and pressure of liquid above the holes. **Teacher:** very good! Why is water falling at different distances? **Students:** Pressure of liquid at higher depths is greater than the pressure at lower depths. Then at high depth, the water is falling at greater distance.	**Allow the learners to work in groups (remember gender balance and learners with special needs).** **Facilitate learners to do activity, make sure all learners participate.** **Provide pause time to think and say or write their ideas.**

STEP 2: **(20 min)**	**Teacher:** What is the pressure at bottom of a swimming pool that is 3 meters in depth? Given g= 10m/s^2, atmospheric pressure is 1.01×10^5 Pa and density of water is 1000 Kg/m^3 – The pressure at a given depth in a static liquid is result of the weight of the liquid acting on a unit area at depth plus any pressure acting on the surface of the liquid. $\mathbf{P} = \mathbf{P}_{\mathbf{atm}} + \rho\mathbf{gh}$ – The pressure due to the liquid alone (also called the gauge pressure) at a given depth in a liquid at rest depends only upon the density of the liquid ρ and the distance below the surface of the liquid h. It is independent of the cross-sectional area.  $\mathbf{P} = \rho\mathbf{gh}$ – Pressure is not really a vector even though it looks like it in the sketches. The arrows indicate the direction of the force that the pressure would exert on a surface it is in contact with.	**Emphasize new concepts. Let learners themselves try to provide the answer and facilitate them to reach on the intended answer.** **Allow the learners to work in groups (remember gender balance and learners with special needs).**

Students: For the data we have: h=3m, g= 10m/s^2 Patm=1.01×10^5 Pa , density= 1000 Kg/m^3

$$P = Patm + \rho gh \ , \ P = 1.01Pa + 31000\ Kg/m^3\ 3\ m\ x\ 10m/s^2 = 131Pa$$

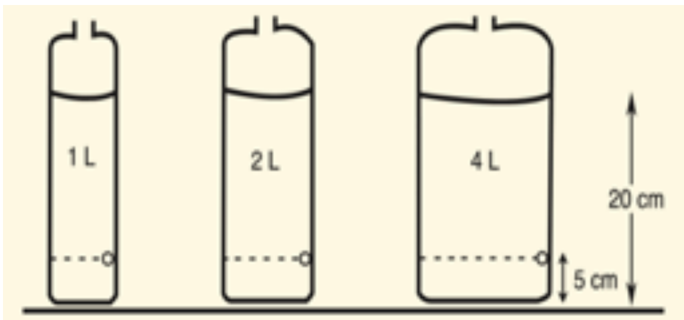
Teacher: I appreciate the answer you provided. Flowers to you.

Teacher: Activity: investigating Water pressure

Materials: Plastic bottles can be used to make apparatus to investigate water pressure in containers of water.

Figure 5.2 shows three sizes of plastic bottles: 1L, 2L and 4L.

One hole, approximately 5mm in diameters (use a pin hole), has been drilled through the side of each bottle, at a height of 5cm from the bottom.



Facilitate learners to do activity, make sure all learners participate.

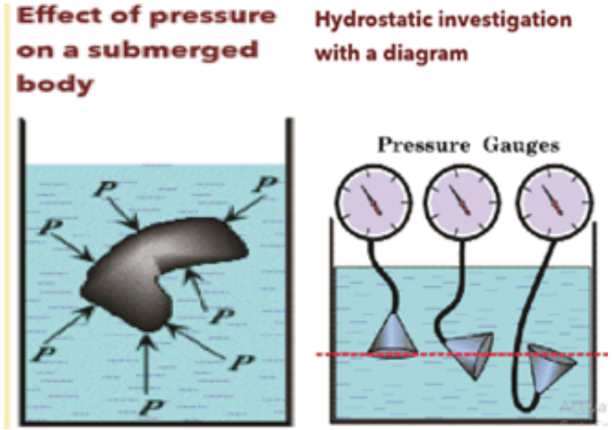
If they are a video, they must have good sound and pictures to give students a chance to visualize.

Display the picture

	Procedure: 1. Using a felt pen, draw a line circling the bottle at the height of the hole (5 cm from the bottom of the bottle) and another line circling the bottle at a height of 20cm from the bottom of the bottle. Place a piece of masking tape over the holes in each bottle. Leave a loose tab so that you can use it to pull off the tape quickly when you want to let water run out of the hole. ***Suggestion!*** Do this experiment outdoors on a paved area where there is no traffic. **Caution:** plastics bottle is non-degradable material we have keep it in appropriate container not thrown it everywhere	**Allow Learners to work in pairs and discuss about their observation on the picture**
STEP 3 **(15 min)**	**Teacher:** Predict what will happen in this situation. **Students:** Water will be squirted out from the bottles horizontally **Teacher:** good! Out of which bottle will the water travel furthest horizontally and why ?	

Students: None of them, because the holes are at the same level and the exerted pressure is the same. ***Again, this tell us that pressure at any point in a liquid, at a particular depth, acts equally in all directions***.

Teacher: Thinks a lot my learners! observe the last pictures and answer questions follow



Teacher: Which way the pressure is it exerted on the submerged object in water on first picture?

Students: The pressure on a submerged object is always perpendicular to the surface at each point on the surface. Pressure cannot exert any force parallel to the surface in which it is in contact.

Allow the class to discuss and Provide opportunities for corrective feedback or positive feedback to students.

Teacher: very good! What is the pressure showed by manometers on the second picture? Explain.

Students: Pressure is the same at the same horizontal line because pressure at a given depth is independent of direction.

Teacher: Why does the water tank is placed at high places?

Student answer: Water tank is placed at high places in order to increase the water pressure as pressure increase according to the depth. That pressure is similar to that created by a large pump

Teacher: Why is it dangerous to stay longer at a depth for divers and in high altitude in aviation?

Students: It is dangerous to stay longer at a depth of 45m, since as result of high pressure, an excess of nitrogen dissolves in the blood and on return to the surface nitrogen bubbles form in the blood in the same way that bubbles form in a bottle of soda water when the cap is removed. Such a condition causes severe pain or even death.

For passengers in aircraft flying at high altitude would experience difficulty in breathing and consequent danger owing to low pressure.

Caution ! *And in cases of emergency the diver is immediately placed in a decompression chamber.*

The problem is overcome by pressurizing the aircraft.

Teacher: Students let together summarize what we learned today

What is pressure in liquid depend on?

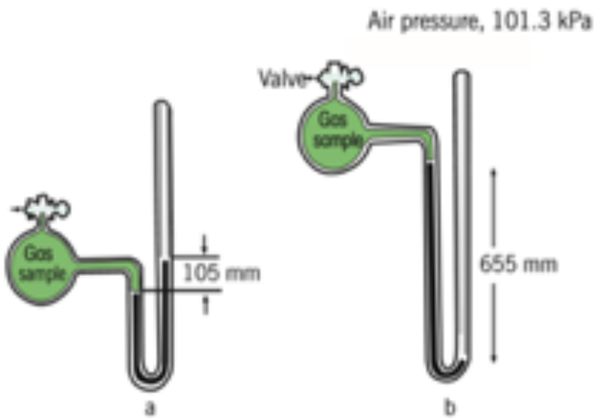
Students: The pressure in a liquid increase linearly with depth from its value P_0 at the surface that is open to the atmosphere or from some other reference point.

Teacher: Good! What is the formula we use to calculate pressure at a given depth?

Students: The liquid pressure at different depths based on gauge pressure is rewritten as $P_g = \rho g h$

Teacher: Which way the pressure is it exerted on submerged object?

Students: The pressure on a submerged object is always perpendicular to the surface at each point on the surface and is the same at the same horizontal line

4 **CONCLUSION** **(10 min)**	**Teacher: Assessment** 1. Explain the effects of pressure on a submerged object 2. Discuss on the water jets when water is poured in a container with 3 holes at different level 3. Find the pressure of that gas sample  4. Suppose you pour water into a container until it reaches a depth of 12cm. Then you add 6.2cm of olive oil (density = 920kg/m^3). How much larger is the pressure at the bottom than at the top of the container, in units of Pa?	**Give time to learners to refresh their ideas and provide suitable feedback**

	Students: Answers 1. The pressure on a submerged object is always perpendicular to the surface at each point on the surface. 2. Pressure cannot exert any force parallel to the surface in which it is in contact. Pressure is the same at the same horizontal line **3. (a)** If it is closed a manometer. We read 105mm of mercury which corresponds to 14.0kPa **(b)** If it is an opened manometer. We read 1013kPa-655 mm of mercury =14.0kPa pressure of the gas 4. Pat bottom= Pwate+Poil $P = 1000*10*0.12 + 920*10*0.062 = 1770.4\ Pa$	
	Teacher: Homework 1. Calculate the pressure at a depth of 8 m in swimming pool filled with water (density of water= 1000kg/m^3 ang take gravitational acceleration to be 9.81 m/s^2	**This homework will be done individually and will be corrected before starting a next lesson**

2. A nurse administers medication in a saline solution to a patient by infusion into a vein in the patient's arm. The density of the solution is 1.0X103kg/m3 and the gauge pressure inside the vein is 2.5 X10^3. How high above the insertion point must the container be hung so that there is sufficient pressure to force the fluid into the patient?

Thank you for your participation in this lesson.

See you in next lesson!

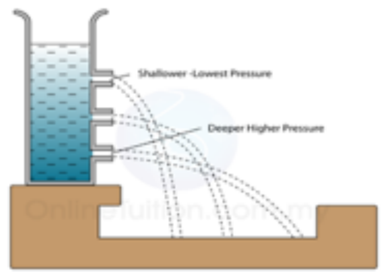
APPLICATION OF PASCAL'S PRINCIPLE

SUBJECT: PHYSICS	**GRADE:** S2	**DURATION:** 40 min

LESSON TITLE: Static pressure in fluids at rest

Learning materials: bath, charts, water and chalk board

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS READINESS** **(2 min)**	**Teacher:** Hello students, how are you today? Today we are going to start a new unit. Observe the figure below  **Teacher:** what does this figure shows/tells you? **Students:** Hydraulic jack lift a car **Teacher:** **Good!** Have you seen something similar to this? **Students:** Hydraulic press a load	**Display the picture** **Let learners themselves try to provide the answer and facilitate them to reach on the intended answer.**

	Teacher: very good! What do you think we will learn in this unit? **Students:** Applications of Pascal's principle **Teacher:** Thank you all. Today we are going to study UNIT 2: Application of Pascal's principle Today's lesson is Static pressure in fluids at rest Teacher: At the end of this lesson one, every learner will be to explain static pressure of fluids at rest.	
2 **INTRODUCTION**	**Teacher:** On previous unit 5, we learnt about factors affect pressure of liquid in equilibrium. With aids of diagram, describe how pressure in fluid increase with respect to the depth. **Students: Answer:**  **Pressure of liquid at greater depths is greater than the pressure of lower depths. Then at high depth, the water is falling at greater distance**	**Provide a pause time for students to think and say or write their ideas.**

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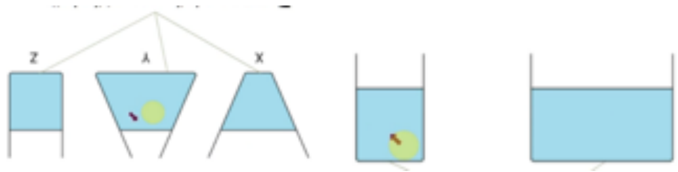
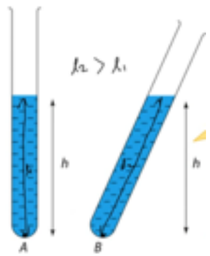
Teacher: Good! observe the following diagrams on this chart

Teacher: What is the pressure at the bottom of each container? explain your answer.
Students: The pressure is the same at the bottom in all containers because pressure in liquid does not depend on the shape and area.
Teacher: very good! observe another figure

Teacher: Where is the high pressure at bottom between the two tubes?
Students: pressure will be the same for two tubes because pressure depends on vertical depth, but not the length of the liquid.
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Display the picture
Allow the learners to work in pair and give time to provide feedback
Display a picture
Allow learner to think individually and provide good feedback
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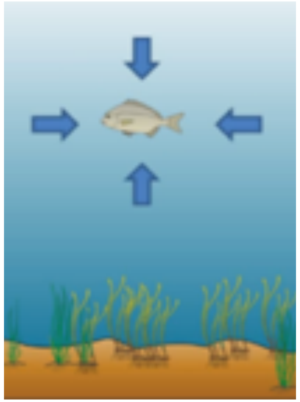
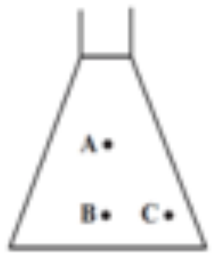
	Teacher: well, done! observe the last picture and tell me which part of the fish experience high pressure.  **Students:** All parts of the fish experience the same pressure because pressure at any point of liquid acts equally in all directions **Teacher: Well**, done students! Give yourself flowers.	**Display a picture** **Allow learners to think and give a pause time to organize ideas and provide good feedback**
3 **LESSON DEVELOPMENT** **(20 min)**	**Teacher: Activity:** Investigating the variation of pressure with depth **Materials:** Bath, Water **Procedures:** - Pour water in the bath. - Let it be in equilibrium for like 5 minutes. **Teacher:** Is that water flowing? **Students: no**, water remains in the bath	**Asks learners to form groups of 4 students (the number may depend on the class size)** **Facilitate learners to do activity, make sure all learners participate.**

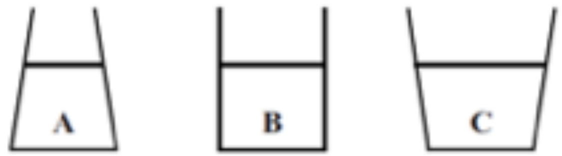
	Teacher: Good! What is the state of motion that water has? **Students:** water is at rest **Teacher:** Excellent! How would you find the pressure at the bottom of the bath? **students:** Pressure at bottom of bath = density of water X acceleration due to gravity X depth of water ($P = \rho gh$). **Teacher:** good students! What is the pressure at bottom of a swimming pool that is 3 meters in depth? Given g= 10m/s^2, and density of water is 1000 Kg/m^3 **Students:** For the data we have h=3m, g=10m/s^2, density=1000 Kg/m^3 $P = \rho gh,\ P = 3\times1000 \times 10 = 30000\ Pa$ **Teacher:** What mean by fluid and static fluid? **Students:** Fluids are a subset of the phases of matter and include liquids, gases and plasmas. While Fluid static (also called hydrostatics) is the science of fluids at rest, and is a sub-field within fluid mechanics. It embraces the study of the conditions under which fluids are at rest in stable equilibrium.	**Asks learners to form groups of 4 students (the number may depend on the class size) Facilitate learners to do activity, make sure all learners participate.**

	Teacher: very good! What pressure in static fluid depend on? **Students:** Pressure of fluid at rest depend to the depth of fluid above any point. Pressure= density of water X acceleration due to gravity X depth of water **Teacher:** How can we call the use of fluid to do work? **Students:** The use of fluid to do work is called hydraulics, and the science of fluids in motion is fluid dynamics. **Teacher:** Suggest the possible properties of fluid. **Student answer:** Fluids display such properties as Density, which is defined as the ratio of mass per unit volume. It is generally represented by the Greek letter ρ, and measured in terms of kilograms/cubic meter, or kg/m^3. $\rho = mass / volume$ Since the volume of a fluid expands and contracts, the density of fluids varies with temperature. **Teacher: Good!** At what conditions do you think that water and air has a maximum density?	**Provide pause time to think and say or write their ideas.** **Concepts.** **Let learners themselves try to provide the answer and facilitate them to reach on the intended answer.**

	Students: The most common fluid, water, has maximum density of 1000kg/m3 at 4°C while air which is a mixture composed principally of the gases nitrogen (78%) and oxygen (21%), has a density of 1.29kg/m^3 at 0°C and 1.20kg/m^3 at 20°C.	**Emphasize new concepts. Let learners themselves try to provide the answer and facilitate them to reach on the intended answer.**
	Application **Teacher:** Calculate the pressure created by a 30 m depth of water given the density of water is 1000 kg/m3 and gravity 9.8 N/kg. **Students:** $P = \rho g h$ P = 30 x 1000 X 9.8 = 294 000 Pa (2.94 x 10^5 Pa, 294 kPa) **Teacher:** How does the swimmer feel if he/she is swimming in a pool by goes deep from the top? **Students:** When a swimmer enters the pool, pressure varies to him/her depending to the depth of water above his/her body. At deep depth swimmer feel a high liquid pressure than swimming at the above surface **Teacher: Very good!** Let together summarize some of the key points that we learnt today.	**Use different questions to probe students to summarize the lesson.**

	Describe what is mean by fluid and fluid static? **Students:** *Fluid static is the science of fluids at rest.* A fluid is defined as a substance that continually deforms (flows) under an applied shear stress (gases and liquids are fluids). **Factors influencing the pressure in fluid at rest** • Liquid exert pressure in all the directions • Liquids exert equal pressure at the same depth • Pressure exerted by liquid increases with the increase in the height of its column • Pressure in liquid does not depends on the shape of the container	**Use different questions to probe students to summarize the lesson.**
4 **CONCLUSION** **(10 min)**	**Teacher: Assessment** 1. Rank the pressures at the three points of the figure below a) $pA < pB = pC$ b) $pA < pB < pC$ c) $pA < pC < pB$ d) $pC < pA < pB$ 	**Provide opportunities for doing assessment and give corrective feedback to learners**

2. Three containers of different shape, but with bases of equal area are filled with water to the same height.



a) The weight of the water is the greatest in container…

(i) A (ii) B (iii) C

(iv) The weight of the water is the same in all the three containers.

b) The pressure at the bottom of the container is the greatest in container…

(i) A (ii) B (iii) C

(iv) The pressure at the bottom is the same in all the three containers

3. Calculate the pressure due to water column of height 100m (Take g = 10 m s^{-2} and density of water = 10^3 kg m^{-3}). What height of mercury column will exert the same pressure? (Density of mercury = 13.6 X 10^3 kg m^{-3})

Provide opportunities for doing assessment and give corrective feedback to learners

Learner's answer

1. A)
2. a) (iii) C

   b) (iV)
3. $h_2 = \dfrac{h_1\rho_1}{\rho_2} = \dfrac{100\times1000}{13.6\times10^3} = 7.35m$

Teacher: Homework

1. A regularly shaped object is immersed in water of density 1000 kgm^{-3}

   a) Calculate the water pressure at the top and the bottom of the object.

   b) What is the resultant pressure on the object?

2. What is the difference between the hydrostatic pressure of blood between the brain and the soles of the feet of a person whose height 165 cm (suppose the density of blood = 1.0×10^3 kg/m^3, acceleration due to gravity = 10 m/s^2)

Thank you for your participation in this lesson

This homework will be done individually and will be corrected before starting a next lesson

ARCHIMEDES' PRINCIPLE AND ATMOSPHERIC PRESSURE

SUBJECT: PHYSICS	**GRADE:** S2	**DURATION:** 80 min

LESSON TITLE: Archimedes' principle

TEACHING MATERIAL: A stone of less than 1kg, water, Eureka can, sewing thread, Dynamometer and Measuring cylinder, beaker, spring balance

LEARNING MATERIALS: notebooks, pens, calculators, geometric materials, S2 Physics Book.

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS' READINESS** **(2 min)**	**Teacher:** Hello dear student! Welcome in today's lesson. **Students:** Hello Teacher! **Teacher:** Suppose that you are drinking fanta and you push the straw deeply in the bottle full of fanta. What happens to the straw if you released it? **Students:** The straw will move up!	**The teacher shares with learners the expected learning outcomes.**

	Teacher: What do think causes the straw to move up? **Student:** I think it is the pressure of the water. **Teacher:** Thank you students! Today's lesson is Archimedes' principle **Lesson objectives:** By the end of this lesson, you should be able to: • State Archimedes' 'principle • Explain Archimedes' 'principle • Explain the applications of Archimedes' 'principle.	
2 **INTRODUCTION** **(8 min)**	**Teacher:** Observe the picture below and answer the question:  **Why is this boat not sinking?** **Students:** Its weight is balanced by a buoyant force from the displaced water.	**Display the picture** **The pictures must be clear in order to give students a chance to visualize.**

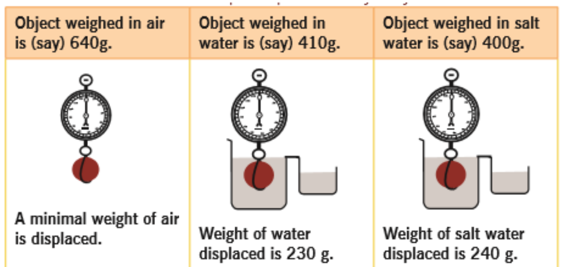
3

LESSON DEVELOPMENT

(50 min)

Teacher: Do the following activity:

With the reference to the table below, do this experiment and answer the questions.



Materials: A stone of less than 1kg, water, Eureka can, sewing thread, Dynamometer and Measuring cylinder

Procedures:

1. Pour water in the Eureka can and make it full.
2. Tie the thread on the stone
3. Measure its weight in air using the dynamometer and record it to be W_1
4. Submerge the stone in water still on the dynamometer and record the new weight W_2
5. Measure the weight of water overflown in the measuring cylinder and record it as W_3
6. Find the difference $W = W_1 - W_2$

Asks learners to form groups of 4 students (the number may depend on the class size) Facilitate learners to do activity, make sure all learners participate.

	Questions: 1. Compare the results obtained from step 5 and 6. 2. What is the volume of the stone? 3. Discuss and explain your findings in question1. **Students:** 1. $W=W_3$. 2. The volume of the stone is equal to the volume of water displaced. 3. The weight of water displaced is equal to the upthrust force exerted by the liquid on the stone. **Teacher:** An object weighs less in water than it does in the air. This loss of weight is due to the upthrust of the water acting upon it and is equal to the weight of the liquid displaced. Because salt water is denser than pure water the object displaces a greater weight of salt water and, therefore, weighs less. The denser the liquid, the easier it is to float in it making it easier to swim in the ocean or a chemical filled pool than a mountain stream.	**Provide pause time to think and say or write their ideas.**

Buoyancy reduces the apparent weight of objects that have sunk completely to the sea floor. It is generally easier to lift an object up through the water than it is to pull it out of the water. In the case of a submerged body, the apparent weight of the body is equal to its weight in air less the weight of an equal volume of fluid and the object that floats will displace a volume of water equal to its weight.

Teacher: Basing on the above observation what can you conclude?

Students: According to Archimedes' principle,

"Any object that is completely or partially submerged in a fluid at rest is acted on by an upward (or buoyant) force. The magnitude of this force is equal to the weight of the fluid displaced by the object and the volume of fluid displaced is equal to the volume of the portion of the object submerged."

Teacher: Observe this figure and comment on it.

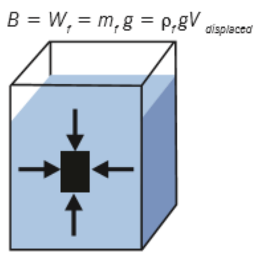


Figure: Force acting on a submerged body.

Use different questions to probe students to understand the content.

	Students: Among completely submerged objects with equal masses, objects with greater volume have greater buoyancy. The horizontal forces on its vertical sides cancel and are removed from consideration. The upward forces against the bottom surface of the object are greater than the downward forces against its top surface. This net force is called the buoyant force. In other words, the "buoyant force" on a submerged body is directed in the opposite direction to gravity and is equal in magnitude. **Teacher: Very good!** Formulate mathematical equations basing on the above figure. **Students:** Force on the object is thus the sum of the buoyant force and the object's weight: $\mathbf{F = W + B}$ • If the buoyancy of an object exceeds its weight, it tends to rise: $\mathbf{F = B - W}$ • An object whose weight exceeds its buoyancy tends to sink: $\mathbf{F = W - B}$ • Commonly, the object in question is floating in equilibrium and the sum of the forces on the object is zero, therefore; $\mathbf{F = W - B = 0}$ **Teacher:** Mention some Applications of Archimedes' principle	**Give opportunity to the learners of describing some applications of Archimedes' principle (mention names, figures and advantages)**

Students:

1. **Submarines**

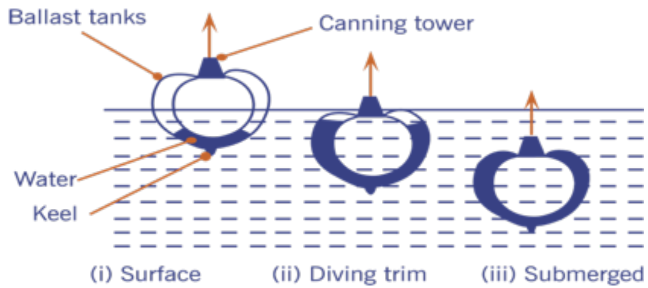


Fig: submarine (Physics for Rwanda secondary schools senior two)

A submarine is made to float or sink by altering the average density. When submerged, the submarine has an average density equal to that of the water around it. In order to bring it to the surface, its mass must be made less and this is done by expelling water from the tanks (this is called ballast).

Situated along the sides of the submarine, replacing the water by compressed air. The boat is provided with large ballast tanks

which can be filled with water. This increases the weight of the submarine, so that it sinks lower into the sea.

In the case of a ship, its weight is balanced by a buoyant force from the displaced water, allowing it to float. If more cargo is loaded onto the ship, it would sink more into the water displacing more water and thus receive a higher buoyant force to balance the increased weight.

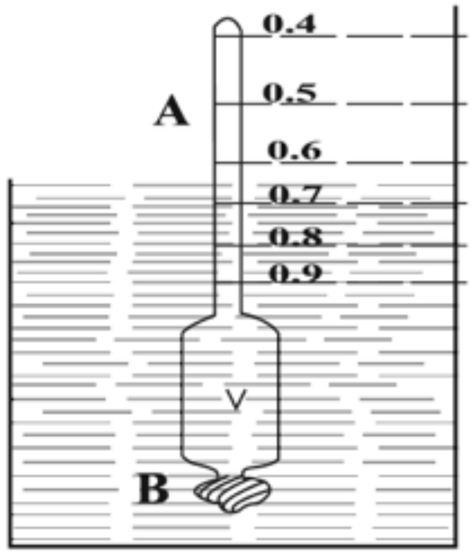
2. Ships

So, how can objects made of aluminum or iron float? The secret lies in increasing the volume of the displaced water. Although a small cube of iron will immediately sink when placed in water, a large boat can float by adjusting the amount of water it displaces.

Fig: boat. (Physics for Rwanda secondary schools senior two)

3. Densimeter (hydrometer bottom)

An hydrometer is an instrument used to measure the weight and specific gravity of a gas or liquid in which it floats. It is a hollow tube, widened at the bottom where a weight is placed (B). The specific gravity of the liquid is read where the scale penetrates the surface of the liquid.



Lactometer is a special type of hydrometer used for testing the purity of milk or to check the richness of milk. It has a range of relative density 1.105 to 1.045.

	Battery Hydrometer is used for measuring the relative density of accumulator acid. It is kept inside a glass tube fitted with a rubber bulb at the upper end. The lower end of the glass tube is connected with a narrow tube which is made of acid resistant material. When in use, this end is submerged in the acid in the accumulator. The acid in a fully charged cell should have a relative density of 1.25 to 1.30. A reading of less than 1.18 indicates that recharging is necessary. 4. Airships and air balloons: Burning gas makes the air inside the balloon less dense, producing an upward force or lift. **Activities for Application:** 1) By using given materials, verify Archimedes 'principle 2) A body weighs 600g in air and 400g in water. Calculate: a) Upthrust on the body, b) Volume of the body, and c) Relative density of the solid	**Provide opportunities for corrective feedback or positive feedback to students.**

Answer:

mass in air = 600g = 0.6kg

mass in water = 400g = 0.4kg

a) upthrust = (mair- mwater) x gravity

= (0.6-0.4)X10= 2N

b) upthrust= density fluid X volume x gravity

i.e 2N= 1000X volume X 10

so, volume=0.0002m^3

c) density of solid= m/v= 0.6/0.0002=3000kg/m^3

relative density of solid=3000kg/m3: 1000kg/m^3

Teacher: In summary, state Archimedes' principle

Students: Statement of Archimedes' principle:

"Any object that is completely or partially submerged in a fluid at rest is acted on by an upward (or buoyant) force. The magnitude of this force is equal to the weight of the fluid displaced by the object and the volume of fluid displaced is equal to the volume of the portion of the object submerged."

Teacher: **Good!** Mention any three applications of Archimedes' principle

Students: A submarine, ship and densimeter

4 **CONCLUSION** **(20 min)**	**Teacher:** Take exercise notebook and give the answer of the following assessment. 1. Define buoyant force 2. Explain the reason why some object sinks in water while other object floats 3. State condition of floating of an object 4. Why do boats made from metal float on the surface of water 5. State Archimedes' principle **Students: Answers:** 1. Buoyant force is upward force, liquid exerted to an object submerged in it. 2. An object floats in fluid if its density is less than density of that fluid while An object sinks in fluid if its density is greater than density of that fluid. 3. Condition/law of floatation:" an object floats when it displaces liquid which is equal to its own weight. 4. For an object to sink, its density must be greater than the density of water. the boat must have a hollow volume inside, so that it occupies large volume, thereby decreasing density. 5. Archimedes'' principle states:'' when an object immersed in a fluid, partially or completely, there the upward buoyant force exerted on that object is equal to the weight of the displaced fluid."	**Teacher supervises the assessment and learner do assessment individually**

Teacher: Homework

1. Discuss other applications of Archimedes principle that are in use today.
2. Discuss how these methods might be useful in finding mass and volume rather than by direct measurement.

   a) Using Archimedes Principle to Measure Mass of an object immersed in a fluid of known density (If an object is immersed completely, it will displace its volume.)

   b) Archimedes principle allows us to calculate the mass of floating objects (If an object is floating, the mass of the displaced water is equal to the mass of the block).
3. A glass beaker is filled with water and placed on a balance. A person holds a finger into the water. The reading on the balance will;

   a) go up

   b) go down

   c) stay the same

   d) Can't tell.

Teacher: Thank you for your participation in this lesson. See you for next lesson!

WORK, POWER AND ENERG

SUBJECT: PHYSICS	GRADE: S2	DURATION: 40 min

LESSON TITLE: Categories of energy in the environment

Learning materials: Manila papers, markers, photos, drawing and calculators

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS' READINESS** **(5 min)**	**Teacher:** Hello students, how are you? **Students**: We are fine. **Teacher: Ok! Thanks,** now, welcome to this new lesson. Observe this picture and comment on it, what are those persons doing?  **Students:** They are working in construction.	**Begin by gaining students' attention, and communicate objective of the lesson**

	Teacher: What do they need so that they could accomplish their work well? **Students:** They need the energy. **Teacher:** Thank you very much my friends; today's lesson is **categories of energy in our environment**, now let me present you the objectives of the lesson By the end of this lesson, you should be able to: i. Classify categories of energy in environment ii. Define potential and kinetic energy iii. Do the exercises related to potential and Kinetic energy.	
2 **INTRODUCTION** **(4 min)**	**Teacher:** What do you remember on the previous lesson? **Students:** In the last lesson we learnt about the concept of work, forms of work and unit of work in SI **Teacher:** What is the meaning of work and its unit? **Students:** The work is the capacity of a force F to move an object through a distance d, then $W = F.d$ The unit of work in SI is the **Joule** of symbol J.	

<table>
<tr>
<td></td>
<td>Teacher: Thank you very much! Now, to start the new lesson, observe a photo (Figure1) and discuss the question below

Fig1
Which types of energy is stored in the girl's arc?</td>
<td rowspan="2">At each step provide a pause time for students to think and say or write their ideas.</td>
</tr>
<tr>
<td>3
LESSON DEVELOPMENT

(20 min)</td>
<td>Students: The type of energy stored in the arc is potential energy and is the energy when an object is at a certain distance with respect to the reference point.
Ok! Good, the forms of energy are classified into two categories, which are they?
Students: The forms of energy are classified into two main categories: potential energy and kinetic energy.</td>
</tr>
</table>

	Teacher: Very good. Can you explain the difference between them? **Students:** 1. **Potential energy:** is the energy stored in an object due to its position with respect to some reference (ground for example) The potential energy is referred to as a stored energy because it can be looked as the energy which will be used when time comes for it to be used **Teacher:** What is the formula of potential energy? **Students:** The formula of Potential energy is $P = mgh$, where m is the mass of the body, g is the acceleration due to gravity. 2. **Kinetic energy:** This is the energy a body has when it is in motion. The Kinetic energy depends on the mass and velocity of a body (***see figure 2***). **Teacher:** What is the formula of kinetic energy? **Students:** Its formula is given by $K_E = \frac{1}{2}mv^2$	**Let learners themselves try to provide the answer and facilitate them to reach on the intended answer.**

	 **Fig 2** **Teacher:** What is the unit of Kinetic and Potential energy? **Students:** Both have the Joule as unit in SI because the energy is the capacity of a body to do the work, they have the same unit as work.	
	Teacher: Application activity 1. A ball of 2kg is kept on the hill of height 3km. calculate the potential energy possessed by the ball. 2. What is the kinetic energy of a car of mass 1200kg moving at speed of 36km/h. **Students: Solutions:** 1. Data: m=2kg, h=3km=3000m, g = 9.8m/s^2 asked: PE=? **Formula:** $P_E = mgh = 2\times 9.8\times 3000 = 58800J$ 2. Data: m=1200kg, v=36km/h=36000m/3600s =10m/s **Formula:** $K_E = \frac{1}{2}mv^2 = \frac{1}{2}\times 1200\times (10)^2 = 60000J$	**Allow the learners to work in groups (remember gender balance and learners with special needs)**

	Teacher: Can you summarise what we come to study today? **Answer:** **Students:** Yes, we learnt that we have two categories of energy: potential energy due to position of object with respect to the reference point and kinetic energy due to motion of body: $K_E = \frac{1}{2}mv^2$ and $P_E = mgh$	
4 **CONCLUSION** **(11 min)**	**Assessment** 1. A girl carrying a bucket of water of mass 5kg. If she does 500J of work, to what height will she raise it? (g=10m/s²). 2. If the car and the motorcycle have the same speed; which one has more energy? ***Why?*** **Which types of energy they possess?** **Solutions:** 1. Data: m=5kg, $\Delta W = P_E = 500J$, asked: h=? **Formula:** PE=mgh, therefore $h = \frac{P_E}{mg} = \frac{500}{5\times 10} = \frac{500}{50} = 10m$ 2. The car has more energy than the motorcycle because the car has the big mass compared to the motorcycle (the energy is proportional to mass of body). This energy is the Kinetic energy because the car and the motorcycle are moving.	**Allow the learners to work individually.**

Teacher: Homework:

1. Search on the internet and discuss about the conservation of mechanical energy.
2. How much work is required to accelerate a 1000kg car from20m/s to 30m/s

Thank you for your participation in this lesson.

LESSON FROM UNIT 9

CONSERVATION OF MECHANICAL ENERGY IN ISOLATED SYSTEM

SUBJECT: PHYSICS	GRADE: S2	DURATION: 40 min

LESSON TITLE: Isolated and open systems
LEARNING MATERIALS: Vacuum flask, cooking vessel, Tripod stand, Bunsen burner, Thermometer, Stopwatch, Charts, projector slides, manila papers, chalk board

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS READINESS** **(4 min)**	**Teacher:** Hello learners! I hope you are all fine, welcome to the lesson today as we going to start a new unit. **Carefully observe the picture**  **Teacher:** What do you see in picture?	**Ask the learners to observe the picture**

	Students: A child swinging back and forth **Teacher:** Does ground support a child? **Students:** No, a child is supported by a chain. **Teacher:** Why does a chain suit to support a child? **Students:** A chain has energy within itself **Teacher:** What do you think make child keep swing? **Students:** The force. **Teacher:** What do you think is our lesson? **Students:** Conservation of mechanical energy in isolated system. **Teacher: Key unit competence** To apply the principle of conservation of mechanical energy for isolated system **Learning objectives:** **By the end of this lesson the learner should be able to:** • Define terms associated with isolated and open system. • Describe an isolated and open system.	**Allow learners to discuss on the picture.**

2 **INTRODUCTION** **(4 min)**	**Teacher:** Observe the materials  **Teacher:** What do you see? **Students:** A cup filled up with hot tea, closed cup with hot tea and thermos flask containing hot tea. **Teacher:** According to what you see, you may now ask questions. **Which tea will get cold first?** **Students:** Tea in open cup **Teacher:** why does a tea in thermos keep hot for long while the one in cup get cold quickly? **Students:** A thermos keeps hot for long time because due its internal structure, the tea inside cannot interact with outside while the tea in a cup gets cold fast because of its interaction with outside.	**Students must be given time to think and note down their ideas.**

<table>
<tr>
<td>3
LESSON DEVELOPMENT

(25 min)</td>
<td>
Teacher: Observe the diagrams showing two white systems


(a) Open system (b) Isolated system

Teacher: What do you see?

Students: A system in (a) is directly exposed outside while a system in (b) is rounded by a ring in blue.

Teacher: How does an isolated system behave on its surroundings?

Students: An isolated system cannot exchange any heat, work, or matter with the surroundings.

Teacher: How does an open system behave on its surroundings?

Students: An open system is a system that has external interactions; it can exchange energy and matter with its surroundings. Such interactions can take the form of information, energy, or material transfers into or out of the system boundary, depending on the discipline which defines the concept.
</td>
<td>Emphasize new concepts.

At each step, provide a pause time for students to think and say or write their ideas.</td>
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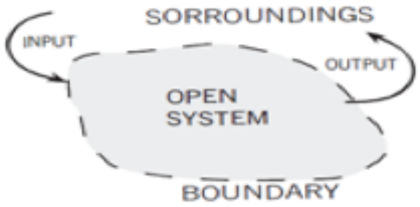


Teacher: What is a closed system?

Students: A closed system is a system that can exchange energy (as heat or work) but not matter, with its surroundings.

Application Activity

1. Highlight any three examples of open system, closed system and an isolated system (three examples for each) that you can found at home.
2. Match the picture to it corresponding definition

No	Picture	Definition
1		i. system can exchange energy and matter to surroundings
2		ii. A closed system is a system that can exchange energy (as heat or work) but not matter, with its surroundings.
3		iii. Isolated system is a system cannot exchange any heat, work, or matter with the surrounding.

Allow the learners to work in groups (remember gender balance and learners with special needs)

Students:

1. ii
2. iii
3. i

Teacher: Very good!, let's together review some of the key points that we learnt

Teacher: What have we learnt in this lesson?

Students: A system is a definite macroscopic region or space in the universe, in which one or more thermodynamic processes take place

Teacher: What are the types of systems?

Students: The types of systems are isolated, closed system and open system.

Teacher: Distinguish between an isolated system, open system and a closed system.

Students:

- An open system is a system that can exchange both energy and matter with its surroundings.
- A closed system is a system that can exchange energy (as heat or work) but not matter with its surroundings.
- Isolated system is a system that cannot exchange either energy or matter with its surroundings.

4 **CONCLUSION** **(7 min)**	**Teacher: Assessment** 1. What is the difference between the vacuum flask system and the cooking vessel system for keeping the temperature? 2. Differentiate isolated system and closed system. 3. Outline the examples of closed system, open system and an isolated system in our everyday life. **Students: Answers** 1. Vacuum flask is very insulated it keeps temperature long time whereas a cooking vessel is open, it loses its temperature very quickly. 2. An isolated system is a system that cannot exchange energy and matter to the surroundings while a closed system is a system that can exchange energy (as heat or work) but not matter with its surroundings. 3. Examples of open system: an open cup of coffee, an open cooking pot, open cooking pan **Examples of closed system:** a cup of coffee with lid on it, a closed plastic water bottle, a cooking pan with lid on it. **Examples of isolated system:** thermos flask, if soup is poured into an insulated container and closed.	**Allow the learners to work individually use plickers or the Cards to collect the answers.** **Provide pause time to think and say or write their ideas** **Provide opportunities for corrective feedback to learners.**

	Teacher: Homework 1. Use diagrams to distinguish between closed system and open system. 2. Clarify the behavior of an open system on the environment. ***Thank you for your participation in this lesson. See you next time***	**Allow the learners to answer the questions.**

GAS LAWS' EXPERIMENT

SUBJECT: PHYSICS	**GRADE:** S2	**DURATION:** 40 min

LESSON TITLE: Boyles law
LEARNING MATERIALS: Chart, syringes, balloons, chalk board, physics book 2

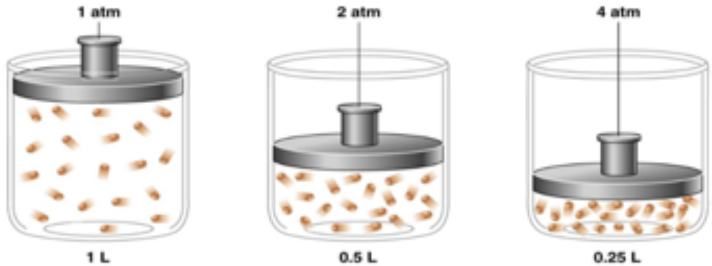
SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS READINESS** **(2 min)**	**Teacher:** Hello student! How are you doing? **Teacher:** I know some of you are enjoying football! What can we do if our ball is out of air? **Students:** we need to pump air inside again **Teacher:** Good! Describe the process of pumping air inside the ball. **Students:** we use much pressure to compress a pump in order to get a little air to enter and continue until our ball is full of air.	**Welcoming the students** **Students must be given time to think and note down their ideas.**

	Teacher: very good! Who can predict what we are going to study? **Students:** we are going to study relation between pressure and volume **Teacher:** Today we are going to continue our unit 10, and the new lesson of today is Boyle's law. By the end of this lesson, learner should be able to: – State and explain Boyle's law – Apply Boyle's law in real life	
2 **INTRODUCTION** **(8 min)**	**Teacher:** In senior one we learnt about properties of gas substances Who can explain why the gas is highly compressible than other substances? **Students:** Gases are highly compressible because most of the volume of a gas is composed of the large amounts of empty space between the gas particles. When compressed, come close to each other, but the force of attraction between the particles is still low. **Teacher:** Explain why tires of bicycle may burst when left outside during hot weather?	

	Students: During the hot summer days, when you expose tyres outside, the temperature of tyres increases faster, consequently, the heated air inside the tyres expands and its pressure rises quickly, which can lead to tyres blowout with disastrous consequences. **Teacher:** Observe the image,  **Teacher:** What can happen to the balloon if syringe is pushed forward? **Students:** Balloon getting smaller **Teacher:** What can happen to the balloon when the syringe is pulled backward? **Students:** balloon become bigger as the beginning **Teacher:** How is the pressure varying with respect to volume? **Students:** pressure and volume increase or decrease interchangeable	**Display the picture** **Let learners themselves try to provide the answer and facilitate them to reach on the intended answer.**

3 **LESSON DEVELOPMENT** **(20 min)**	**Teacher:** Learners let us redo the experiment showed on picture above into the groups **Activity:** Demonstrate interdependent of pressure and volume **Materials:** Balloons, Syringe **Procedures:** – Give the balloons and syringes to the students – Tell them to pump the air into the balloon using their mouths – Ask them to put on the pumped/inflated balloon into the syringe like shown below. – Then press on the syringe 's plunger like shown in the figure above  **Teacher:** Learner State Boyle's law and the images to explain well your answer.	**Allow the learners to work in groups (remember gender balance and learners with special needs).** **If there is any video it can be used with a good sound**

Students: Boyles's law state that" *"the volume of a fixed mass of gas is inversely proportional to the pressure, provided the temperature remains constant"*



Teacher: Derive the physical equation which relate the variables of the law above

Students: Boyle's Law is written as: $pV = k$ or $p = \frac{k}{V}$

where P: Pressure V: Volume and K: is a constant

Give time learners to think and discuss

For two states of variables (P_1, V_1) and (P_2, V_2) of a given mass of a gas. The relationship between them is: $p_1V_1 = p_2V_2 = k$

Teacher: A sealed syringe contains $10\times10^{-6} m^3$ of air at $1\times10^5 Pa$ The plunger is pushed until the volume of trapped air is $4\times10^{-6} m^3$. If there is no change in temperature what is the new pressure of the gas?

Students: , $p_1 = 1\times10^5\,Pa, V_1 = 10\times10^{-6}\,m^3, V_2 = 4\times10^{-6}\,m^3$

and $p_1V_1 = p_2V_2$

Therefore; $p_2 = \dfrac{p_1V_1}{V_2}, p_2 = \dfrac{1\times10^5\times10\times10^{-6}}{4\times10^{-6}} = 2.5\times10^5\,Pa$

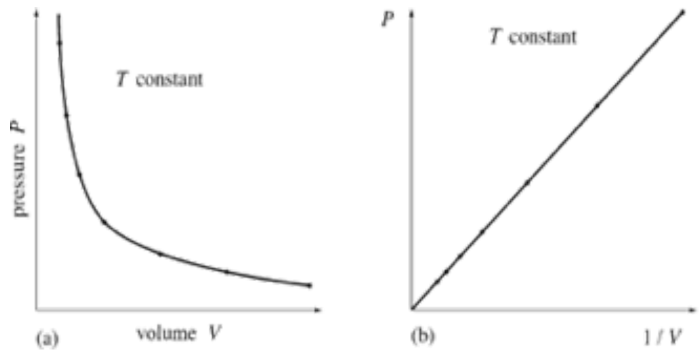
The new pressure in the syringe is $2.5\times10^5\,Pa$

Teacher: What is the name given to the process above?

Students: The process where the temperature and volume change at constant pressure is called ***Isothermal process***

Teacher: Represent the graph relate pressure and volume at constant temperature in your notebook

Students: the graph representing Boyle's law the



Give time to the learners to think and write down their ideas

Learners work in pair to solve question

Emphasize new concepts.

Application:

Teacher: Discuss the applications of Boyle' law in the real life

Student Answer: The Boyle's law is applicable in bicycle pump while pushing up and down

- **Pushing down:** pressure increases while volume decreases.
- **Pushing up:** Pressure decreases while volume increases

2. A gas at a volume of 4 litres is at a pressure of 2 atm. The volume is changed to 16 Litres, ***what must the new pressure be?***

   a) 2 atm   b) 12 atm   c) 10 atm   d) 0.5 atm

Answer: D

Teacher: Let us end our lesson of today here. Describe Boyles's law in a few words and where can be applied.

Students: Boyles's law state that" ***"the volume of a fixed mass of gas is inversely proportional to the pressure, provided the temperature remains constant"***

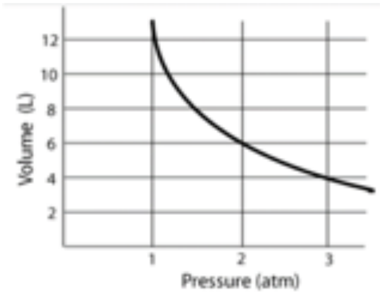
The Boyle's Law can be applied in compressing gases

Let learners themselves try to provide the answer and facilitate them to reach on the intended answer.

Use different questions to probe students to summarize the lesson.

4 **CONCLUSION** **(10 min)**	**Teacher: Assessment** 1. What are the state variables of a gas? A. Pressure, Elasticity and Compressibility B. Elasticity and Compressibility only C. Kinetic energy, pressure and Volume D. Number of moles, Pressure, Volume and Temperature 2. A balloon is filled with 73 L of air at 1.3 atm of pressure. What pressure is needed to change the volume to 43 L? A. 2.5atm B. 2.2atm C.3.2atm 3. A fixed mass of gas at a constant temperature has a pressure of 2000 Pa and a volume of 0.02 m^3. It is compressed until the volume is 0.005 m^3 . What is its new pressure? A. 8000Pa B. 6000Pa C. 10000Pa D.12000Pa 4. Plot the graph of volume against pressure of the data given in the table. <table><tr><td>**Pressure P(atm)**</td><td>4.1</td><td>5.2</td><td>6.3</td><td>7.4</td><td>8.5</td><td>9.6</td></tr><tr><td>**Volume V(L)**</td><td>12.2</td><td>13.4</td><td>14.6</td><td>15.8</td><td>16.10</td><td>17.12</td></tr></table> **Students: Answers:** 1) **D** 2) **B** 3) **A**	**Allow the learners to work individually** **Provide opportunities for corrective feedback to learners**

4) Graph showing the volume (in L) against the pressure (in Atm)



Now I want to give you a homework assignment so that you try to apply some of what we have learned today at your own.

Teacher: Homework

1. A fixed amount of a gas occupies a volume of 1L and exerts a pressure of 400 kPa on the walls of its container. What would be the pressure exerted by the gas if it is completely transferred into a new container having a volume of 3 litres (assuming the temperature and quantity of gas remains constant)
2. A gas exerts a pressure of 3 kPa on the walls of container 1. When container 1 is emptied into a 10-litre container, the pressure exerted by the gas increases to 6 kPa. Find the volume of container 1. Assume that the temperature and quantity of the gas remain constant

This homework will be done individually and will be corrected before starting a next lesson

3. At 1.70 atm, a sample of gas takes up 4.25L. If the pressure in the gas is increased to 2.40 atm, what will the new volume be

Thanks, you for your attention today, see you next year time

MAGNETIZATION AND DEMAGNETIZATION

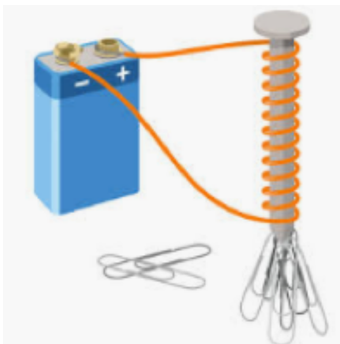
SUBJECT: PHYSICS	**GRADE:** S2	**DURATION:** 40 min

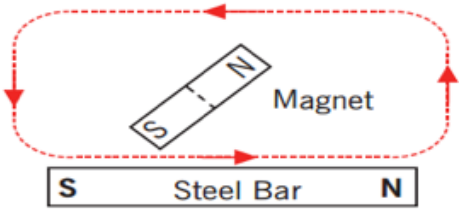
LESSON TITLE: Magnetization and Demagnetization
LEARNING MATERIALS: **Bar magnet, conducting wires, nails, fire, hammer, batteries**

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS' READINESS** **(5 min)**	**Teacher:** Hello Students welcome in today's lesson. Observe attentively the figure below.  **Teacher:** What do you observe on picture?	**Welcoming the students** **Display the picture**

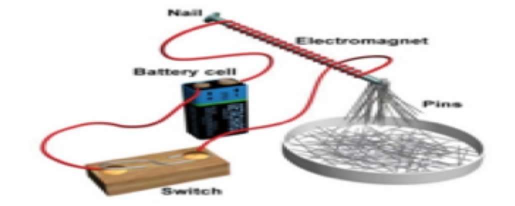
	Students: The hand holds a magnet. **Teacher: Thank you!** How do you know that is a magnet? **Students:** It attracts other objects **Teacher: Excellent!** When you remove the magnet will the objects continue to attract each other? **Students: No**, they will lose the properties of magnet. **Teacher:** It is correct; could you guess what we will learn in this lesson? **Students:** The today's lesson is magnetization. **Teacher: Thank you all**. Today we are going to study **Unit 11: Magnetization and Demagnetization**. **Today's lesson is Magnetization and Demagnetization.** **Learning objective:** 1. To magnetize objects using different methods of magnetization 2. To demagnetize magnets using different methods of demagnetization	**Students must be given time to think and note down their ideas.**

2 **INTRODUCTION** **(5 min)**	**Teacher:** Put in contact the nail and the magnet. What will happen? **Students:** The nail becomes magnet immediately. **Teacher:** Putting the magnet into fire or hammering a magnet; predicts what will happen. **Students:** The magnet loses its properties. **Teacher: Wow!** You are good learners. Let us move to the next activity  Bring each of the metallic materials (copper, zinc, steel, soft iron, aluminum) you wish to magnetize in close proximity to a strong magnet. • Then use the magnetized item to pick up drawing pins, paper clips or iron fillings. • If, after removing the magnet for a few minutes, there is little adhering to the items, it will not be useful as a permanent magnet. Gently tapping, for example with a pencil, should some magnetized items still in contact? **Students: No**, they are removed from the magnet	**Let learners themselves try to provide the answer and facilitate them to reach on the intended answer.**

3 **LESSON DEVELOPMENT** **(20 min)**	**Teacher:** Do the following activity and discuss the main point in it related to magnetization and demagnetization. 1. Bring a permanent magnet in contact with a nail and bring small nails near the nail in contact with the magnet. What happens?  2. Wound a copper wire around a nail and connect two ends of the copper wire on the battery as shown below. Bring the paper clips near to the nail. What do you observe? 	**Allow the learners to work in groups (remember gender balance and learners with special needs).** **If there is any video it can be used with a good sound**

	3. Rub a magnet around the steel bar in the direction shown below then bring the nail near the steel bar. What happens?  **What do you understand by the term magnetization?** **Students:** Magnetization is a process by which a magnetic material attains magnetic properties either temporary or permanently. **Teacher:** List and explain the methods of magnetization **Students:** Methods of magnetization are by induction, by electric current, by rubbing or stroking (single or double stroking). **By induction:** This method involves simply placing the magnetic material (soft iron) close to a strong magnet without touching and the material becomes a temporary magnet. Induced magnet is a temporary because when the permanent magnet is removed the magnetic material will usually lose its induced magnetism (magnetic properties).	**Give time learners to think and discuss and write down their ideas**

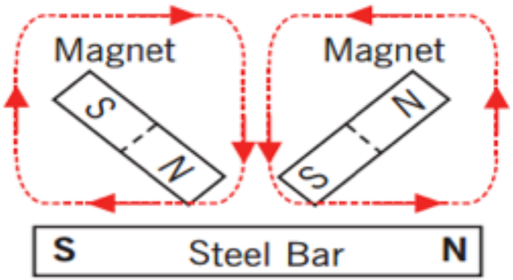
By electric current: is by passing a current in a coil of insulated copper wound round a piece of soft iron, The soft iron rod will have magnetization lasting so long as the current flows. But if the piece inside the coil is of steel, it is found to have acquired a permanent magnetization.



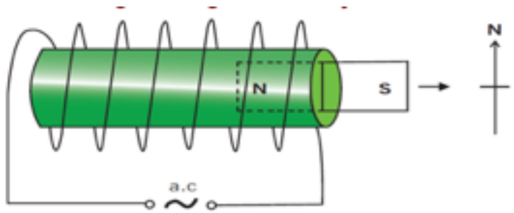
By touching or stroking: when a piece of unmagnetized magnetic material touches or is brought near to the pole of a permanent magnet, it becomes a magnet itself.

or **single stroking method:** is a method of magnetizing a magnetic substance by rubbing with a single magnet.

Double stroking: is a method of magnetizing a magnetic substance by rubbing with a pair of magnets.



Emphasize new concepts.

	Teacher: Excellent! Do the activities below and answer to the questions. 1. Hammer a bar magnet using a hammer for 5 min and after bring it near the small nail. **What do you observe?** 2. Take a bar magnet and heat it in fire for 10 min, then remove it from fire and after bring it near the small nail. **What do you observe?**  3. Introduce a magnet into a solenoid and connect the solenoid to a battery. After 10 min, remove the magnet and bring it near the nails. **What do you observe?**  **Students:** In all cases, the magnet loses its magnetic property. It does not attract the nails.	**Let learners themselves try to provide the answer and facilitate them to reach on the intended answer.**

Teacher: How do you call this method? Explain

Students: This method is called Demagnetization. It is a process of removing totally or partially the magnetic properties of a magnet.

Teacher: Very good! list the methods that are used to demagnetize a magnet.

Students: The method of demagnetization include: hammering, heating method, electric method.

By hammering: the magnet will lose the magnetic properties when hammered for several time.

By heating: The magnet will become permanently demagnetized if exposed to higher temperatures for a certain length of time or heated at a significantly higher temperature (Curie temperature)

By electric method: by connecting the solenoid to an alternating current, place the magnet inside the solenoid, switch on a.c supply and slowly withdraw the magnet in East-West direction until it is some distance away from the solenoid while a.c. current still on, hence by this motion of a magnet inside the solenoid lead to the loss of its magnetic properties.

	Teacher: Good! Let us summarize our lesson. What are the main points of today's lesson?	Use different questions to probe students to summarize the lesson.
	Students: The main points of today's lesson are: • Magnetization is the process by which a magnetic material attains magnetic properties either temporary or permanently. • Methods of magnetization are by induction, by electric current, by rubbing or stroking (single or double stroking). • Demagnetization is the process of removing totally or partially the magnetic properties of a magnet. • Methods of demagnetization are by heating, by hammering, by electric current (a.c)	
4 **CONCLUSION** **(10 min)**	**Teacher: Assessment** 1. Differentiate the different methods of magnetization. 2. Differentiate the terms magnetization and demagnetization. 3. List two types of magnetization by stroking. 4. The following are the methods of demagnetization except **A**. Hammering **B**. Heating **C**. Induction **D**. Using direct current	**Allow the learners to work individually**

	Students: answers 1. Magnetization by induction is the process by which a piece of magnetic material becomes amagnet when it is near or touching a permanent magnet. Magnetization by using electric current is a type of magnet in which the magnetic field is produced by an electric current. Magnetization by stroking: this is done by stroking a magnetic substance with a magnet. there two types of magnetization by stoking such us single and double stroking. 2. Magnetization is the process by which a magnetic material attains magnetic properties either temporary or permanently while demagnetization is the process of removing totally or partially the magnetic properties of a magnet. 3. Single stroking and double stroking. 4. C	**Provide opportunities for corrective feedback to learners**
	Homework A magnet attracts a piece of iron. The iron can then attract another piece of iron. On the basis of domain alignment, explain what happen in each piece of iron.	**This homework will be done individually and will be corrected before starting a next lesson**

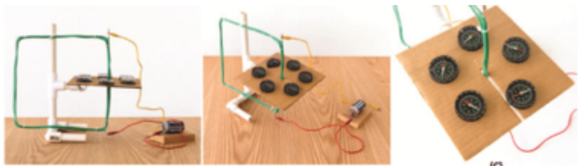
APPLICATION OF ELECTROSTATICS

SUBJECT: PHYSICS	**GRADE:** S2	**DURATION:** 40 min

LESSON TITLE: introduction to electric field
LEARNING MATERIALS: Pictures, Charts, Battery Cells (1.5v), A Conducting Wire, Magnetic Needles, Slotted Cardboard

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS' READINESS** **(5 min)**	**Teacher:** Hello dear students you are welcome in today's lesson. **Observe carefully the picture.**  **Teacher:** What do you look at the picture? **Students:** The lightning.	**Display the picture** **Let leaners themselves try to produce the answer and facilitate them to reach on the intended answer.**

	Teacher: Wow! People say the lightning is like electricity. Do you agree with them? **Students: Oh!** Yes, as the electricity burns, the lightning does. **Teacher:** How does the lightning reach the ground? **Students:** There is attraction force between the lightning and the ground **Teacher: Many flowers!** Could you suggest the lesson of today? **Students:** The force between two charged bodies. **Teacher:** Well done for all today we are going to study ***Unit 12 Applications on electrostatic***. Today's lesson is 'Electric field ' **Learning objective:** By the end of the lesson, you should be able to explain Electric field.	
2 **INTRODUCTION** **(7min)**	**Teacher:** Rub a pen using a silk cloth or hair a number of times. Lower the pen gradually until it comes very close to the pieces of paper **Teacher:** What do you observe? **Students:** The pen attracts the pieces of paper.	

	Teacher: Great work! Why did the pen not attract the pieces of paper when it was very far from them? **Students:** The attraction force between the pieces of paper and pen becomes weak. **Teacher: excellent!** What is Electric field? **Students:** The region around charge where the electrostatic force acts (attraction or repulsion) is called Electric field	
3 **LESSON DEVELOPMENT** **(25 min)**	**Teacher:** Now, let us do this activity in order to investigate electric field. Are you ready? **Activity:** **Materials:** One battery cell, a conducting wire, 5 magnetic needles, and a slotted cardboard. **Procedure** • Arrange the materials as shown below  (A) (B) (C) • Remove the battery and note the changes on needles • Reconnect the battery and note the changes on needles	**Allow learners to work in group and invite one member of the group to present their finding and after that harmonize.**

	Teacher: What is the main cause of the directions change when the battery is connected? **Students:** The main cause is the presence of electric current. By using electricity, we create a magnetic field that is stronger than the earth's field. **Teacher:** What happens to a charged particle when another charged particle is located in the area surrounding it **Students:** When a charged particle is located in the area surrounding another charged particle, it experiences a force. **Teacher:** How do you call the space around the charged particle where the force is exerted on the other charged particle? **Students:** The space around the charged particle is called an electric field. Or electrostatic field. **Teacher:** State the devices that working on the principle of electric field **Student:** Photocopier, electromagnet **Teacher:** Let together summarize some of the key points that we have learnt. Briefly tell us what we have seen in the lesson. **Students:** We talked about Electric field. Electric field is the region around charged particle where its electrostatic force acts.	**Help learners to summarize what has been leant**

5 **CONCLUSION** **(5min)**	**Teacher: Take a paper and do the following evaluation** **Assessment:** 1. What does electric field mean? 2. Complete the sentence: The force between two bodies is stronger as…………………….. **Students: Answer** 1. Electric field is a space around the charged object where the force is exerted on the charged particle. 2. The force between two charged particles is stronger as the distance between two charged particle decreases. **Teacher: Homework.** 1. What is needed to describe electrostatic force? 2. Search for other devices that use the principle of electric field. ***Thank you for your participation.*** ***See you in next lesson.***	**Allow learners to work individually** **Provide corrective feedback**

ARRANGEMENT OF RESISTORS IN ELECTRIC CIRCUIT

SUBJECT: PHYSICS	**GRADE:** S2	**DURATION:** 80 min

LESSON TITLE: Arrangement of resistors.
LEARNING MATERIALS: battery or dry cells, incandescent lamps or light bulbs, wires, switches

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS' READINESS** **(3min)**	**Teacher: Hello students, welcome to this physics Lesson!** **Teacher:** Once you switch on a torch, you can move in the darkness. **How does it operate?** **Students:** There is an electric circuit inside the torch that gives out the light energy. **Teacher: Wow, Very good!** To day now we are going to study **Unit 13**: Arrangements of resistors in electric circuit. **Lesson 1. Arrangement of resistors.**	**Remember that in S1 students learned simple circuits and components unit 12, therefore put a stress on practices than theories.**

<table>
<tr>
<td></td>
<td>By the end of this lesson, you should be able to:
• List the elements used of simple electric circuit
• Set up resistors in series and in parallel
• Calculate the equivalent resistance in series, parallel or series parallel connections
• Explain the advantages of series and parallel connections.</td>
<td></td>
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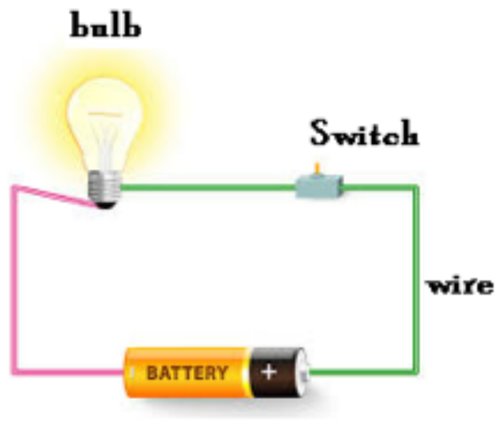
<td>2
INTRODUCTION

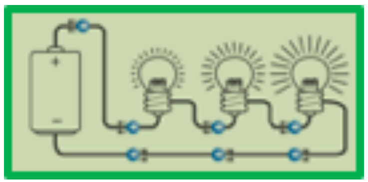
(7min)</td>
<td>Teacher: Using the wire, light bulb, and battery. Put them together to make the bulb light.

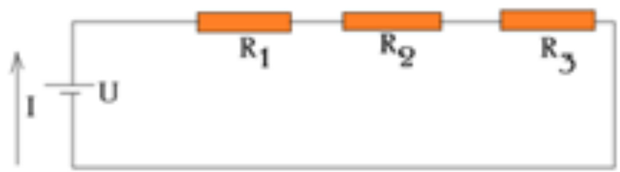
Students:


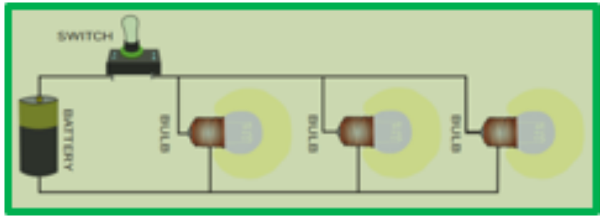
Teacher: Discuss basic components of simple electric circuit.</td>
<td>Tell students the materials needed and give them a small time to take them.

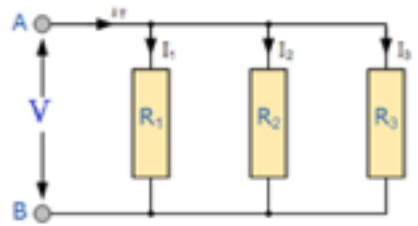
Let the learners discover the concepts themselves.

Students must be given time to think and note down their ideas.</td>
</tr>
</table>

	Students: A simple circuit has conductors, **a switch, a power source** and **a load**. **Conductors** are usually copper wires with no insulation. They make the path through which the electricity flows. One piece of the wire connects the current from the power source (cell) to the load. The other piece connects the load back to the power source. **The switch** is a small gap in the conductor where you can close or open the circuit. When the switch is closed, the circuit is closed and electricity flows. **The power source** is a cell (more than one cell put together is known as a battery). The load is anything that uses some of the power from the cell . **The load** is also known as a resistor. In our example **resistor** is bulb while a power source is battery cell.	
3 **LESSON DEVELOPMENT** **(60min)**	**Activity one:** **Teacher:** using the wires, 3 light bulbs, and battery cells, connect them together to make the series bulbs light. **Students:** 	**From activity 1 to 3 give the learners the time to collaborate into their group (don't forget to monitor individual special needs and gender balance)** **Emphasize new concepts.**

	Teacher: connect only one bulb, then two bulbs! Discuss your observation (What happen when circuit has one or two bulb(s)? What happen when the circuit has three bulbs?) **Students:** When a **bulb** in a **series** circuit is unscrewed all **bulbs** in the circuit go out. Increasing the number of **bulbs** in a **series** circuit decreases the **brightness** of the **bulbs**. Therefore the t**otal resistance is sum of all resistances in series circuit**. **Teacher:** Can you draw a schematic illustration of this circuit? Write the mathematical equation of total resistance when you use n resistors in series. **Students:**  $R_{eq}=R_1+R_2+R_3+...+R_n$	**At each step, provide a pause time for students to think and say or write their ideas.**

	Activity two: **Teacher:** using the wires, 3 light bulbs, switch and battery cells connect the bulbs in parallel and observe the light. **Students:**  **Teacher:** What happen when circuit has one or two bulb(s)? What happen when the circuit has three bulbs? **Students:** If light **bulbs are** connected in **parallel** to a voltage source, the **brightness** of the individual **bulbs** remains **more**-or-less constant as **more** and **more bulbs are** added to the "ladder". The current increases as **more bulbs are** added to the circuit and the overall resistance decreases. **Teacher:** Draw a schematic illustration of this circuit? Write the mathematical equation of total/ equivalent resistance when you use n resistors in series.	**Use different questions to probe students to understand the content.**



$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots + \frac{1}{R_n}$$

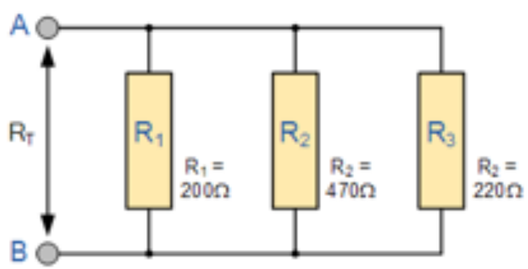
Activity Three:

Teacher: Ten resistors, each with 300Ω resistance, are set up in series. What is their equivalent resistance?

Students:

$$R_{eq} = R_1 + R_2 + R_3 + \ldots + R_{10} = (300 + 300 + 300 + \ldots + 300)\Omega = 3000\Omega$$

Teacher: Find the total resistance, RT of the following resistors connected in a parallel network.



Make sure that each concept is well explained.

Students: $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} = \frac{1}{200} + \frac{1}{470} + \frac{1}{200} = 0.0117$

$$R_T = \frac{1}{0.0117}\Omega = 85.67\Omega$$

Teacher: What are advantages of connecting resistors in series? Discuss advantages of connecting resistors in parallel.

Students: Series circuits: They do not overheat easily. This makes them very useful in the case of something that might be around a potentially flammable source, like dry plants or cloth. They are easy to learn and to make. Their simple design is easy to understand, and this means that it's simple to conduct repairs. The current that flows in a series circuit has to flow through every component in the circuit. Therefore, all of the components in a series connection carry the same current. Parallel circuit: Every unit that is connected in a parallel circuit gets equal amount of voltage. It becomes easy to connect or disconnect a new element without affecting the working of other elements. If any fault happened to the circuit, then also the current is able to pass through the circuit through different paths.

	Teacher: Fantastic Good students, Is there any more question please? **Student:** What are disadvantages of connecting resistors in series? Can we experience any disadvantage of connecting resistors in parallel please? **Teacher:** Good question, who can tell us about these connections' disadvantages? Any idea! **Students:** Parallel connection: It requires the use of lot of wires. We cannot increase or multiply the voltage in a parallel circuit. Finally fails at the time when it is required to pass exactly same amount of current through the units. Series connection: If one point breaks in the series circuit, the total circuit will break. Secondly if the number of components in a circuit increase, circuit resistance will increase. **Summary:** √ **Teacher:** What have we learnt from this lesson? √ **Students:** A simple circuit consists of conductors, a switch, a power source and a load. For series connection, $R_{eq}=R_1+R_2+R_3+...+R_n$ while for parallel connection, $\frac{1}{R_{eq}}=\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}+...+\frac{1}{R_n}$	**Allow/ask the students to make their own summary**

	For series connection once one point breaks the total circuit break too but for parallel the breaking of one point doesn't affect the full circuit.	
4 **CONCLUSION** **(10min)**	**Assessment and homework:** **Teacher:** Students take your exercises notebook and work on the following: 1. Ten resistors, each with 300Ω resistance, are set up in parallel. What is the equivalent resistance? 2. Twelve resistors of equal resistance are set up in series. If the total resistance is 600Ω, what is the resistance of each resistor? 3. Three resistors are in a series. They have 10Ω, 18.3Ω, and 21.22Ω of resistance respectively. What is the total resistance? 4. What is disadvantage of set up devices in series connection? 5. What is an advantage of set up devices in parallel connection? **Students:** 1. $\frac{1}{R_{eq}} = \frac{n}{R} \Rightarrow R_{eq} = \frac{R}{n} = \frac{300\Omega}{10} = 30\Omega$	

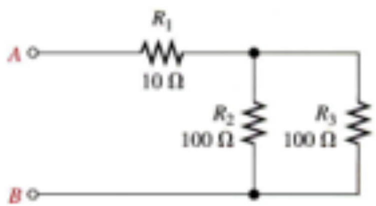
2. $$R_{eq} = nR \Rightarrow R = \frac{R_{eq}}{n} = \frac{600\Omega}{12} = 50\Omega$$

3. $$R_{eq} = R_1 + R_2 + R_3 = 10\Omega + 18.3\Omega + 21.22\Omega = 49.52\Omega$$

4. If one point breaks in the series circuit, the total circuit will break. In addition, more number of components in a circuit increase, greater will be the circuit resistance.

5. It becomes easy to connect or disconnect a new element without affecting the working of other elements. In addition, if any fault happened to the circuit, then also the current is able to pass through the circuit through different paths.

Teacher: **Excellent**, now as homework you have to observe this circuit and find equivalent resistance between point **A** and point **B**.



Thank you very much for your participation in this lesson.

Provide opportunities for corrective feedback or positive feedback to students.

LESSON FROM **UNIT** 14

REFLECTION OF LIGHT IN CURVED MIRRORS

SUBJECT: PHYSICS	**GRADE:** S2	**DURATION:** 80 min

LESSON TITLE: Reflection of light in curved mirrors

LEARNING MATERIALS: curved mirrors, spoon, light source, concave, convex mirror, optical pins and small movable screen.

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS' READINESS** **(4min)**	**Teacher:** Hello my students! Welcome in today's lesson! Are you ready? **Students:** Hello Teacher, we are ready! **Teacher:** **Good!** Take a spoon and view your face through it. How your image look like? **Student:** My image looks small and erected. **Teacher:** Do you see your image on both side of the spoon? **Students:** Yes but looks differently.	**Provide a spoon to learners** **- Bring different types of mirror (convex, concave and plane) and distribute them to students.**

	Teacher: Who can suggest the type of mirrors does the spoon represent? **Students:** The spoon represents a curved mirror. **Teacher: Very good!** Who can guess the lesson of today? **Students:** The lesson of today is reflection of light in curved mirrors. **Teacher: wow! Correct!** **Lesson Objectives / Instructional Outcomes of the lesson are:** By the end of this lesson, you should be able to locate by construction images formed in curved mirrors and state their characteristics.	
2 **INTRODUCTION** **(16min)**	**Teacher:** Let us start by doing this simple activity. Take different mirrors and observe images of objects formed by those mirrors. Do the images have the same properties?  Different Types of Home Mirrors **Students:** No! some images are small, erect, inverted, magnified , etc!	**Divide the class into the following two teams basing on gender and special needs.**

3 **LESSON DEVELOPMENT** **(50min)**	**Teacher:** To describe images formed by curved mirrors, let us perform this simple activity: **Form two team:** one of concave mirrors and the other of convex mirrors: **(1) The Convex Team:** Place the convex mirror at a fixed position and move object such as pen at different positions to observe characteristics of images formed. **(2) The Concave Team:** Place the concave mirror at a fixed position and move object at different positions to observe characteristics of images formed. Each team discuss on your findings. **Learners from convex team:** **Sample List of possible characteristics of images for a Convex Mirror:** i. The image is always upright. ii. The image is always located behind the mirror (a virtual image). iii. The image size is always smaller than the actual size of the object.	**One team of concave mirrors and the other of convex mirrors Tell them the materials needed and give them a small time to take them.** **Then, engage in a class discussion compiling each team's list on the chalkboard.**

Learners from concave team:

Sample List possible characteristics of image for a Concave Mirror:

i. The image may be upright or inverted.

ii. The image may be located in front of the mirror (**a real image) or behind the mirror (**a virtual image).

iii. The image size may be smaller, larger, or the same size as the object.

iv. The characteristic of the image depends on where the object is placed in relation to the focal point.

v. An object placed closer to the concave mirror than the focal point always produces an upright, enlarged, and virtual image.

vi. An object placed beyond the focal point always produces an inverted, real image.

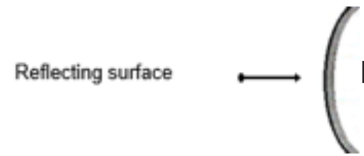
To be able to describe the images formed by curved mirrors let us define curved mirrors

Teacher: Differentiate a concave from convex mirror.

Students: Concave mirror is the mirror with the curved (spherical) reflecting surface.

Reflecting surface is inward

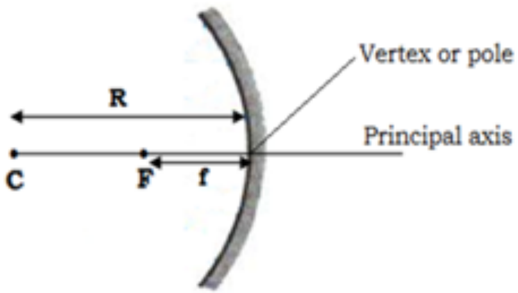
Convex mirror is a mirror whose reflecting surface is curved outwards



Reflecting surface is outward

Teacher: What are the elements of curved mirrors

Students: Elements of curved mirrors are:



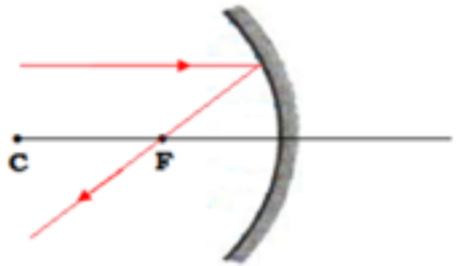
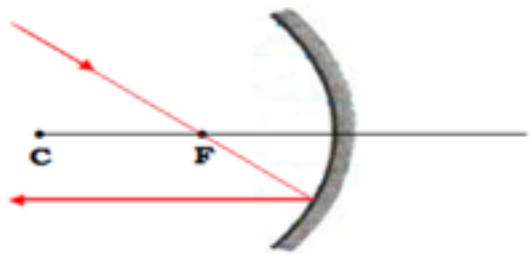
Every curved mirrors has:

Centre of curvature(C): It is the Centre of the sphere from which the mirror is sliced. For concave mirrors, the Centre of curvature is in front of the reflecting surface and for a convex mirror is behind the reflecting surface.

Students must be given time to think and note down their ideas.

Ask questions to learners to provide definition of concave and convex mirrors.

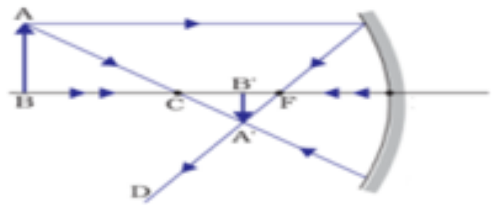
	Vertex is the point of the mirror surface where the principal axis meets the mirror. The vertex is also known as the pole. It is the geometric Centre of the mirror. **Focal point (F)** is the point midway between the vertex and Centre of curvature. It is also called the "principal focus". **Radius of curvature (R)** is the distance between the centre of curvature and the vertex. It is the radius of the sphere from which the mirror was cut. **Focal length (f)** is the distance from the mirror to the focal point. **Aperture** is the surface of the mirror. **Teacher:** How does ray of light reflect through curved mirrors? **Students:** Light always follows the laws of reflection. For a spherical mirror, the normal at the point of incidence on the mirror surface is a line that extends through the centre of curvature.	**Present the figures of curved mirrors on a chart or draw them on chalkboard.** **Emphasize new concepts.**

	Principal Ray Diagrams **To construct the image, two of the following three rays are drawn from the top of the object:** 1. A ray parallel to the principal axis after reflection actually pass through the focal or appears to diverge from the focal point.  2. A ray through the focal point is reflected parallel to the principal axis.  	**Present figure on a chart or draw them on chalkboard.**

Teacher: What are the characteristics of images formed by a concave mirror according to the position of object? User ray diagrams

Students: Answer:

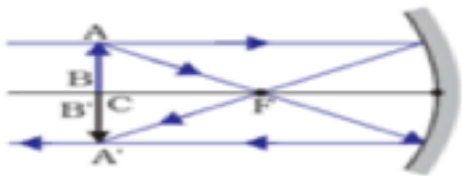
a) Object located beyond the centre of curvature



Characteristics of images:

- Real
- Inverted
- Formed between C and F
- Diminished

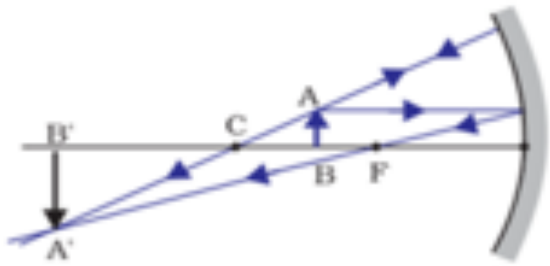
b) Object located at the centre of curvature.



Characteristics of images:

- Real
- Inverted
- Same size as object
- Formed at C

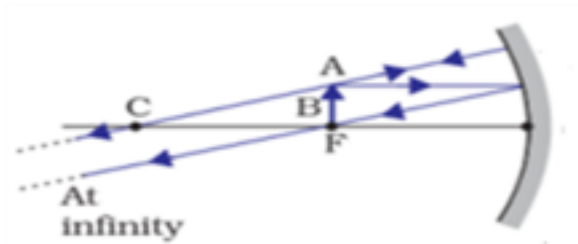
c) **Object between C and F**



Characteristics of images:

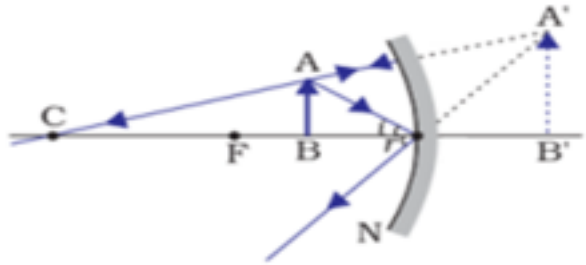
- Real
- Inverted
- Formed beyond C
- Magnified

d) **Object at the focal point**



Characteristics of images: image is at infinity because reflected rays are parallel.

e) Object between the focal point and the vertex



Characteristics of images:

- Virtual
- Upright
- Magnified
- Located behind the mirror

Teacher: what are the characteristics of image formed by convex mirror? Show ray diagram

Students: Answer:

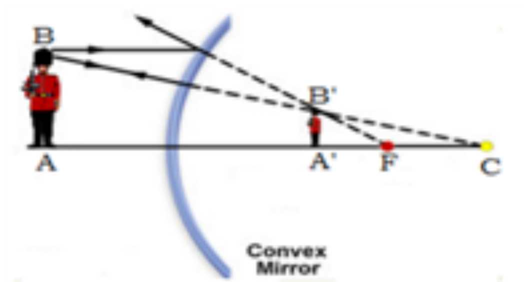
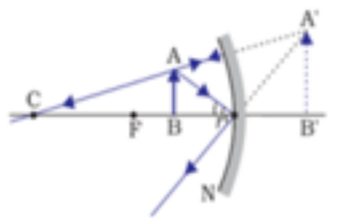


Image is virtual, Upright and diminished.

Allow learners to work in pair and brainstorm on answers.

	Activity of application **Teacher:** From your knowledge on characteristic of image, what are the application of curves mirrors **Students: curved mirrors are used as:** • Reflectors in car headlamps and search lights • Essential components of large telescopes • Car wing mirrors because convex mirrors give a wider field of view. **Teacher:** In summary what we have learnt in this lesson? **Students:** During this lesson we have learnt: A curved mirror is the mirror with the curved (spherical) reflecting surface. The properties of the image formed by curved mirror depends on the type of the curved mirror and the position and size of the object. **Curved mirrors have many applications in daily life. Such as:** • Reflectors in car headlamps and search lights • Essential components of large telescopes • Car wing mirrors because convex mirrors give a wider field of view.	**Use learner's ideas to formulate the lesson summary.**

4 CONCLUSION **(10min)**	**Teacher: Assessment** Knowing curved mirrors and description of their images answer to the following questions: 1. Differentiate concave mirrors from convex mirrors 2. Construct the ray diagram for the object located between f and the pole and state the characteristics of the image formed. **Students: Answer:** **1. Concave mirror** (*Converging mirror*) whose reflecting surface curving inwards. **Convex mirror** (*Diverging mirror*) is a mirror whose reflecting surface is curved outwards  Image is Virtual, Upright, Magnified and Located behind the mirror. **Teacher: Homework** Using internet connection, search for the other applications of curved mirrors. ***This is the end of our Lesson! See you in next lesson!***	**Allow the learners to work individually** **Provide pause time to think and say or write their ideas provide opportunities for corrective feedback to learners**

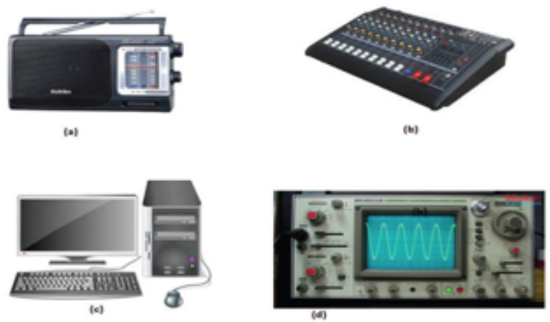
BASIC ELECTRONIC COMPONENTS

SUBJECT: PHYSICS	**GRADE:** S2	**DURATION:** 80 min

LESSON TITLE: Illustration of standard symbols of some electronic components
LEARNING MATERIALS: radio, telephone, laptop, calculators and chalk board, physics book 2

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS' READINESS** **(2min)**	**Teacher:** Hello my dear students! How are you? I hope you are doing well **Did you listen evening news to the radio at home?** **Students:** Yes, we listen the news at evening. **Teacher:** Very good! How many to you have a telephone? **Students:** Some of us we have it at home **Teacher:** But make sure that you left it at home always. how do we call a telephone and a radio? **Students:** All of them are electronic devices	**Guides learner's discussion**

	Teacher: Wonderful! do you know the parts of radio? **Students:** Yes but not all. **Teacher:** Very good! Could you suggest what we will learn in this lesson? **Students:** Electronic components **Teacher:** Very Nice! Today we are going to continue our unit 15: Basic electronic Components. Today's lesson is illustration of Standard symbols of some electronic components **Learning objectives** At the end of this lesson, you will be able to identify symbols of electronic components and name different electronic components.	**Use the real materials like a radio, telephone and laptop** **Learners will bring the unused part of radio from home and teacher find real materials to help learners.**
2 **INTRODUCTION** **(8min)**	On previous lesson we have seen the meaning of electronics as branch of physics. **Teacher:** A semi-conductor is formed by ……… bonds **A**. Covalent **B**. Electrovalent **C**. Co-ordinate **D**. None of the above **Answer: A**	**Allow the learners to work in groups (remember gender balance and learners with special needs).**

	Teacher: Give the difference between electricity and electronics. **Students:** Electronics refers to the flow of charge (moving electrons) through non-metal conductors; mainly semi-conductors, whereas electrical refers to the flow of charge through metal conductors. **Teacher:** Observe the pictures below and answer the questions follow.  **Teacher:** Write and discuss the names and type of the following devices **Students** **a)** Is a radio receiver **b)** Is an audio mixer (amplifier) **(c)** Is a computer **d)** Is the oscilloscope, **Note: They all have motherboards that contain electronic components so they are electronic devices**	**(If any video, it can be used).** **Provide pause time to think and say or write their ideas.** **Asks learners to form groups of 4 students (the number may depend on the class size)**

3

LESSON DEVELOPMENT

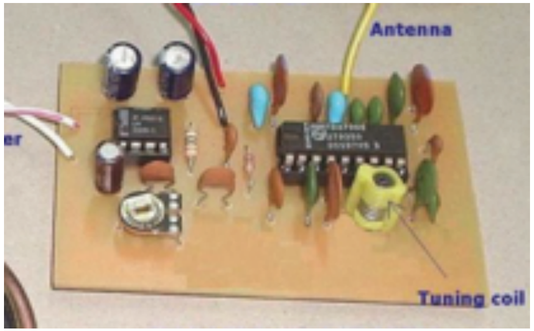
(60min)

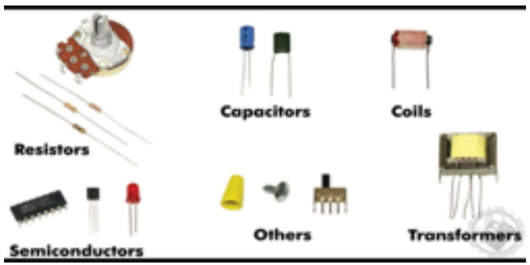
Teacher: Activity of Investigating the components of a radio as device

Material: parts of unused radio especial Printed Circuit Board

Instructions:

- observe the circuit (known as heart of radio) given
- Try to name the components parts of it
- Discuss the functions of some parts of it you know





Motherboard of radio **Electronic components**

Teacher: what made up a radio?

Student: Radio is made up with different electronic components

Teacher: Name the basic electronic components of radio

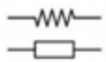
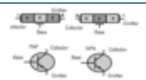
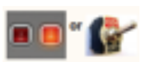
Students: Capacitors, resistors, coil, diodes ,transistors, transformer, etc

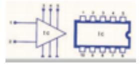
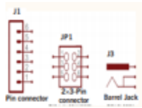
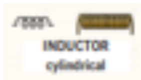
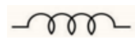
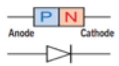
Teacher: What is an electronic component?

Students: Electronic components are basic electronic elements or electronic parts usually packaged in a discrete form with two or more connecting leads or metallic pads

Teacher: **Vey good!** Suggest the symbols and functions of basic components of a radio as device.

Students:

NAME	IMAGE	SYMBOL	FUNCTIONS
1. capacitor			Components that store electrical charge in an electrical field.
2. Resistor			Components used to resist current.
3. Transistor			A semi-conductor device capable of amplification
4. switches			Components that may be made to either conduct (closed) or not (open).

NAME	IMAGE	SYMBOL	FUNCTIONS
5. Integrated circuits or ICs			A Microelectronic computer circuit incorporated into a chip or semiconductor; a whole system rather than a single component.
6. Terminals and connectors			Components to make an electrical connection.
7. Magnetic or inductive components			These are Electrical components that use magnetism
8. Ordinary diodes			Components that conduct electricity in only one direction.
9. Zener diode			A Zener diode allows current to flow from its anode to its cathode like a normal semiconductor diode, but it also permits current to flow in the reverse direction when its "Zener voltage" is reached.

<table>
<tr>
<td rowspan="2"></td>
<td>Teacher: Who can describe types of electronic components

Students: Passive electronic components are those which utilises or store energy in form of voltage or current that do not have gain or directionality. E.g. resistors, capacitors, inductors

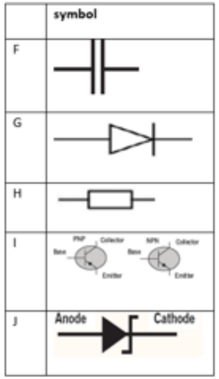
Active electronic components are those who delivers or produce energy or power in form of a voltage or current. Ex: diode, transistor</td>
<td rowspan="2">Allow th learners to work in groups (remember gender balance and learners with special needs).</td>
</tr>
<tr>
<td>Application activity

Teacher: what happen to some radios continue to speak after being removed from the source of energy (AC current or solar)?

Students: Those radio store electrical charge in an electrical field through their capacitors, this keep them to continue speaking after being removed from the energy source.</td>
</tr>
</table>

Match the following electronic components with their respective circuit symbols

	Components
A	Resistor
B	Capacitor
C	Ordinary diode
D	Zener diode
E	Transistor



Answer: **A**=H, **B**=F, **C**=G, **D**=J, **E**=I

Teacher: As we end up the lesson, let together review some of the key points that we learnt.

Explain what is means by electronic component and name the two types of electronic components.

Students:

- **Electronic components** are basic electronic elements or electronic parts usually packaged in a discrete form with two or more connecting leads or metallic pads.
- Each electronic component has its specific symbol.
- There are two types of electronic components i.e (passive and active)

4

CONCLUSION

(10min)

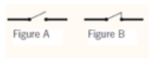
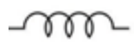
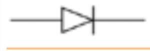
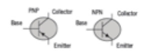
Teacher: Assessment:

1. **The symbol below stands for** 

   A. Capacitor **B**. Resistor

   C. Inductor **D**. None of above

2. **Which symbol is for transistor?**

A	B.	C.	D.
			

3. **The following are passive electronic components except?**
   A. Resistor **B**. Inductor **C**. Capacitor
   D. Transistor **E**. Diode

4. **Is a transistor a passive or an active electronic component?** Justify your answer.

Students: Answer:

1). **B** 2). **D** 3). **D**

4). A transistor is an active electronic device because it has gain or directionality

Teacher: Homework:

Find the mains components of motherboard of a radio and investigate how it works.

Thank you for your participation in this lesson.
See you next time.

Allow the learners to work individually

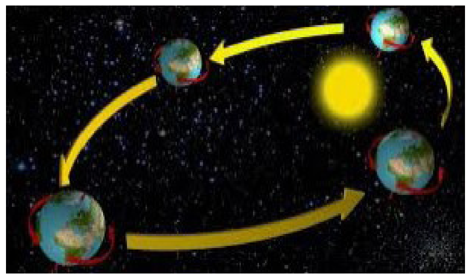
Sample Scripted Lessons For Senior Three

GRAPHS OF LINEAR MOTION

SUBJECT: PHYSICS	GRADE: S3	DURATION: 40 min

LESSON TITLE: Uniform and non-uniform linear motion.

Learning materials: Picture showing moving car,

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS' READINESS** **(2min)**	**Teacher:** Good morning students! How are you today? Welcome in this lesson 	**Begin by gaining student's attention** **Welcoming them in the lesson.** **Display the pictures or charts and allow learners to ask questions.**

Teacher: What do you observe on the pictures?

Student: On picture we see clock needle, the earth revolving around the sun and a car moving on road.

Teacher: From the pictures, which object that moves equal distance in equal period of time?

Student: Clock needle and the earth move equal distance in equal period of time?

Teacher: What about the car moving on road.

Student: Car may move different distance in equal time interval.

Teacher: Who can suggest the two types of motion

Student: The car moves in non-uniform motion, and the earth revolves in uniform motion.

Teacher: Who can guess the title of today's lesson?

Student: The lesson of today is uniform and non-uniform motion.

	Teacher: Wow! Today we start a new unit: Graphs of linear motion. The lesson of today is **uniform and non-uniform linear motion.** **Lesson Objectives/Instructional Outcomes:** By the end of this section, the learner should be able to • Identify uniform and non-uniform motion • Describe graphs of uniform and non-uniform linear motion. • Appreciate that linear motion can be represented using graphs.	
2 **INTRODUCTION** **(8min)**	**Teacher:** Observe actively the picture and ask questions related to your observation. 	

	Why are some cars left behind while others are in the front? **Students:** Because cars are moving with different speed and acceleration.	
3 **LESSON DEVELOPMENT** **(25min)**	**Teacher:** Let us perform the following activity **Activity: To plot the graph of uniform motion/non uniform motion** Materials: rechargeable toy car, stopwatch, flat surface or flat table, tape measure or meter rule. St**eps/procedures** 1. Bring a rechargeable toy car and stopwatch 2. Put it on flat surface or on the table 3. Let it move for the first time 4. Record the distance d1 by using tape measure 5. Record the time t1 by using stopwatch 6. Repeat the procedure for another distance d2 and for another time t 2 7. Repeat the experiment until you get at least six different outcomes. Fill them in the table below	

	8.	

Variables	Trial 1	Trial2	Trial3	Trial4	Trial5	Trial6
Distance						
Times						

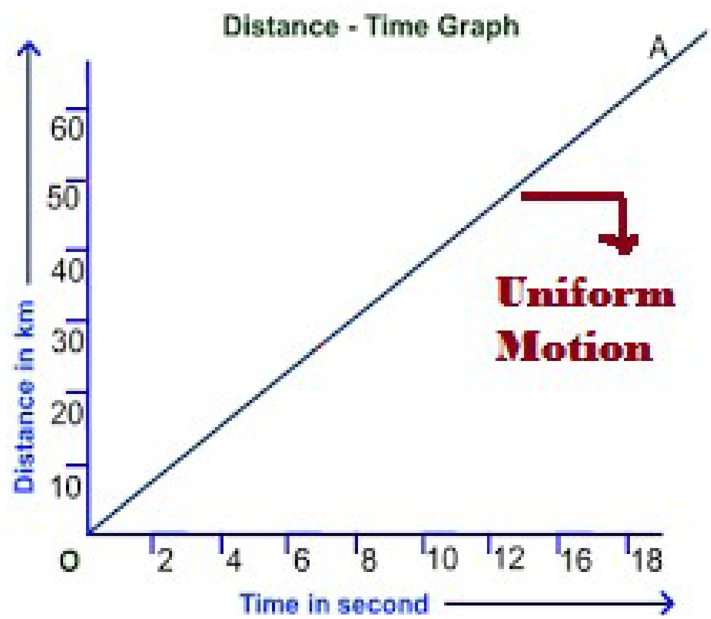
9. Plot the data/outcomes on the graph so that the distance be on vertical axis and time on horizontal axis.
10. After drawing the curve given by the outcomes of an experiment, analyze and explain the type of the motion

(Is it uniform? or non-uniform motion?)

Students: Results of activity:

Give the materials to learners to try and lead them until they perform it correctly.

Let the learner from different groups perform experiment.

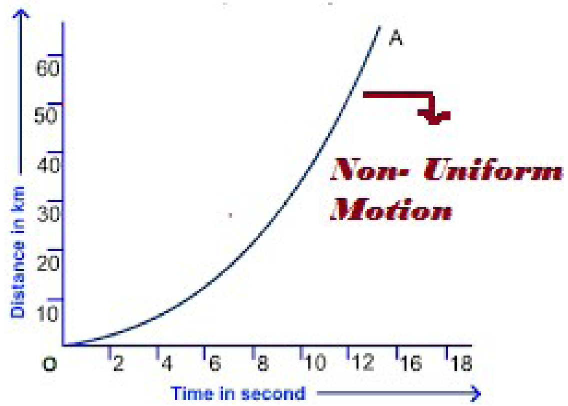


Teacher: From the graph, how does distance vary with respect of time?

Student: The change of distances are equal in equal time intervals (uniform motion)

To get their own outcomes until they get six different results / outcomes.

Encourage the students to ask questions on what they don't understand.

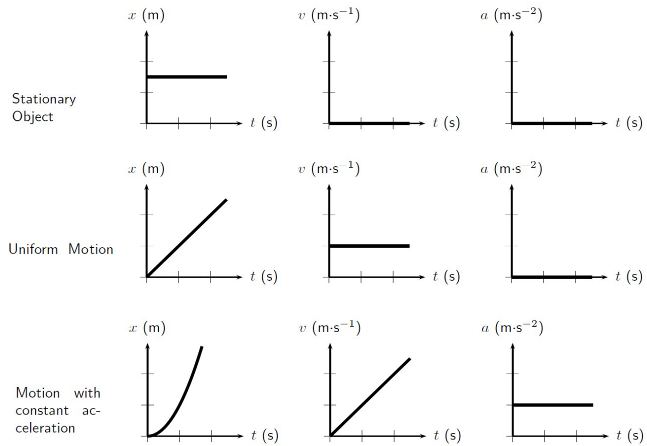
	 **Teacher:** from this figure, how does distance varry with time? **Student:** The change of distances is not equal in equal time intervals (non- uniform motion. **Teacher:** Who can suggest the difference between uniform and non-uniform motion? **Student : Uniform motion** is an object moving at the same velocity traveling equal distances in equal intervals of time • A moving body is said to be in **a non-uniform motion** state if it travels unequal distances in equal intervals of time. The motion in a straight line is called **linear motion,** also referred to as **rectilinear motion.**	**Help /guide them to plot the best fit graph which is good for analyzing the motion.**

Uniform linear motion is a type of motion in which the body moves with constant velocity. In other words, it moves with zero acceleration or along a straight path with constant speed.

An example of this kind of motion is a car moving along a straight section of road at a constant speed.

Non uniform linear motion is the kind of motion in which a body moves with a varying velocity. This motion can be **accelerated** or **decelerated.**

Teacher: Draw the graphs of stationary, uniform and non-uniform motion.



Present the figure on a chart or draw it on chalk board.

Provide pause time to think and say or write their ideas

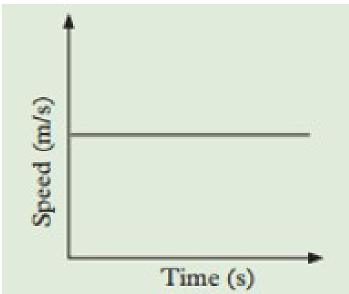
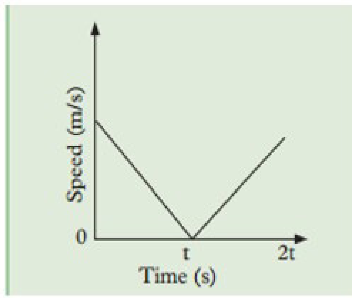
	Teacher: From the figures give the differences in velocities for: a) Stationary object b) Object in uniform motion c) Object in non-uniform motion **Students:** Answers: 1. stationary object has zero velocity, 2. object in uniform motion has a constant velocity and 3. object in non-uniform motion has varying velocity **Teacher:** To understand well the concept let us solve the following example: **Example:** Calculate the speed of the car that covered 240Km in 8hrs **Student:** Data given: Distance covered=240Km Time taken = 8hrs Required Speed=? $speed = \frac{distance\ covered}{time\ taken} = \frac{240km}{8hrs} = 3\,km/h$	**Allow the learners to calculate the answer to example given.** **Correct some answers from learners**

Teacher : Let us use the following table to understand the comparison of uniform motion and non-uniform motion.

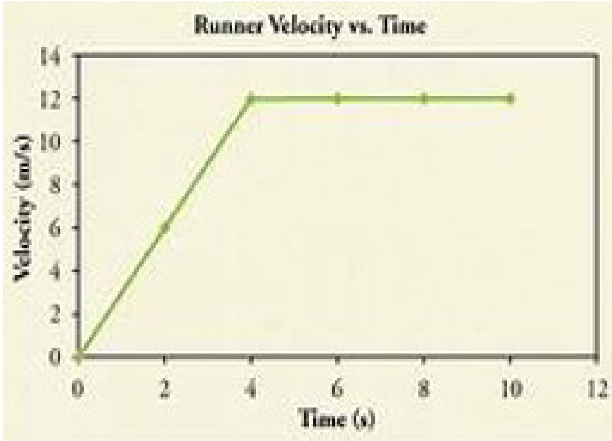
BASIS FOR COMPARISON	UNIFORM MOTION	NON-UNIFORM MOTION
Meaning	Uniform motion implies the movement of a body along a straight line with steady speed.	Non-uniform motion alludes to the movement of an object along a straight line with variable speed.
Distance	Covers equal distances in equal time interval.	Covers unequal distances in equal time interval.
Average speed	Is similar to actual speed of the object.	Is different from actual speed of the object.
Graph	Distance-time graph shows a straight line	Distance-time graph shows a curved line
Rectilinear motion	Zero acceleration	Non-zero acceleration

Presents the table of comparison on a chart or draws it on the chalk board.

	Application activity: **Teacher:** Discuss and explain reasons why the car cannot only move with the uniform motion or with only non-uniform motion. **Students:** 1. The road cannot be a straight line 2. Some road areas are very slopping /inclined so that the car has to accelerate or decelerate 3. You can meet the obstacles in the way like traffic jam, etc. **Teacher:** Notice that in practice, the uniform motion is not applicable for the cars moving along the road because of many reasons like the ones listed above.	**Let learners work in pair to discuss on the question.**
	Teacher: In summary who can remind us of what we learnt: **Student:** Today we learnt: **Uniform linear motion** is a type of motion in which the body moves with constant velocity. **Non uniform linear motion** is the kind of motion in which a body moves with a varying velocity	**Allow/ask the students to make their own summary**

4 **CONCLUSION (5min)**	**Teacher:** Take papers to answer the following assessment questions: 1. Define the following terms: a) Speed b) Distance c) Velocity d) Uniform linear motion e) Non uniform linear motion 2. The following graph represents which type of motion? a)  b) 	**Allow the learners to work individually**

3 . The graph is showing the runner's velocity versus time



a) Show on the graph where the runner is moving in uniform motion.

b) Show on the graph where the runner is moving in non uniform motion

Students: Answers:

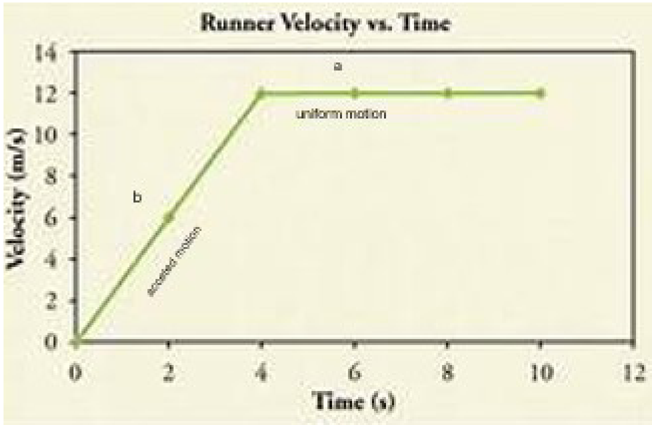
1. a) Rate change of distance

   b) Length of the path followed by a moving body

   c) Rate change of displacement

   d) The speed is constant

   e) The speed changes

	2. a) Uniform because the speed is constant. b) Non uniform because the speed changes. 3. 	**Provide pause time to think and say or write their ideas** **Provide opportunities for corrective feedback to learners.**

FRICTION FORCE AND NEWTON'S LAWS OF MOTION

SUBJECT: PHYSICS	GRADE: S3	DURATION: 40 min

LESSON TITLE: Newton's first law of motion

LEARNING MATERIALS: Coins, table, sheets of paper (cardboard), manila paper and chalkboard

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS' READINESS** **(2min)**	**Teacher:** Hello students, how are you? **Students:** Fine thank you teacher **Teacher:** Welcome to this unit. Now, observe this picture, what do you see?	**Begin by gaining student's attention** **Welcoming them in the lesson and communicate the objective of the lesson**

Students: We see a girl driving a car

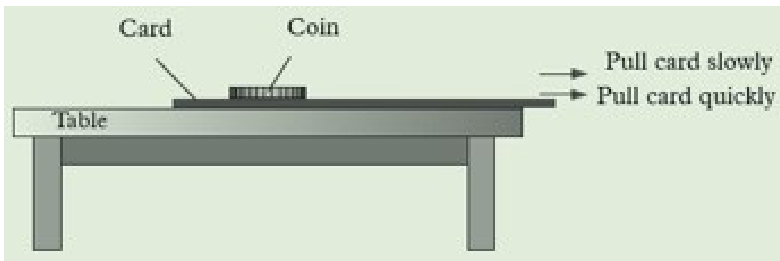
Teacher: What does she wear? Why?

Students: She is wearing a seat belt to protect her from the forward motion when the car stops suddenly or during the accident.

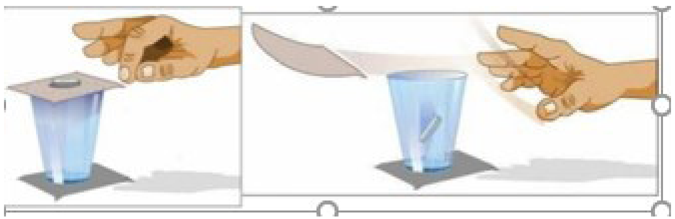
Teacher: Excellent! Now we are going to study the first lesson of this unit, and this lesson is called Newton's first law of motion

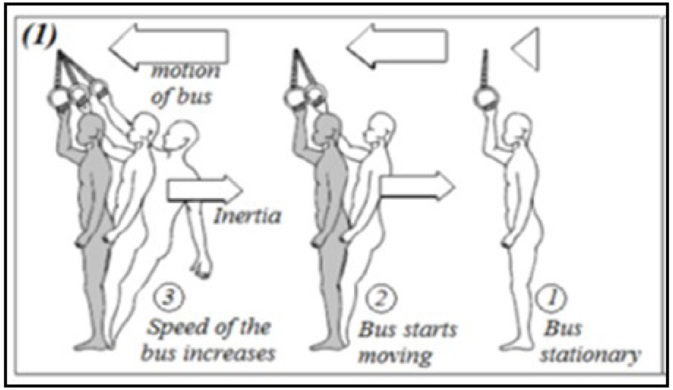
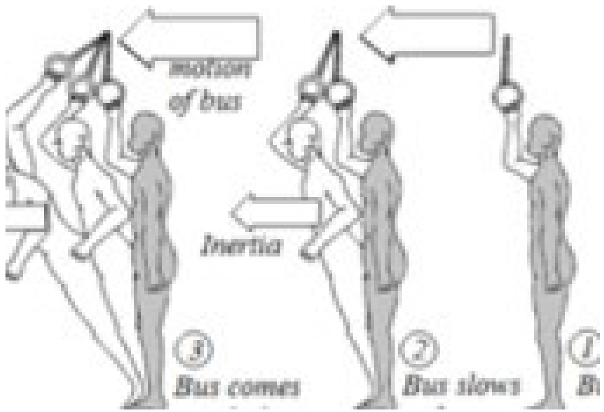
Students: Is there any relation between the seat belt and today's lesson?

Teacher: Yes. But to study this lesson let me present to you the objectives of the lesson.

	Lesson Objectives/Instructional Outcomes: By the end of this lesson, you should be able to: – State the Newton's first law of motion – Explain the inertia of bodies.	**The introduction is done by revising the previous lesson.**
2 **INTRODUCTION** **(4min)**	**Teacher:** Before starting this lesson, let me ask you to talk about the previous lesson. What did we study last time? **Students:** last time we did exercises on graphs of linear motion. **Teacher:** Thanks a lot! The new lesson that we are going to see has the relationship with the previous one. Now, here we have materials which will help us to study our new lesson: Table, Coin, smooth cardboard.	**Brings the materials and asks learners to observe and think. Use learner's questions to formulate a key question.**
	 	**Tell students the materials needed and give them a small time to take them.**

3 **LESSON DEVELOPMENT** **(20min)**	**Teacher:** Using those materials, you are going to do the experiment, and this will clearly explain our lesson. **Steps:** 1. Place the cardboard on the table and let a part of it extends beyond the edges of table (see the figure above). Place the coin on the cardboard. 2. Pull the cardboard slowly away and observe what happens to the cardboard and the coin. 3. Return the cardboard and the coin and pull it again but abruptly(suddenly) and observe what happen to the coin and cardboard. 4. Discuss with other learners your observations in steps 2 and 3 and suggest a reason why the coin behaves differently in these steps. Why does the coin not move together with a paper for step 3? **Students:** The coin resists changing its place. It falls behind due to the inertia which maintains it to stay at rest. **Teacher:** Thanks a lot. What you have observed is the effects of force on the body either at rest or at uniform motion which is explained using Newton's first law of motion. Can you state the Newton's first law of motion according to what you observed in your experiment?	**Guide slow learners to do the activity.** **Use 10 minutes for concept clarification and emphasize on the key terms.**

	Students: This law states that if a body is at rest or in uniform motion on a straight line, will continue to be in this state unless acted upon an external force. This law explains how the matter resists to the change of its state (motion or rest). **Teacher:** What is the meaning of the term **inertia** stated above? **Students:** The term inertia is the property of matter to resist changing its state (either at rest or in uniform motion). **Teacher:** Think to another example which explains the inertia? **Students:** Instead of using a table, we can use the beaker  When the cardboard is flicked, the coin falls into the glass. This because the inertia of the maintains its state at rest and it falls into the glass due to gravity **Teacher:** Tell me the application of inertia in real life situation.	**Students must be given time to think and note down their ideas.** **Emphasize new concepts (the term inertia)** **At each step, provide a pause time for students to think and say or write their ideas.**

	Students: The example application of the inertia is the passengers moving in the car.  	**Let the learners think to the application of inertia in real life situation.**

	When a car stops suddenly, the passengers tend to move forward (they have a tendency of moving forward). And when a car starts to move forward from rest, passengers are jerked backwards because of **inertia.**	**Provide opportunities for corrective feedback or positive feedback to students.**
	Application activity: Explain why a stopped car must be pushed by many people? **Students:** A group of many people can push a stalled car to a high speed faster than one person or the small kids. An object of a big mass requires a big effort to displace it and an object of small mass requires less effort to displace it. **Teacher:** Can you conclude our day's lesson? **Students:** Yes, we conclude that the Newton's first law of motion states that **a body remains in its state of rest or uniform motion in a straight line unless acted upon by an external force.** The resistance of the body to move or to remain at rest is called the inertia. And the mass of the body is one factor of it.	**Give an opportunity to students to ask questions depending on their special educational needs and ask them different questions leading to the summary of the lesson**

4 **CONCLUSION** **(14min)**	**Teacher:** Assessment. 1. Briefly explain why wearing safety belts in moving vehicles are very important. 2. Explain why the mass of a body and the force applied to the body are factors of inertia 1. Wearing safety belts in moving cars is very important because they hold passengers onto the seat in case the vehicle comes to stop or decelerates suddenly, preventing them from lurching forward. This reduces any chances of serious injury in case of an accident 2. i) Mass: the mass of body is a factor of inertia because a large mass requires a large force to produce a given acceleration or deceleration than a small mass, therefore a large mass has a greater inertia. ii) Force applied on the body: When the force applied to the body is increased, its tendency to remain at rest is reduced. This would result to movement of body from its state of rest.	**Encourage learners to do the research while doing homework.**

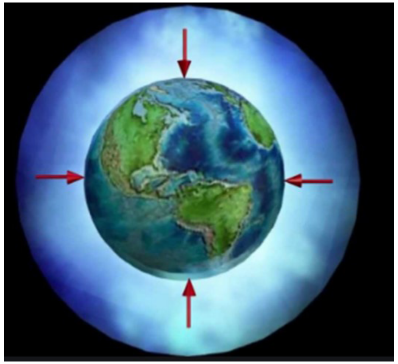
	Teacher: Homework: 1. Distingwish the inertia from the weight of an object 2. Explain why Newton's first law is also called the law of inertia 3. What affects inertia of the body? **Thank you for your participation in this lesson.**	

APPLICATIONS OF ATMOSPHERIC PRESSURE

SUBJECT: PHYSICS	**GRADE:** S3	**DURATION:** 80 min

LESSON TITLE: Existence of atmospheric pressure.

LEARNING MATERIALS: Water, two beakers, block of wood,computer, YouTube Reference books, chalkboard, chalks, etc.

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS' READINESS** **(5min)**	**Teacher:** Hello dear student! Welcome in today's lesson. Carefully observe this picture. 	**Begin by gaining student's attention** **Welcoming them in the lesson and communicate the objective of the lesson**

What does this figure shows/tells you?

Students: A force that is applied to the earth.

Teacher: Have you seen something similar to this?

Students: yes, our weight is a force that is applied to the earth.

Question: What do you think we will learn in this unit?

Students: forces applied to the earth

Teacher: Thank you all. Today we are going to study

Unit 3: Applications of Atmospheric Pressure

Today's lesson is Existence of atmospheric pressure.

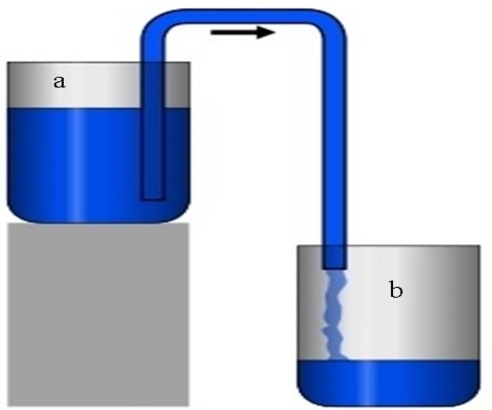
Lesson Objectives:

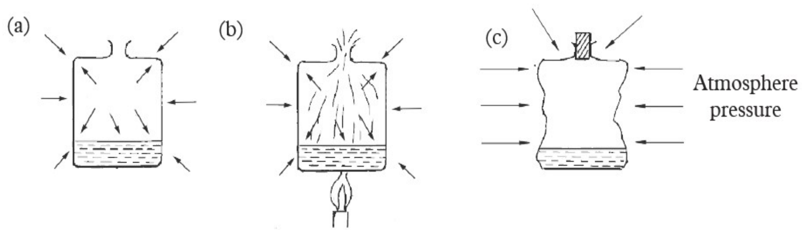
By the end of this lesson, you should be able to differentiate distance and displacement

- Explain the existence of force exerted by air on a surface
- Appreciate existence of atmospheric pressure

Display the picture

Provide a pause time for students to think and say or write their ideas.

2 **INTRODUCTION** **(15min)**	**Teacher: Observe critically the below picture and answer** questions related to it. **Materials:** Water, two beakers, block of wood, tube **Steps:** • Poor water in beaker a by using sucker (from chemistry lab) or your mouth, suck water up in the tube • Instantly, invert the tube into beaker b, as indicated in picture. • Observe the phenomenon  What causes water to rise upward? **Students:** Atmospheric pressure	**Tell students the materials needed and give them the time to observe.** **Facilitate learners to perform the experiment** **Students must be given time to think and note down their answers.** **Emphasize new concepts.**

3 **LESSON DEVELOPMENT** **(50 min)**	**Teacher:** Activity 1: To illustrate the existence of atmospheric pressure using a can **Materials** • A thin walled can • Water • A cork • Source of heat **Steps** 1. Pour some water in a large thin walled can. 2. Boil off the water in the can and immediately cork the can. 3. Allow it to cool and observe what happens. 4. Explain your observations to another group member  	**Show learners the materials needed and give them the time to take materials**

	a) before heating b) heating c) after heating **Students:** Before the can in this activity is heated and corked, the air inside and outside the can exerts pressure equally on the walls of the container that balances with atmospheric pressure (Fig. (a)). When the can is heated (Fig. (b)), the steam that is formed expels the air inside the can. After cooling the can, the steam condensed, and a partial vacuum is formed inside (Fig. (c)). The air pressure inside the can decreases. The atmospheric pressure acting on the surface of the can from outside is greater than the air pressure inside. It therefore makes the can to crust or collapse inward as shown in Fig. (c). **Teacher: Activity 2:** To demonstrate existence of atmospheric pressure using a wet coin. **Materials** • A coin • bench • water	**In group of 4 learners perform activity.** **At each step, provide a pause time for students to think and say or write their ideas.**

Steps:

1. Place a coin on top of a bench. Lift it and note the ease with which you do that.
2. Now, wet the bench surface and the coin also. Place the coin on the wet surface.

a) Lifting a dry coin from tabletop

b) Lifting a wet coin from tabletop

3. Lift the coin up, note the ease with which you do that this time round? Explain clearly your observation
4. Compare your observations on steps 1 and 3. Explain the difference in the two observations

Students: The water between the coin and the bench expels air, reducing the air pressure under the coin. The atmospheric pressure above the coin presses it to the bench, making it more difficult to lift the coin.

Teacher: What do the two activities show you?

Students: Activities show us the existence of atmospheric pressure. This atmospheric pressure plays an important role in our daily lives.

Activity for application

Teacher: What is atmospheric pressure?

Students: Atmospheric pressure is the pressure exerted by the weight of the air above an area.

	Teacher: Complete the missing words 1. When a glass is filled with water and covered by a cardboard, once it is .... downwards, water remains in the glass due to .... 2. Before the can in this activity is heated and corked, the air inside and outside the can exerts pressure .... on the walls of the container that balances with atmospheric pressure When the can is heated, the steam that is formed expels the air inside the can. After cooling the can, ... condensed and a partial vacuum is formed inside 3. The air pressure inside the can decreases. The atmospheric pressure acting on the surface of the can from outside is .... than the air pressure inside. It therefore makes the can to crust or collapse inward. 4. The water between the coin and the bench expels air, ... air pressure under the coin. The atmospheric pressure .... the coin presses it to the bench, making it more difficult to lift the coin. 5. What changes do you think can happen if the atmospheric pressure does not exist?	**Ask learners to complete the missing words** **Provide pause time to think and say or write their ideas**

	Students: answers 1. a) inverted b) atmospheric pressure **2. Answer:** 1. Equally 2. the steam 3. Greater **3. Answer:** 1. Reducing 2. Above **4. Answer:** – Bleeding in noise – people may fall – impossible to drink by using straw… **Summary** **Teacher:** In three lines, write what you have learnt in this lesson **Students:** The existence of the atmospheric pressure can be proved by the following experiments like inverted glass tumbler, a thin walled can, a wet coin and a drinking straw, ...	**Provide opportunities for corrective feedback to learners**

4 **CONCLUSION** **(10min)**	**Teacher: Assessment** 1. Discuss and explain clearly 3 examples of existence of atmospheric pressure 2. How to detect the existence of atmospheric pressure in our environment? **Students: Answers:** 1. The existence of the atmospheric pressure can be proved by the following experiments. 1. Crushing can experiment. 2. Overturned glass full of water 3. A wet coin on the table. **2.** **A)** When a person sucking a straw, reduces the air pressure inside the straw. The atmospheric pressure forces the water into your mouth through the straw. **(B)**The atmospheric pressure pushes the liquid in higher container and passes through the flexible tube(siphon) to the lower container. **C)** When the piston is pulled (upstroke) the pressure inside reduces and the atmospheric pressure on the surface of the liquid pushes the liquid into the barrel. D) The atmospheric pressure is the same at the same level.	**Provide review Opportunities for students. 6 min for assessment** **Allow students to work individually.**

	Teacher: Homework: 1. Explain the action of a drinking straw. 2. Draw and explain the features of a siphon. 3. Conduct research from the reference books on how you can explain the existence of atmospheric pressure using Magdeburg hemisphere. **Teacher:** This is the end of the lesson. ***See you in next lesson!***	

RENEWABLE AND NON-RENEWABLE ENERGY SOURCES

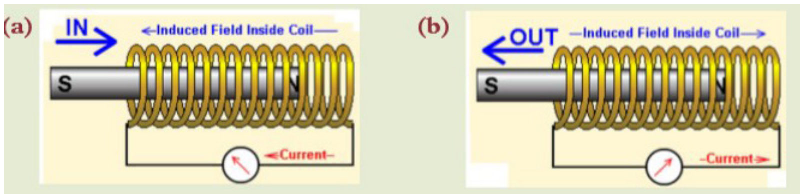
SUBJECT: PHYSICS	**GRADE:** S3	**DURATION:** 80 min

LESSON TITLE: Energy transformations

LEARNING MATERIALS: Galvanometer, Connecting wires, Coil (solenoid) , Bar magnet , Insulated copper wire , Clamp and stand, 1 m of string, Pendulum bob, Calculator, Weighing scale.

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS' READINESS** **(3 min)**	**Teacher:** Hello, Dear students welcome again to this unit 4 sessions! Before we move forward, I had an experience: If I eat too much at the night, I wake up hungry!!! What do you think happened? **Students:** The biochemical energy into the food have been absorbed /changed into glucose by digestive processes.	**Begin by gaining student's attention**

	Teacher: Fantastic, that is good!!! Today we are going to learn more about energy transformations. By the end of this lesson, you should be able to: • Define energy transformation • Analyse transformation of energy into different forms	**Welcoming them in the lesson and communicate the objective of the lesson**
2 **INTRODUCTION** **(7 min)**	**Teacher:** What are the forms of energy? **Students:** Examples of forms of energy include electrical, thermal, nuclear, mechanical, electromagnetic, sound, and chemical energy. **Teacher:** Which form of energy does the car use to move? A) Mechanical B) electrical C) Light (electrical) D) Sound **Student:** Mechanical **Teacher:** Which of the following is not mechanical energy? A) Pedaling a bike B) Rowing a boat C) Turning on a light bulb C) Running up a hill **Students:** Turning on a light bulb **Teacher:** What is a machine that changes electrical energy into light and sound energy? A) Battery B) alarm clock C) apple D) light bulb	

	Students: alarm clock **Teacher:** What object can change electrical energy into light energy? A Candle B) A fire C) A lamp D) A radio **Students:** A lamp	
3 **LESSON DEVELOPMENT** **(60 min)**	**Demonstration 1.** **Teacher**: 1. Make a coil (solenoid) using an insulated copper wire. 2. Connect the ends of the solenoid using connecting wires to a sensitive galvanometer 3. Quickly introduce (push) the bar magnet into the solenoidand stop (Fig.(a)). 4. Withdraw the magnet quickly from the coil and stop (Fig(b)).  	**Make sure that the materials that are going to be used have been organized and ready.**

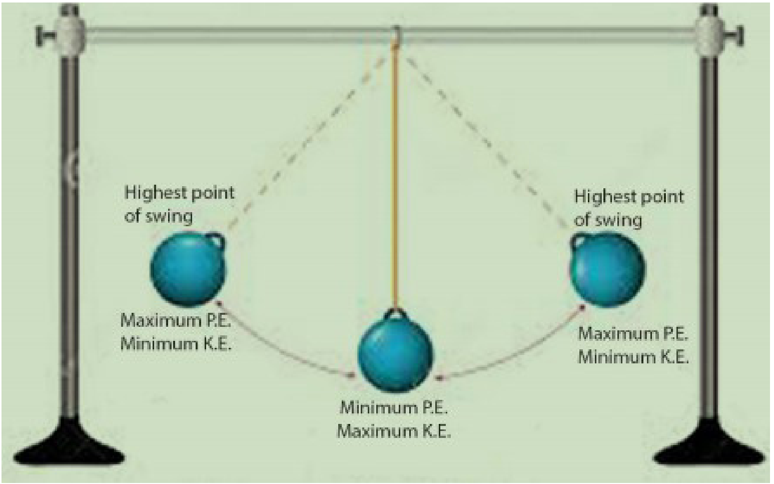
	5. Move both the bar magnet and the coil at the same speed and in the same direction. Observe and explain what happens to the galvanometer. **Students:** When magnet is moved into the coil, the pointer of galvanometer deflects to show that there is electric current induced in coil, it means that mechanical energy used to move magnet is transformed into electrical energy. This concept is applied for electric generators. **Demonstration 2:** **Teacher:** • Measure and record the mass, m, of the pendulum bob. Tie the bob with a string and suspend it on a clamp with the string such that the bob is just about to touch the ground when hanging freely.	**Help the learners to form the group by respecting the gender balance.** **Guide learner's throughout the demonstrations and let them work on them.**

- Pick an arbitrary vertical height at which you will release their pendulum. Measure and record this height, h. Preferably it should range from 15 cm - 40 cm from the floor. Calculate the potential energy of the bob at this height.
- Release the pendulum bob from this height. Observe and explain what happens.

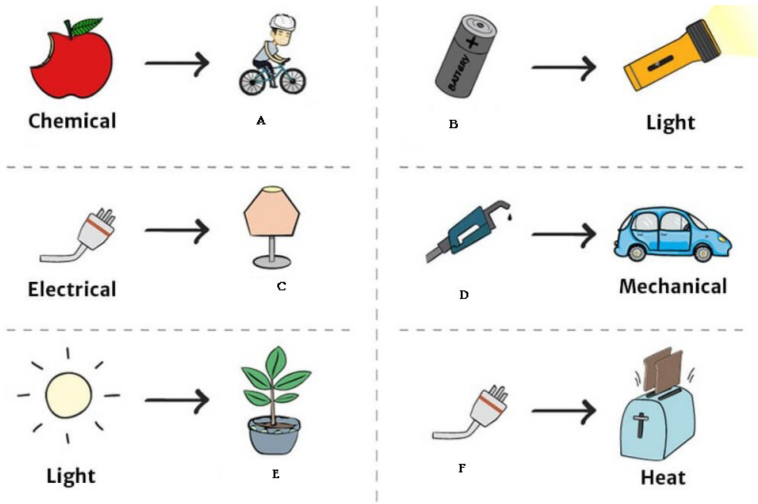
Where will the pendulum have the greatest potential energy? Where will it have the greatest kinetic energy?

Guide the learners to explore different parameters.

Emphasis more effort to the slow learners.

	Students: At the highest point of swing, potential energy is maximum while kinetic energy is minimum (zero). When the pendulum bob is set to oscillate, the potential energy is transformed to kinetic energy.  **Teacher:** What is energy transformation? **Students:** Energy transformation is process of changing of energy from one form to another by using a transducer(any device that converts energy from one form to another)	**Provide pause time to think and say or write their ideas**

	Teacher: All energy transformations obey the law of conservation of energy. Can you state the law of energy conservation we learnt? **Students:** Law of energy conservation states that energy cannot be created nor destroyed but simply changes from one form to another. **Teacher:** How does energy transfer differ from energy transformation? **Students:** Energy transfer is the movement of energy from one location to another. Energy transformation is when energy changes from one type to another. While energy can be transferred or transformed, the total energy always remains the same. **Teacher:** Observe the photo and name form of energy from A to F.	



Students: A: Mechanical B: Chemical C: Light D: Chemical E: Chemical F: Electrical

Teacher: What are other energy transformations you know in your real-life experience? Discuss.

Students: Electrical energy is moved from the wall socket through the cable and stored in the phone battery until used.

The Sun transforms nuclear energy into heat and light energy.

Provide opportunities for corrective feedback to learners

	Our bodies convert chemical energy in our food into mechanical energy for us to move An electric fan transforms electrical energy into kinetic energy. Lightning converts electrical energy into light, heat and sound energy **Teacher:** As we are moving forward, Is there any more question or clarification please? **Student:** I don't see some examples of transducer in real life; Can't I have a list? **Teacher:** **A microphone,** for example, converts sound waves that strike its diaphragm into an analogous electrical signal that can be transmitted over wires. **A light bulb**, for example, converts electrical energy into visible light. **Electric motors** are another common form of electromechanical transducer, converting electrical energy into kinetic energy to perform a mechanical task. The inverse of an electric motor,a **generator**, also is a transducer, turning kinetic energy into electrical energy that can then be used by other devices.	**Use different questions to probe students to summarize the lesson.**

	Lesson summary: **Teacher:** Write a short note on what we have seen in this lesson **Students:** Energy transformation is a process of changing of energy from one form to another . A device that converts energy from one form to another is known as a transducer. All energy transformations obey the law of conservation of energy that states that energy cannot be created nor destroyed but simply changes from one form to another.	**The assessment will be done individually and you may mark it.**
4 **CONCLUSION** **(10min)**	**Aassessment:** **Teacher:** 1. Define the term " energy transformation" 2. State energy transformation when: a. Someone receives a phone call. b. An avocado falls down from tree . c. Someone lighting a bulb by using a battery	

	Students: 1. Process of changing of energy from one form to another by using a transducer. 2. a) electrical energy to sound energy. b) Potential energy to kinetic energy. c) Chemical energy to electrical energy, electrical energy to light energy. ***Teacher: Thank you very much for today's achievements and participation.***	**Provide opportunities for corrective feedback or positive feedback to students.**

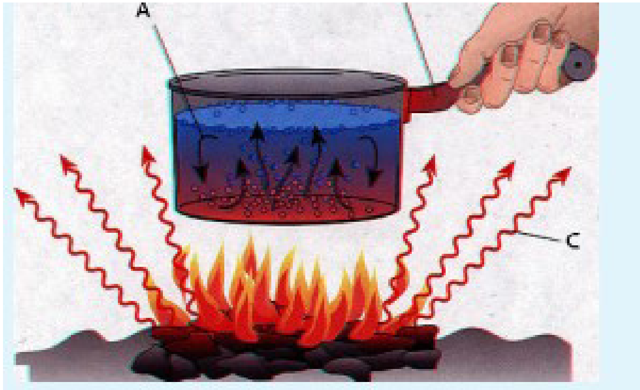
HEAT TRANSFER AND QUANTITY

SUBJECT: PHYSICS	**GRADE:** S3	**DURATION:** 40 min

LESSON TITLE: Heat and temperature

LEARNING MATERIALS: Charts, test tubes, beaker, A stirrer, cooking oil, Water Bunsen burner, clamps, stands and thermometers, chalk board.

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS' READINESS** **(5 min)**	**Teacher:** Dear students, Hello. How are you all? It is pleasure to introduce to you that, we are going to start the unit 5. **Teacher:** Look at this image	**Display the picture**



Teacher: Why does the fire in below the saucepan influences the steam rises in the saucepan?

Students: Fire transfer heat to saucepan which influence the steam to rise up.

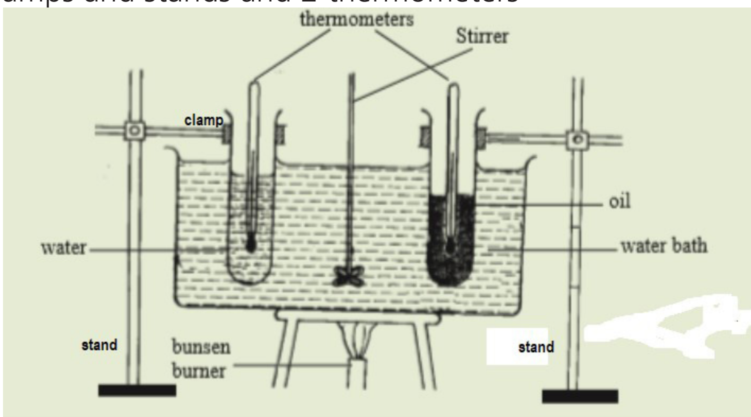
Teacher: Why does the hand of the saucepan holder does not feel any heat when manipulating the saucepan?

Students: Because hand of saucepan is not a conductor of heat

Teacher: Discuss briefly, where do you think the knowledge of this unit can be applied in real life?

Let learners themselves try to provide the answer and facilitate them to reach on the intended answer.

	Students: knowledge can be applied in on solar heater, vacuum flask, electrical devices, etc. **Teacher:** What do you think we will learn in this unit? **Students:** Heat and temperature **Teacher:** Learners, our new unit to start is Unit5, Heat transfer and quantity and new lesson of today is Heat and Temperature By the end of the lesson, the learners should be able to: - differentiate the heat and temperature	**Provide a pause time for students to think and say or write their ideas.**
2 **INTRODUCTION** **(5min)**	**Teacher:** Observe the pictures    **Teacher:** What do you observe in pictures?	**Allow the learners to work in groups (remember gender balance and learners with special needs).**

	Student: There is a fire and thermometers **Teacher:** Good! What is the role of the two? **Student:** fire is used to cook and heating substance while thermometers are used to measure the temperature **Teacher:** To investigate the difference between heat and temperature **Materials:** Two test tubes, A beaker, A stirrer, cooking oil (about 200g) Water (200g), Bunsen burner (source of heat) 2 clamps and stands and 2 thermometers 	**Asks learners to form groups of 5 students (the number may depend on the class size) Facilitate learners to do activity, make sure all learners participate.** **Provide pause time to think and say or write their ideas.**

	Procedure • Take equivalent masses of water and cooking oil in two identical test tubes fitted with two identical thermometers. • Place these tubes in a large beaker containing water i.e. water bath (Fig 5.1) • Record the initial temperature of both water and oil in the tubes. • Heat the water in the beaker and make sure that the heat is distributed uniformly by stirring the water. • After some time, note the temperature reading of water and oil in the tubes. **Teacher:** Are the two-temperature reading the same? Explain. **Students:** When the same amount of heat energy is supplied to equal masses of two different substances, that are initially at same temperature, they both gain equal amounts of heat energy, but their temperature rise to different values. **Teacher:** Learners, who can tell us the difference between heat and temperature.	**Emphasize new concepts. Let learners themselves try to provide the answer and facilitate them to reach on the intended answer.**

Students:

Heat	Temperature
Heat is the energy that moves from one object to another because of a temperature difference. Heat is expressed in joule. Heat is measured by calorimeter.	Temperature is a quantitative measure of an object's hotness or coldness. Temperature is expressed in Kelvin. Temperature is measured by thermometer.

Teacher: Based on comparison, what is the difference between heat and temperature?

Students:

Basis for comparison	Heat	Temperature
Meaning	Heat is the amount of energy in a body	Is the measure of intensity of heat
Measures	Total kinetic and potential energy contained by molecules in an object	Average kinetic energy of molecules in a substance

Property	Flows from hotter object to cooler object	Rises when heated and falls when cooled
Working ability	yes	No
Unit of measurement	Joules	Kelvin
Device	Calorimeter	Thermometer
Symbol	Calorimeter	T

Application activity:

Teacher: Good! Next, discuss in group where the concept of heat and temperature are applied in your everyday live

Students: Heat and temperature are applied in kitchen, vehicles engine, flask, electrical device like immersion heater, etc

Teacher: Explain the similarity and contractions between temperature and heat

Students: When the same amount of heat energy is supplied to equal masses of two different substances, that are initially at same temperature, they both gain equal amounts of heat energy, but their temperature rises to different values.

Use different questions to probe students to summarize the lesson.

	Teacher: We are reaching the end of our lesson. Briefly explain the difference and similarity between heat and temperature **Students:** Heat is a form of energy which is transferred from a region of high temperature to a region of low temperature while temperature is the degree of hotness and coldness of the body. The SI unit of temperature is Kelvin while SI unit of heat energy is Joule Two substances of equal masses can be at the same temperature but contain different amounts of heat energy.	**Provide opportunities for corrective feedback or positive feedback to students.**
4 **CONCLUSION** **(5min)**	**Teacher: Assessment** 1. Define the following terms: a) heat b) temperature 2. Give the SI unit of heat 3. Give the SI unit of temperature **Students: Answers** 1. a) Heat is a form of energy which is transferred from a region of high temperature to a region of low temperature b) Temperature is the degree of hotness and coldness of the body.	

	2. Is Joule 3. Is Kelvin **Teacher: Homework** Go through in SET primary search and discuss to the mode of heat transfer that will be our next lesson. ***Thank you for your participation in this lesson***	**Learners will search the answers for homework and provide findings before starting next lesson**

LAWS OF THERMODYNAMICS

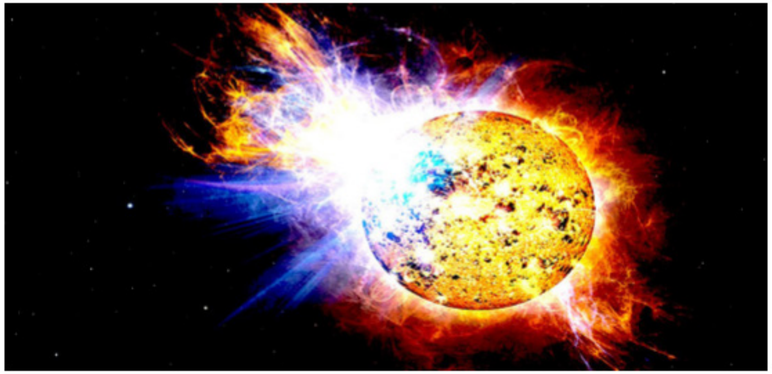
SUBJECT: PHYSICS **GRADE:S3**

LESSON TITLE: Introduction to thermodynamics

TEACHING AND LEARNING MATERIALS: Reference books, chalkboard, chalks, etc.

Duration: 40 min

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS' READINESS.** **(2min)**	**Teacher:** Hello dear student! Welcome in today's lesson. Carefully observe this picture.	**Display the picture**



What does this figure shows/tells you?

Students: a hot object

Teacher: Predict what we will learn in this unit?

Students: Heat transfer

Teacher: Thank you all. Today we are going to study

Unit 6: Laws of thermodynamics

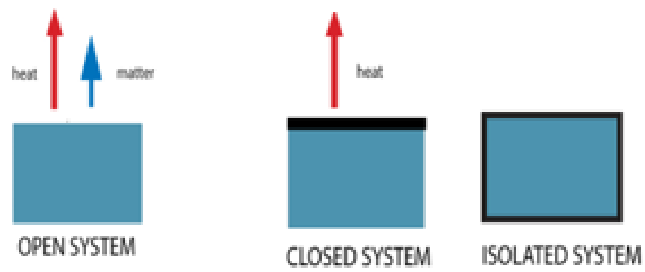
Today's lesson is Introduction to thermodynamics

Lesson Objective:

By the end of this lesson, you should be able to:

- Define thermodynamic as applied to heat transfer
- Describe the types of systems and internal energy.

Let learners themselves try to provide the answer and facilitate them to reach on the intended answer.

2 **INTRODUCTION** **(6min)**	**Teacher:** Observe the picture below and then answer questions  **Teacher:** Refer to the figure above, define a) Open system b) Closed system and c) Isolated system **Students:** a) A system that exchanges both energy and matter with its surroundings is called an open system b) A system that can exchange only energy with its surroundings, but not matter is called **A closed system** c) A system that cannot exchange either matter or energy with its surroundings is called an isolated system.	**Ask learners to observe the picture and encourage them to answer questions related to it.** **Students must be given time to think and note down questions.**

3 **LESSON DEVELOPMENT** **(25min)**	**Teacher: Activity 1: Heat transfer from one substance to another** **Steps** 1. Set up the apparatus as shown in figure bellow. 2. Record the initial temperature of water in the beaker. 3. Heat the water for 2 min and record its final temperature. 4. Stop heating and wait for the water to cool for 1 min. Record its final temperature. 5. Explain how heat is transferred from one particle to another in the water. 6. Describe the effect of heat gain on the internal energy of a particle. 	**Organize learners into groups** **Distribute apparatus into groups of 4** **Ask learners to follow steps and do activity** **Use different questions to probe students to understand the content**

	Students: Heat travels in three different ways in three different states that is conduction in solid (aluminum container), convection in fluids (water and air) and radiation in a vacuum. It depends on which form of heat transfer. For example, in conduction, there is no movement of particle from one place to another, while in convection, hot particles which are less dense move upwards and they are replaced by cold particles which are denser hence movement of particles. Heat gained increases the internal energy of the system, and hence temperature of the system increases. **Teacher: Activity 2: To define thermodynamics and distinguish between the three types of systems** **Materials:** Water, Beaker, Bunsen burner, Thermometer, Solid ice **Steps:** 1. Heat the water in the beaker till it boils. 2. Measure and record the temperature.	**At each step, provide a pause time for students to think and say or write their ideas.**

3. Dip the solid ice into the boiled water, measure the temperature again.
4. Compare the reading with that of step 2. What do you observe? Explain
5. Distinguish between open, closed and isolated system.
6. Classify the behavior the beaker and its contents in

steps 2 and 3 as one of these systems giving reason for your answer.

Students: Dynamics is the study of why things move the way they do.

The temperature of the liquid increases.

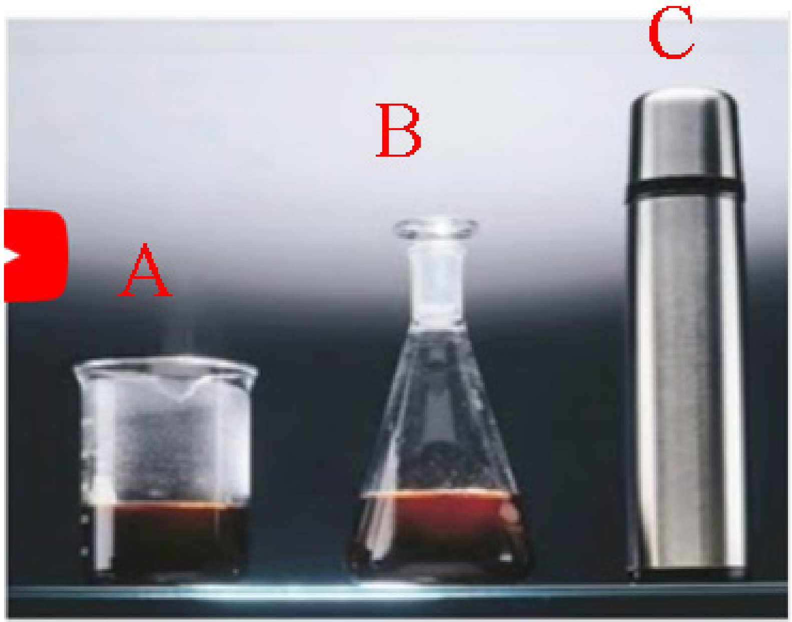
Ice melts and the temperature of the mixture reduces.

An open system is one in which energy can be transferred between the system and its surroundings (The stovetop system is open because heat can be lost into the air)

A closed system is one that cannot transfer energy to its surroundings (Example: a cup of coffee with a lid on it, or a simple water bottle)

Isolated systems allow neither mass nor energy to flow through their boundaries.

	Example: a thermos flask. Beaker and its container are an open system because they exchange heat energy. **Teacher: Define thermodynamics** **Students:** Thermodynamics is the study of heat energy exchange between a system and its surroundings **Teacher:** What are the types of thermodynamics? **Students:** There are three types of thermodynamic systems Based on the possible heat transfer, they are classified as open, closed or isolated systems **Teacher:** Activity for application a. Inside those 3 containers there is a hot liquid. observe them and state in which container the liquid will be cooled first and the one will be cooled last. Explain why. b. Identify which is among A, B and C, is an open system and Isolated system	



Students:

a) The container A will be cooled first, the next is container B lastly is container C. this depends on how each container communicate with the surrounding air.

b) A and B are Open systems and C is isolated system

	Summary **Teacher:** What have we learnt from this lesson? **Students:** An open system is a system that exchange both energy and matter with its surroundings. A closed system is a system that can exchange only energy with its surroundings, not matter. An isolated system is a system that cannot exchange either matter or energy with its surroundings. Thermodynamics is the study of systems involving exchange of energy in the form of heat and work.	**The teacher request learners to perform application activity.**
4 **CONCLUSION** **(7min)**	**Teacher: Assessment** 1. Which has more internal energy? A. Bathtub full of cool water B. Cup of hot water 2. State the types of systems in thermodynamics and differentiate them **Students: Answers:** **1. A** **2. An open system:** is a system that exchange both energy and matter with its surroundings. An open heating pot is an example of an open system, because heat and water vapour are lost to the air.	

A closed system: a system that can exchange only energy with its surroundings, but not matter. A heating pot with a very tightly fitting lid would be approximated to be a closed system.

An isolated system: is a system that cannot exchange either matter or energy with its surroundings.

Teacher: Homework:

Consider the figures below A, B and C

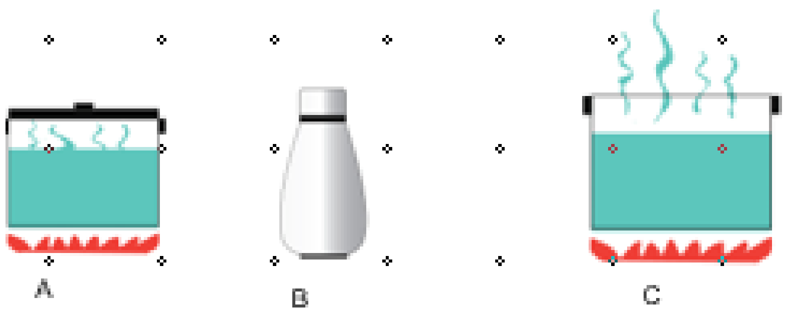
a) Which one is

  i. An isolated system

  ii. An open system and

  iii. A closed system.

b) Give reasons for each case.



Teacher: Thank you all for your participation in this lesson. See you next time.

Provide review Opportunities for students

Provide opportunities for corrective feedback or positive feedback to students.

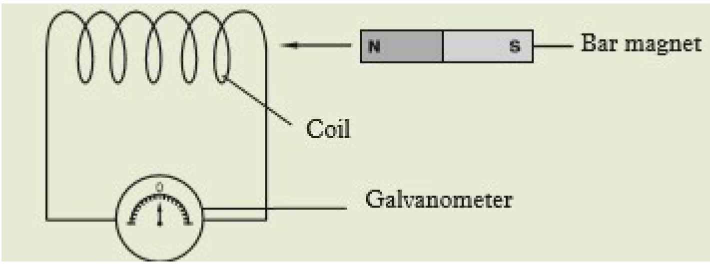
INTRODUCTION TO ELECTROMAGNETIC INDUCTION

SUBJECT: PHYSICS	**GRADE:** S3	**DURATION:** 40 min

LESSON TITLE: Demonstration of Introduction to Electromagnetic Induction.

LEARNING MATERIALS: Charts, galvanometer, U-shaped magnet and copper wire, chalkboard.

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS' READINESS** **(5 min)**	**Teacher:** Hello my dear students, how are you? **Students:** Fine thanks **Teacher:** Welcome to this unit: Electromagnetic induction Have you ever seen the magnet? **Students:** Yes, we have seen it **Teacher:** What is the role of magnet? **Students:** It is used in radio receiver and in microphone	**Welcoming students in the lesson and communicate them the objective of the lesson**

	Teacher: Thank you my friends, now we are going to study the lesson which is **Demonstration of electromagnetic induction** in which we are going to deal with the role of magnet. **Lesson Objectives/Instructional Outcomes:** By the end of this lesson, you should be able to explain the phenomenon of electromagnetic induction	**Ask learners different questions to see their prior knowledge.**
3 LESSON DEVELOPMENT (20 min)	**Materials:** bar magnet, coil; centre zero galvanometer, connecting wires. **Steps:** 1. Make a coil using insulated copper wire as indicated below 2. Connect the ends of the coil to a sensitive center zero of galvanometer, write down your observations 3. Introduce a bar magnet into the coil and stop. 	**Show the learners the materials to use.**

	4. Withdraw the magnet from the coil and stop. Write your observations 5. Repeat the experiment by moving the coil and keeping the magnet stationary. Observe and write what happens to the galvanometer in each case. 6. Move both coil and magnet in the same direction with the same speed. Write down what happens to the pointer of the galvanometer. 7. Suggest the explanations **Students:** When the magnet is introduced into the coil, the pointer of the galvanometer shows a deflection in one side but returns to the zero position when the magnet is brought to rest When the magnet is withdrawn from the coil, the pointer deflects but in the opposite direction. However, when the magnet stops, the pointer once again returns to the zero position. Similar effects are observed when the coil moves instead of magnet. No deflection observed when the magnet and coils move at the same speed in the same direction.	**The experiment must be done in groups. The groups depend on the size of the class or Lab.** **Guide learners to perform the experiment.** **Encourage and help slow learners**

	Teacher: From this activity, what can you conclude? **Students:** We conclude that an electromotive force is induced when there is a relative motion between the coil and the magnet **Teacher:** what is the name of the produced current? **Students:** This current is called the **induced current** **Teacher:** what is the name of this phenomenon of production of current without a generator? **Students:** This phenomenon is called **electromagnetic induction** and is caused by the change of magnetic field line passing in a closed loop (**change of magnetic flux**). **Application activity** **Teacher:** What are four important apparatus used to produce the induced emf? **Students:** To produce the induced emf the apparatuses used are: coil, magnet, connecting wire and center- zero galvanometer	**Provide the time for sharing their work with the whole class through experiment** **Invite the group's representative to present their findings.**

4 **CONCLUSION** **(5 min)**	**Teacher: Assessment:** 1. What do you observe when there is a relative motion between magnet and coil in EM induction? 2. What causes the production of emf in the system? 3. Suggest one method of producing high emf? 4. What is the magnetic flux? **Students: Solution** 1. There is a deflection of the pointer in the galvanometer. 2. The emf is caused by the change in a magnetic flux 3. We can increase the speed of magnet – We can increase the number of turns in the coil 4. The magnetic flux is the number of field lines passing in a closed loop.	**The assessment is done individually and should be awarded.**
	Teacher: Homework 1. Search on the internet other methods of producing electromagnetic force. 2. What are applications of Em induction? ***Teacher: Thank you all for kind attention. See you in next lesson. Bye!***	

ELECTRICAL POWER TRANSMISSION

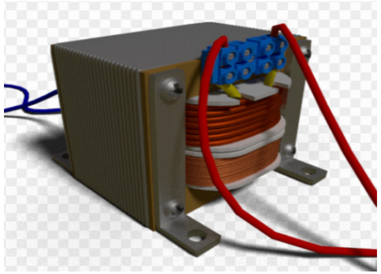
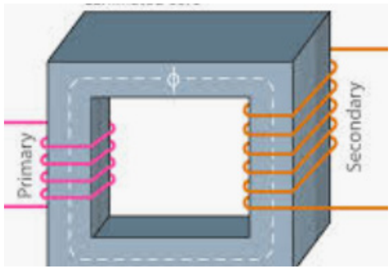
SUBJECT: PHYSICS	**GRADE:** S3	**DURATION:** 40 min

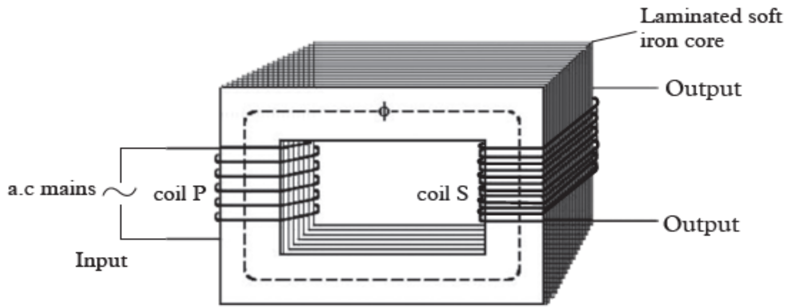
LESSON TITLE: Structure and working of a transformer

LEARNING MATERIALS: Charts, manila papers, chalk board, reference books, transformer in the school or near your school Insulated copper wires, Galvanometer, Switch, Connecting wires

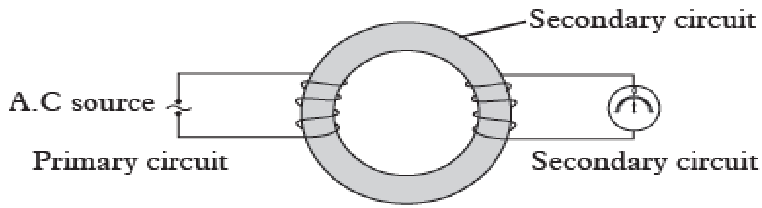
SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS' READINESS** **(5 min)**	**Teacher:** Hello learners! Welcome to our lesson today. Now, we are going to start a new unit. Do you know a transformer? **Students:** Yes, we see transformers at villages. **Teacher:** What did you see on transformers? **Students:** Cables connecting transformer and pylon. **Teacher:** Observe the picture carefully	**Begin by welcoming students in the lesson**

		**Learners must be given time to observe, to think and note down their ideas.**
	Teacher: What do you see? **Students:** Cables, transformers, pylons **Teacher:** What would you suggest being our lesson today? **Students:** Electrical power transmission **Teacher:** Very good! today we start a unit 8: E**lectrical power transmission and today's** lesson is Structure and working of a transformer.	
	Lesson Objectives/Instructional Outcome By the end of this lesson, you should be able to: i. Describe a transformer. ii. Distinguish primary coil and secondary coil iii. Sketch a transformer. iv. Explain the functioning of a transformer.	**Communicate the objectives of the lesson.**

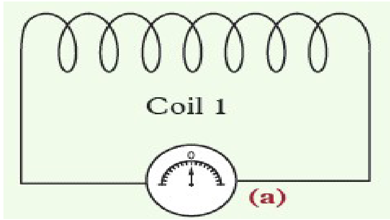
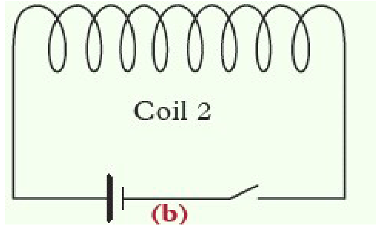
2 **INTRODUCTION** **(15 min)**	**Teacher:** Observe the pictures below and answer the following questions. a.  b.  c.  **Teacher:** What is inside in a transformer? **Students:** Laminated soft iron core, primary coil and secondary coil. **Teacher:** What is a transformer? **Students:** A transformer is a device which is used in electrical power transmission especially for long distances.	**Allow learners to observe.** **Help learners to answer questions of their classmates.**

3 **LESSON DEVELOPMENT** **(50 min)**	**Teacher:** Carefully observe the diagram  **Teacher:** What do you see on the diagram? **Students:** A transformer has a primary coil, secondary coil, laminated soft iron core. **Teacher:** What is a transformer consists of? **Students:** A transformer consists of two coils insulated from each other and wound on the same soft-iron core. One coil contains a few turns of thick wire, and the other coil contains many turns of thin wire. **Teacher:** What are the differences between the primary coil and secondary coil? **Students:** primary coil (p) is the coil that is connected to a.c mains while secondary coil (s) the one through which the stepped up or stepped down electrical current output is delivered to the outer circuit.	**Students must be given time to ask and answer** **Use different questions to probe students to understand the content.**

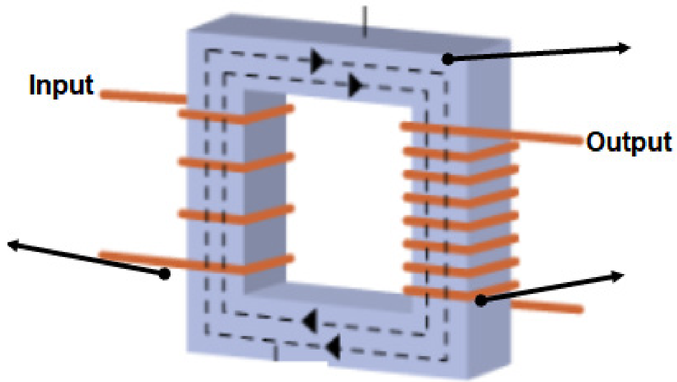
	Teacher: How does a transformer work? **Students:** A transformer is an electric device that transfers electrical energy from one circuit to another by electromagnetic induction. In transferring this energy, a transformer steps up or steps down the voltage or electromotive force from the source. The circuit that induces the electromotive force is called the primary circuit, while the circuit where the electromotive force is induced is called the secondary circuit. Although the two coils are not connected, changes in current in the primary circuit induces an electromotive force in the secondary circuit. This effect is called mutual induction. **Teacher:** What is the mutual induction? **Students:** A transformer works on the principle of mutual induction. The production of an electromotive force in a circuit by a change in the current in an adjacent circuit that is linked to the first by the flux lines of a magnetic field. Mutual induction occurs on switching the current on and off in the primary circuit. The switching on and off of the current can also be achieved by replacing the battery and the switch with an a.c power supply. The mutual induction is more pronounced when the two coils are wound round a soft iron core.	**Emphasize new concepts.** **At each step, provide a pause time for students to think and say or write their ideas.**

	This was shown by Michael Faraday who used a soft iron ring.  **Fig. Faraday' ring** **Teacher:** What is the role of transformers we see at the village? **Students:** The transformers on village are used to step down electrical power to supply homes with suitable voltage and step up for long distance transmission. **Teacher:** Why technicians need transformers in electrical transmission? **Students:** To avoid risks associated with power transmission due to high or low voltage **Teacher:** May electrical power be transmitted without transformers? **Students:** If no transformers, electrical power may only be transmitted for a short distance.	**Provide opportunities for corrective feedback or positive feedback to students.**

	Teacher: Where else do we find transformers? **Students:** Apart from electrical transmission, transformers are found in radio, telephone, and all home appliances that functioned by electricity **Teacher:** Write down where do we apply transformers in real life/ home? **Students:** Transformers are used power generation plants, Industrial factories, residential areas, commercial equipment like televisions, home inverters, heating equipment and low voltage electronic devices (radios, chargers, phones, laptop cables, ...) **Application activity** **Teacher:** Observe the circuits below and make the similar circuits 1. Make two coils using the insulated copper wire. Connect the coils in currents. 2. Close the switch in coil 2. What happens to the pointer of the galvanometer? Explain. 3. Quickly open and close the switch severally. Observe what happens to the galvanometer? Explain your observations.	

	Students:   **Teacher:** Clearly explain your observation **Students**: We have observed that when a switch in (b) is closed, galvanometer pointer in (a) is deflected. By quickly closing and opening a switch in (b), galvanometer pointer in (a) is quickly deflected forth and back which means the induction of emf in (a). Therefore, by switching the current on and off in one coil, an electromotive force is induced in another coil.	**Guide learners to connect** **A coil and a battery.** **A coil and galvanometer.**

	Teacher: Very good! Let's together review some of the key points that we have learnt. **Teacher:** What is a transformer? **Students:** A transformer is an electric device that transfers electrical energy from one circuit to another by electromagnetic induction. In transferring this energy, a transformer steps up or steps down the voltage or electromotive force from the source **Teacher:** What are main parts of a transformer? **Students:** primary coil, secondary coil, laminated soft iron core. **Teacher:** How does a transformer work? **Students:** A transformer works on the principle of mutual induction which is the production of an electromotive force in a circuit by a change in the current in an adjacent circuit that is linked to the first by the flux lines of a magnetic field.	**Allow learners to work in groups**

4 **CONCLUSION** **(10 min)**	**Teacher:** Formative assessment 1. Using a simple drawing, label the parts of a transformer.  2. Which part of a transformer is connected to ac power supply? 3. How does a transformer work? **Teacher: Answers** 1. The primary coil, secondary coil and laminated soft iron core. 2. Primary coil.	**Provide opportunities for corrective feedback or positive feedback to students.** **Allow students to ask their questions.**

	3. A transformer works on the principle of mutual induction which is the production of an electromotive force in a circuit by a change in the current in an adjacent circuit that is linked to the first by the flux lines of a magnetic field. **Teacher:** Take notebooks and write the homework exercises. **Homework** 1. Conduct research from reference books on transformers. In your research, find out the structure and operations of a transformer a. Write a short report on your findings. b. Present your report to the whole class through your secretary ***Thank you for your participation in this lesson.*** ***See you next time***	**Provide corrective feedback or positive feedback to the students.**

ELECTRIC FIELD INTENSITY

SUBJECT: PHYSICS	GRADE: S3	DURATION: 40 min

LESSON TITLE: Electrostatic force and coulomb's law

LEARNING MATERIALS: two identical balloons, silk clothes, clamp, stand, thread

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 STUDENTS' READINESS (2 min)	**Teacher:** Good morning class! Welcome to this lesson. Today we have a new lesson related to electric charges seen in electrostatics. What is electrostatics? **Students:** Electrostatics is the study of electric charges. **Teacher:** What is the relationship between the positive and negative charges? **Students:** They attract. **Teacher:** Very good! Could you suggest the lesson of today? **Students:** Maybe it is electrostatic force.	**Begin by welcoming students in the lesson** **Students must be given time to think and note down their ideas.**

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<td>Teacher: Thank you all! Today we are going to learn unit 9: Electric field intensity, the title of the lesson is “electrostatic force and coulomb’s law”.

<u>Lesson Objectives</u>

Teacher: By the end of this lesson, you should be able to:
– Define electrostatic force
– State the coulomb’s law
– Calculate the electrostatic force between two charges</td>
<td rowspan="2">Communicate the objectives of the lesson</td>
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<tr>
<td>2
INTRODUCTION

(8 min)</td>
<td>Teacher: Hello students, in physics S1, you have learned the meaning of electrostatic charges and modes of charging.

Now, do you remember the types of electrostatic charges? State the two types of electrostatic charges.

Student: The two types of electrostatic charges are:
– Positive charges
– Negative charges

Teacher: What happen when a rubbed pen in the hair when it is placed nearest the small pieces of paper?

Student: The small pieces of paper are attracted by the rubbed pen.

Teacher: State the electrostatic law</td>
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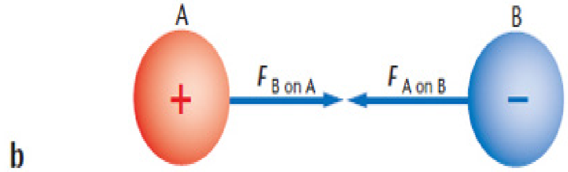
	Student: Like charges repel and unlike charges attract. **Teacher:** Good! It means that, there is the force between charges. How can you call this force? **Students:** It is electrostatic force.	
3 **LESSON DEVELOPMENT** **(20 min)**	**Teacher: Experiment: To demonstrate the electrostatic law between two positively charged balls** **Materials:** • Two identical balloons A and B • Silk clothes • Clamp and a stand • hread **Steps** 1. Charge two balloons by rubbing them on silk cloth. Suspend balloon A on a stand. 2. Bring charged balloon B near the suspended balloon A. 3. Charge the two balloons with the silk cloth more vigorously while maintaining the distances and repeat steps 2 and 3. What do you observe? 4. State the effect of the amount of charge on the force between them.	**Tell students the materials needed and give them a small time to take them.** **In groups of 4-6 students for each group.** **Ask learners to follow instructions and complete the task and note their observations.**

	5. Discuss the observation made with other members of your group **Teacher:** What do you observe from this experiment? **Student:** There are different observations: – Balloons were charged and they gained the identical charges – When B is brought near A they repel (because same charges) **Teacher:** what happen when balloons are rubbed vigorously and placed nearest each other? **Students:** When rubbed vigorously, they acquire many charges and when brought near each other the force between them increases, also the force of repulsion increases when they close each other. How can we call this force? **Teacher:** The force of repulsion or attraction between two bodies that are charged is called Electrostatic force.	**Give time for sharing with the whole class through presentation**

The figure below shows the vector nature of electrostatic forces:

Force of repulsion



Force of attraction

We can say that "**like charges repel, unlike charges attract**".

Students: By observation of the figure, there is the force between two electric charges. What does this force depend on?

Teacher:" The force of attraction or repulsion between two electrically charged particles is directly proportional to the magnitude of their charges and inversely proportional to the square of the distance between them". This statement is called coulomb's law.

Emphasize on the new concepts.

Students: We have seen the statement of coulomb's law. How can we express mathematically this law?

Teacher: Mathematically coulomb's Law can be written as follow:

$$F_E = \frac{k|q_1||q_2|}{r^2}$$

Where:

k= the Coulomb constant that equals 9.0×10^9 N.m^2/C^2

$|q_1|$ = the absolute value of the net charge on one object

$|q_2|$ = the absolute value of the net charge on the other object

r = the distance between two charges.

Use different questions to probe students to understand the content.

Examples of application of Formula:

Teacher: Suppose that two point charges, each with a charge of +1.00 Coulomb are separated by a distance of 1.00 meter. Determine the magnitude of the electrical force of repulsion between them

	Students: $Given: Q_1 = 1.00\ C$ $Q_2 = 1.00\ C\ d = 1.00\ m\ Find: F$ $F = k.Q_1.Q_2 / d_2$ $F = \left(9.0\ x\ 109\ N \bullet m^2 / C^2\right) \times 1.00 \times 1.00 / 1.00$ $F = 9.0\ x\ 10^9\ N$	**Provide opportunities for corrective feedback or positive feedback to students.**
	Teacher: Hello students, can you summarize the lesson for today? **Students:** We can summarize the lesson for today as follow: 1. The force of repulsion or attraction between two bodies that are charged is called Electrostatic force. 2. Coulomb's law states that" the force of attraction or repulsion between two electrically charged particles is directly proportional to the magnitude of their charges and inversely proportional to the square of the distance between them".	**Teacher helps learners to summarize the lesson by asking different questions and give feedback to students**

4 **CONCLUSION** **(10 min)**	**Teacher: Assessment** **For questions 1-3, choose the correct response from the choices given.** 1. An electron is placed near a proton. Which force is mainly responsible for the attraction between the two particles? A. Gravitational B. Electrostatic C. Nuclear C. Magnetic 2. A positively charged object is moved towards a negatively charged object. What is the motion of the objects when they come close to each other? A. Neither object has any effect on the other B. The objects move towards each other C. The objects move away from each other D. The objects move towards each other, then move	**Make the groups of learners to do the assessment and gender issue must be respected then, give the feedback.**

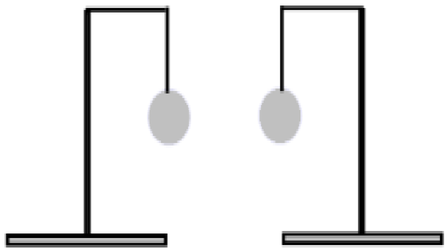
3. A neutral glass rod is rubbed by a piece of silk with no net charge. The rod gains a positive net charge and the silk gains a net negative charge. What is the sum of the charges on the silk and the rod?

   A. Zero

   B. Twice the charge on the rod

   C. Twice the charge on the silk

4. Two pith spheres covered with conducting paint are hanging from two insulating threads. When the spheres are brought close to each other, they attract each other. What type of charge is on the spheres? After they touch, will they separate or cling together? Discuss all possibilities.



5. What is the distance between two charges of +7.8 μC and +9.2 μC, if they exert a force of 4.5 mN on each other?

Students' Answers

1. B   2. B   3. A

4. Since the spheres attract each other, they have opposite charges. If the spheres have equal amounts of charge, they will neutralize after touching and hang from the threads vertically. If one sphere has a larger amount of charge, they will share the charge after touching (same charge on each) and repel each other.

6.

$$F = k\frac{Q_2 Q_1}{d^2}$$

$$d^2 = k\frac{Q_2 Q_1}{F}$$

$$d = \sqrt{k\frac{Q_2 Q_1}{F}} = \sqrt{9\times 10^9 \frac{7.8\times 9.8}{4.5}}$$

$$d = 29.7\times 10^4 m$$

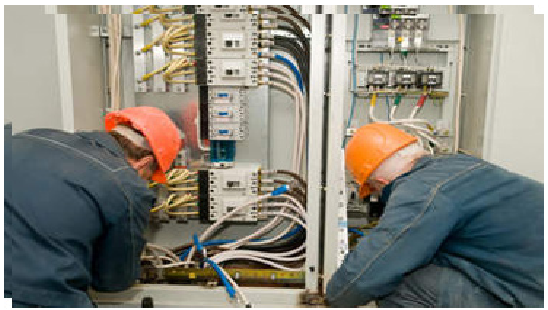
	Teacher: Now I want to give you a homework assignment so that you try to apply some of what we have learned today at your own. **Homework** 1. If two equal charges, each of 1C, were separated in air by a distance of 1km, what would be the force between them? 2. Explain are we advised to disconnect our electronic devices when there is storm? ***Thank you for your participation in this lesson.***	

HOUSE ELECTRIC INSTALLATION

SUBJECT: PHYSICS	**GRADE:** S3	**DURATION:** 40 min

LESSON TITLE: Standard symbols for electric installation

LEARNING MATERIALS: Charts, projector slides, flash cards, manila papers, chalk board

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS' READINESS** **(2 min)**	**Teacher:** Good morning students! Welcome to our lesson today. Now we are going to start a new unit. Carefully observe this picture, I will ask you the questions. 	**Begin by welcoming students in the lesson** **Display the picture and ask related questions.**

	Teacher: What does this figure shows/tells you? **Students:** installation of electric cables in the house **Teacher:** Have you seen something similar to this? **Students:** Yes/ Installation of electricity at home **Teacher:** What do you think we will learn in this unit? **Students:** House Electric Installation. **Teacher:** Thank you very much! **The key unit competence** By the end of the unit, you should be able to analyze and carry out a simple electric installation. **Lesson Objectives/Instructional Outcomes:** The learner should be able to describe symbols used in electrical engineering drawing.	**Communicate the objectives of the lesson**
2 **INTRODUCTION** **(5 min)**	**Teacher:** Observe carefully the following electrical devices. 	

	Teacher: Give the names of devices above **Students:** Fuse, Lamps, cables, Switches, Resistor, Battery, Ammeter and dry cell **Teacher:** Did you see a schematic diagram of electric circuit? **Students**: Yes, we saw **Teacher:** What did you see on schematic diagram of electric circuit? **Students:** Symbols but not real devices. **Teacher:** What do you think is our lesson today? **Students:** Standard symbols used in electric circuit.	
3 **LESSON DEVELOPMENT** **(25 min)**	**Activity** **Teacher:** Observe the materials: Different fuses, A socket, A switch, Bulb Chart showing standard symbols for electrical installation. Take the electrical devices provided to you. Draw their symbols as used in electrical circuit. Now, take the chart provided to you. Compare your drawings of the symbols with the ones on the chart.	**Show students the devices.** **Provide pause time to think and say or write their ideas.**

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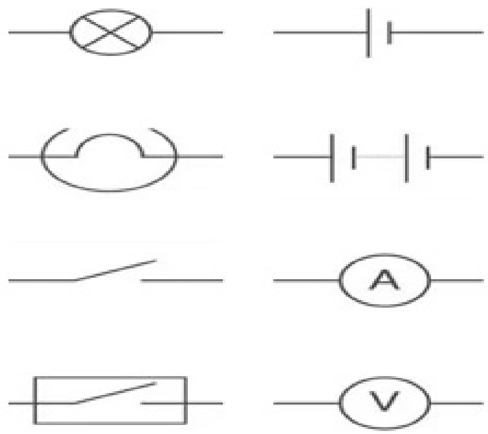

Teacher: How accurate were your drawings?

Students: The drawings on chart are very clear and same as drawings of learners

Teacher: What is a definition of electrical symbol?

Students: An electrical symbol is a visual symbol that represents a particular type of electrical component in electronic devices such as wires, batteries etc. The electrical symbols are very important especially whenfixing electrical appliances because it tells you where the wire of neutral and live goes.
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Provide opportunities for corrective feedback to learners.
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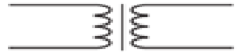
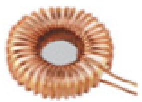
However, standard electrical symbols are used to represent various electrical and electronic devices inschematic diagrams of electrical or electronic circuits. They are easy to understand.

Teacher: Use a table to show component picture, name and symbol

Students:

COMPONENT	NAME	SYMBOL
	dry cell	
	Lamp	
	fuse	

Emphasize to New concepts

	Switch	
	Transformer	
	A.C supply	
	cables/wire	
	Earthling wire	
	Inductor	

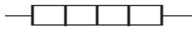
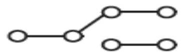
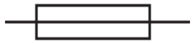
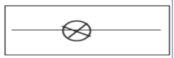
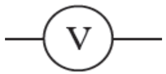
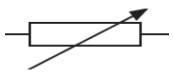
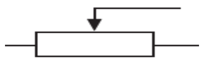
Allow the learners to work in group.

Provide pause time to think and say or write their ideas.

	Application activity **Teacher:** Discuss other devices needed in the electrical installation at your home. **Student: Electric meter:** to measure electrical energy **Electric socket:** to plug in the appliances **Lightening arrestor**: to protect building from lightening **Teacher:** What is the importance of electrical symbols? **Students:** The electrical symbols are used in designing schematic diagram of electrical house installation. **Teacher:** Thank you very much! Now, let us together review some of the key points that we have learnt What have we learnt from this lesson? **Students:** An electrical symbol is a visual symbol that represents a particular type of electrical component in electronic devices such as switches, resistors, lamps, wires, batteries …	**Individual activity** **Provide opportunities for corrective feedback to learners.**

Teacher: Draw any six electrical symbols

Students:

DEVICE	SYMBOL	DEVICE	SYMBOL
Cell		Transformer	
Battery		Heating element	
Ac supply		2-way switch	
Ammeter		Fuse	
Lamp		Switch	
Voltmeter		Bell	
Galvano-meter		Fixed resistor	
Variable resistor (Rheostat)		Potentio-meter	

4

CONCLUSION

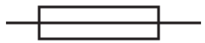
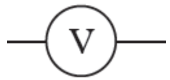
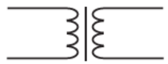
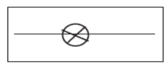
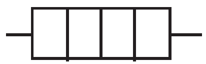
(8 min)

Teacher: Formative assessment

1. a) Name five electrical components used in house wiring.

   b) Draw the standard electrical symbols used for each of the component named in (a)

2. Match the device with the corresponding symbol

DEVICE	SYMBOL	DEVICE	SYMBOL
1. Ammeter		**6.Heating element**	
2.Cell		**7. Fuse**	
3. Ac supply		**8. Lamp**	
4. Voltmeter		**9. Switch**	
5. Lamp			

Learners work individually.

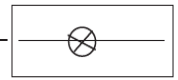
Pass around to check participation of learners.

Mark the work done by learners

Provide opportunities for corrective feedback to learners.

Students: Answers

1. Five electrical components that are used in in house wiring, wires, lamps, switches, fuses,

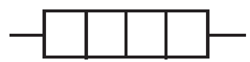
2.   

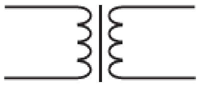
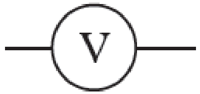
Switch Fuse Lamp

ac supply wire

Teacher: Homework:

Table below shows standard symbols for electrical installation. Fill in the appropriate name or symbol in missing places.

	Name	Standard symbol
a.	Bulb/lamp	
b.		
c.	Fuse	
d.		
e.	Dc voltage	

f.		
g.	Electric bell	
h.		

Thank you for your participation in this lesson.

See you next time.

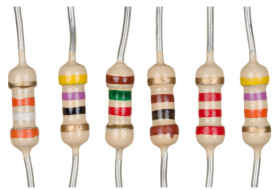
BASIC ALTERNATING CURRENTS CIRCUITS

SUBJECT: PHYSICS	**GRADE:** S3	**DURATION:** 80 min

LESSON TITLE: Differences between Alternating current (ac) and direct current (d.c)

LEARNING MATERIALS: Charts, flash cards, manila papers, chalk board

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS' READINESS** **(5 min)**	**Teacher:** Good morning students! Welcome to our lesson today, now we are going to continue with our unit but before we continue, which type of electric current do you use at your home? **Students:** At home we use alternating current. **Teacher:** good! Suppose you construct a simple circuit using radio cells. Which type of the current do you produce? **Students:** This type is called direct current	**Use different questions to probe students to recall what was learnt previously and let students themselves answer all questions.**

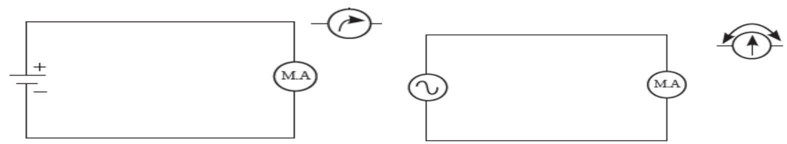
	Teacher: Excellent! Could you suggest today's lesson? **Students:** Alternating current (ac) and direct current (d.c) **Teacher:** Today we are going to study the Differences between Alternating current (ac) and direct current (d.c) **Learning objective** By the end of this lesson, the learner should be able to: • Differentiate between an alternating current and a direct current. • Appreciate advantage of A.C. over D.C.	**Communicate the lesson objectives.**
2 **INTRODUCTION** **(10 min)**	**Teacher:** in your groups observe the pictures and answer the questions below.     	**Allow the learners to work in groups respecting gender balance and special need.**

	1. What is the use of a galvanometer? 2. What happens when a dry cell is connected in series with a galvanometer in the circuit? 3. What will happen if a bicycle dynamo connected in series to centre-zero galvanometer is turned by the wheel? 4. How many types of electric current? **Students: Answers** 1. To measure small electric current 2. Galvanometer deflects indicating the flow of current in circuit in one direction. (Direct current) 3. Galvanometer deflects back and forth to indicate the flow of current in two directions. (Alternating current) 4. There are two types of electric current: alternating current (ac) and direct current (dc)	
3 **LESSON DEVELOPMENT** **(55 min)**	**Teacher:** In your groups do the following activity **Activity 1** 1. Connect a dry cell across a centre-zero milliammeter and a resistor, making sure the positive polarity is connected to the positive polarity of the milliammeter. Note and explain what happens to the pointer.	

2. Connect a bicycle dynamo in series with a centre-zero galvanometer and resistor. Make the dynamo turn by use of the wheel. Observe and explain what happens to the galvanometer pointer.

3. Compare and discuss your observation in steps 1 and 2 with your classmates.

4. In steps 1and 2, the pointer in the galvanometer deflects.



(a) d.c Source (b) a.c Source

Fig. shows an electric circuit of d.c and a.c sources respectively.

Students:

1. When a dry cell is connected, galvanometer pointer is deflected in only one direction.

2. When a bicycle dynamo is connected, a galvanometer pointer deflects forth and back (in two directions).

3. Both dry cell and bicycle dynamo generate the electric current but of different type.

Teacher: Well done students! In addition, the polarity for d.c source remains constant making the current to flow in only one direction while that of a.c source switches polarity from positive to negative and back again over time.

Invite one member of the group to present their findings then after harmonize.

This makes the current with respect to the voltage oscillates back and forth.

Teacher: What is an alternating current?

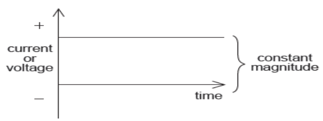
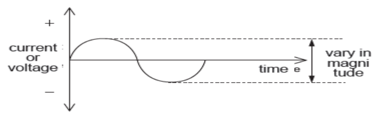
Students: Alternating current is the current which flows back and forth in two directions. It reverses its direction periodically while continuously varies in magnitude.

Teacher: What is a direct current?

Students: Direct current flows in one direction in the circuit and has a constant magnitude.

Teacher: What is the difference between direct current dc and alternating current ac?

Students: Difference between d.c and a.c power source

<table>
<tr><th>D.C</th><th>A.C</th></tr>
<tr><td>Flows in one direction in the circuit and has of constant magnitude
</td><td>Reverses its direction periodically while continuously varies in magnitude.
</td></tr>
<tr><td>d.c voltage cannot travel very long distance due to energy losses.</td><td>Easier, safe and cheaper to transfer over long distances.</td></tr>
</table>

Emphasize new concepts.

Provide opportunities for learners to ask questions and provide corrective feedback.

Frequency = 0 Hz	Frequency = 50 Hz or 60 Hz depending on the country.
Obtained from a cell or battery	Obtained from a.c generator and the mains
Hindrance to flow of current in d.c circuit called resistance	Hindrance to flow of current in a.c circuit is called impendence
Power factor is always1	Power factor lies between 0 and 1
Can be stored in batteries	Cannot be stored.

Activity of application

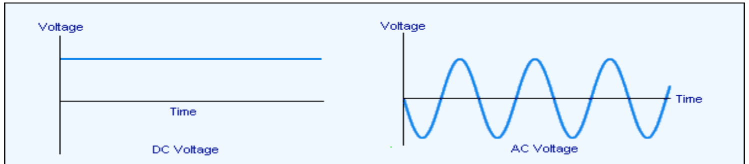
Teacher: Discuss where direct current(dc) and alternate current (ac) are used in real life and explain why?

Students: Alternating current, AC is mainly used in the industry of transportation and production of electricity. so our houses are powered by ac, that is why the mains sockets in our homes and at work provide an alternating current to power whatever is needed, but direct current,

DC is more widely used for the electronics devices (cell phones, televisions, Torches, radios, flashlights. themselves and for many other applications.

Teacher: Let together review some of the key points that we learnt.

provide opportunities for corrective feedback to learners

	What are the types of electric current? **Students:** There are two types of electric current, Direct current(dc) flow and alternate current(ac) flow **Teacher:** What is the difference between dc current and ac current? **Students:** The difference between AC and DC lies in the direction in which the electrons flow. In DC, the electrons flow steadily in a single direction, or "forward." In AC, electrons keep switching directions, sometimes going "forward" and then going "backward."  **Representation of Visual Difference between DC and AC voltages**	
4 **CONCLUSION** **(10 min)**	**Teacher:** Take your exercise notebook and do the following assessment. **Assessment** 1. Write down two differences between d.c and a.c power source. 2. Why do we use ac power for transmission electric current?	

	Students: Answers <table><tr><th>D.C</th><th>A.C</th></tr><tr><td>Flows in one direction in the circuit and has of constant magnitude</td><td>Reverses its direction periodically while continuously varies in magnitude.</td></tr><tr><td>d.c voltage cannot travel very long distance due to energy losses.</td><td>Easier, safe and cheaper to transfer over long distances.</td></tr></table> 1. We mostly use AC for transmission of electrical energy. Reason: This is because it is comparatively easier tochange voltage level in case of AC (with the help of transformer) as compared to DC. Changing voltage level is important because transmission at high voltage reduces transmission losses. **Teacher:** Write down this homework **Homework** 1. What is the main difference between AC and DC? 2. Which of the following is true about both alternating current (a.c) and direct current (d.c)? i. Causes heating ii. Can be stepped up or down with transformer. iii. Can be used to charge a battery	**Give time to do assessment, provide feedback.**

	A. (i),(ii), (iii) B. (i) and (ii) C. (i) and (iii) D. ((ii) and (iii) ***Thank you for your participation in this lesson.*** ***See you next time.***	

REFRACTION OF LIGHT

SUBJECT: PHYSICS	GRADE: S3	DURATION: 40 min

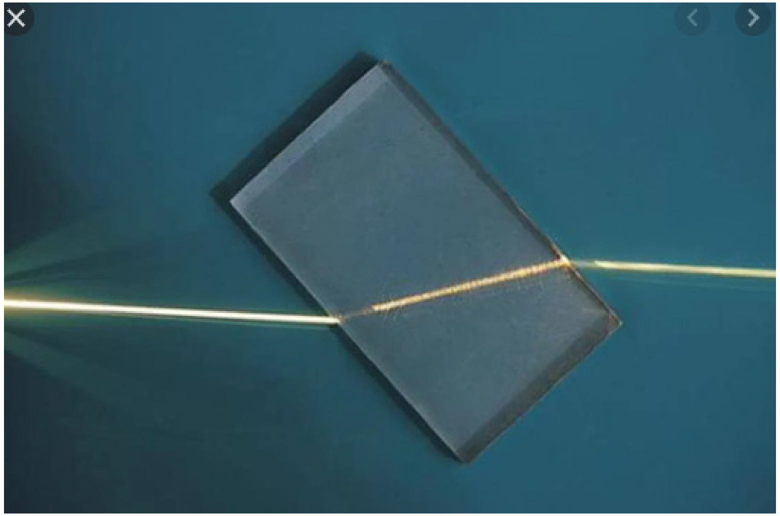
LESSON TITLE: : Phenomena of refraction of light

LEARNING MATERIALS: Plastic ruler, clear water in a transparent container, geometrical set, rectangular glass block, ray box or a small torch lamp.

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS' READINESS** **(2 min)**	**Teacher:** Hello learners! Welcome in the lesson. Observe the following picture. 	**Display a picture or use a graph chart.**

	Teacher: What is your first impression on the picture? **Student:** My first impression on the picture is rainbow. **Teacher:** Wow! What is the main cause of rainbow? **Students:** The main cause of rainbow is light. **Teacher:** Who can suggest the name of this light phenomenon? **Student:** The phenomenon may be a **refraction of light.** **Teacher:** All right! Who can suggest the lesson of today? **Student:** The lesson of today is refraction of light. **Teacher:** Wow! Today we start a new unit called **refraction of light** **Teacher:** The lesson of today is phenomena of refraction of light **Lesson Objectives/Instructional Outcomes:** By the end of this section, the learner should be able to explain the terms associated with refraction of light explain the refraction of light in different media	
2 **INTRODUCTION** **(5 min)**	**Teacher:** Observe actively and ask questions related to your observation	

	 **Teacher:** How does pen in water looks like? **Student:** The pen appears to be broken.	**Ask learners to make group.** **Go round and reorganize them to avoid a tendency of fast or slow learners grouping themselves into one group.**
3 **LESSON DEVELOPMENT** **(25 min)**	**Teacher:** Let us perform the following activity **Materials:** a rectangular glass block, a ray box (or laser beam torch) **Steps:** 1. Pass a narrow beam of light through a rectangular glass block in a semi-dark room and observe the path of light. 2. Use a protractor to measure angle between ray and normal in air and in glass block 3. Draw observation on a paper	**And make attention on special needs.**



Teacher: What have you observed from your experiment?

Student: In all the above experiments, when light travels from air to another medium like water or glass and vice versa, there is a change in the direction of the path of light at the boundary of the two media.

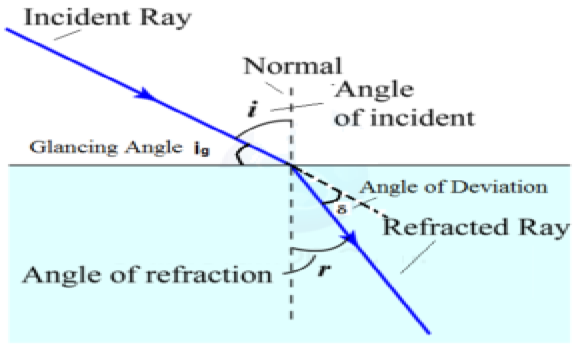
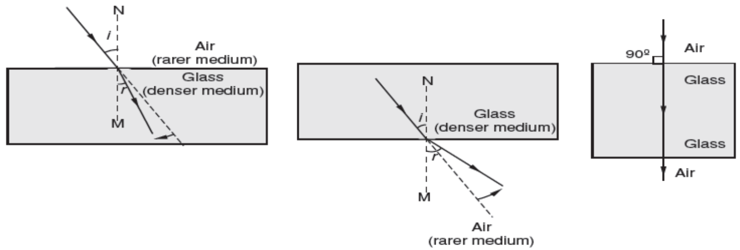
Teacher: This phenomenon of light is called "refraction" who can suggest its definition?

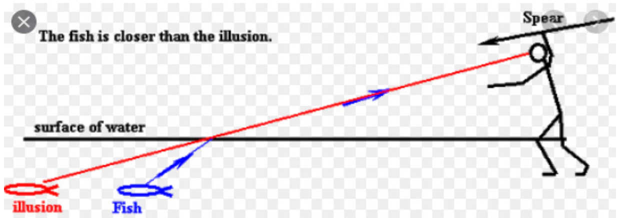
Students: Refraction of light is the bending of light rays when they travel from one medium to another of different optical density.

Teacher: How to illustrate refraction with ray diagram?

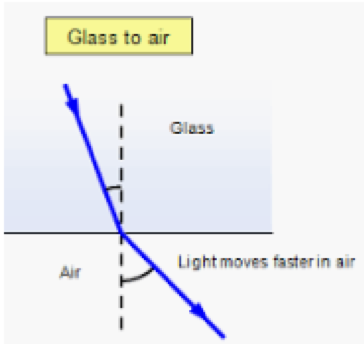
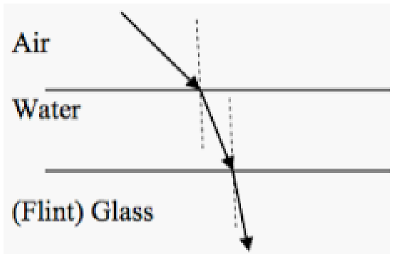
In their groups, guide them to do the activity and to explore different parameters.

Ask them to present their findings in a class discussion through their secretaries

	  (a) Refracted ray moves towards the normal (b) Refracted ray moves away from the normal (c) No refraction at normal incidence **Teacher:** Suggest the meaning of the terms refracted ray, angle of incidence, angle of refraction and normal line. **Students:** Refracted ray is transmitted ray into the second medium and travels in a different direction than the incident ray. Normal line is the line which is perpendicular or normal to the surface.	**Use different questions to probe students to understand the content.** **Provide opportunities for corrective feedback to learners.**

	Angle of incidence is the angle between the incident ray and the normal line. **Angle of refraction** is the angle formed between the refracted ray and the normal **Teacher:** Observe the following figure and answer the questions related **Application activity:**  **Teacher:** When you see a fish in water, how do you aim to catch it? **Student:** If the fisherman aims at the center of the **fish** the **spear** will miss (the spear passing in front of the fish) but if they aim at where they think the tail is then they will hit the body of the **fish**. **Teacher:** What if your weapon were a laser? **Student:** If the weapon is a laser the fisherman points it at the apparent position of the fish since the light will be refracted at the real position and hit the fish.	**Summarize their presentation by helping the learners to understand the accurate definition of terminology used in refraction**

	Teacher: In summarizing the lesson who can remind us of what we leant? **Student:** Today we learnt refraction of light. **Teacher:** Who can remind us of what refraction is? **Student:** Refraction is the bending of the path of a light as it passes across the boundary separating two media. **Teacher:** How light rays are refracted in different medium? **Students:** A ray passing from a rarer medium to a denser medium bends towards the normal on the other hand, a ray passing from a denser medium to a rarer medium bends away from the normal	**Present the figure on a chart or draw it on chalk board.** **Allow the learners to work in the group or in pairs**
4 **CONCLUSION** **(5 min)**	**Teacher: Assessment** Define the term "refraction of light" Draw diagrams to illustrate refraction for a ray of light on: a) glass – air boundary b) Water – air-glass boundaries **Student: Answers:** 1. Refraction of light is the bending of light rays when they travel from one medium to another of different optical density.	**Provide pause time to think and say or write their ideas**

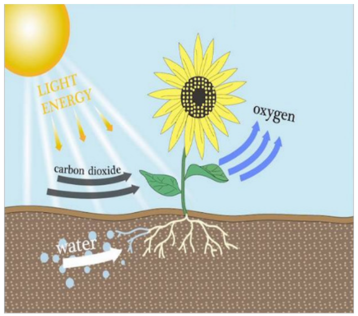
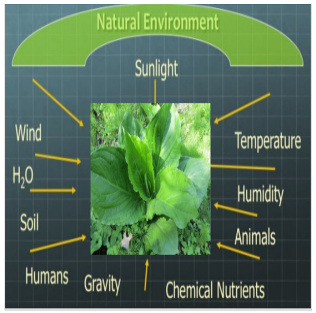
	a.  b.  **Teacher: Homework** Use internet to search for the applications of refraction of light in real life. ***Thank you for your participation in this lesson. Bye!***	**Provide opportunities to ask questions for corrective feedback or positive feedback to students.** **Let learners work individually**

PROPERTIES OF PHYSICAL PROCESSES AFFECTING PLANT GROWTH

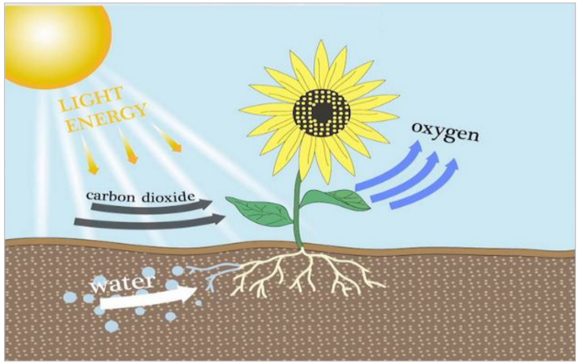
SUBJECT: PHYSICS	GRADE: S3	DURATION: 80 min

LESSON TITLE: Environmental factors and their impact on plant growth

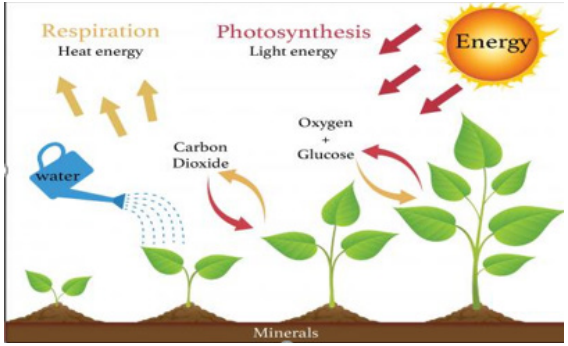
LEARNING MATERIALS: charts, real live plant, bean seeds, plastic cup, water, manila paper, marker pens

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 STUDENTS' READINESS (10 min)	**Teacher:** Hello learners! Welcome in today's lesson. Today we start a new unit. Observe the picture and answer to the following questions  	**Begin by gaining students' attention, revisiting pertinent skills and previous knowledge from biology or chemistry and communicate objective of the lesson.** **Present the pictures on chart**

	 **Teacher:**What does this picture represent? **Students:** Plants **Teacher:** What are the elements that affect its growth? **Students:** **Light,water,temperature,wind,nutrient.** **Teacher:** Suggest the title of the new unit **Students:** The title of the unit is properties of physical processes affecting plant growth. **Teacher:** The lesson of to day is **Environmental factors and their impact on plant growth.** **Lesson Objectives/Instructional Outcomes:** By the end of this lesson, the learners should be able to Explain environmental factors and their impact on plant growth. Apply knowledge of physics to explain environmental factors affecting plant growth.	**Teacher may read quickly the learning objectives or present them on a manila paper.**

2 **INTRODUCTION** **(10 min)**	• Appreciate the need to think scientifically and evaluate environmental factors that affects plant growth. **Teacher:** Observe the picture below and answer the questions  What do plants need in order to grow? **Students:** They need water, soil, light enrgy,.. **Teacher:** What is the role of plants on human being? **Students:**Plants produce oxigen and food to human being	
3 **LESSON DEVELOPMENT** **(50 min)**	**Teacher:** Discuss the environmental factors that affect plant growth and present your findings on a manila paper.	

The following are factors affecting plant growth.



Teacher: What is quantity of light and how it affects plant growth?

Students: Light quantity is the intensity or concentration of sunlight and varies with the period of the year. The more sunlight a plant receives (up to a point), the more food it produces through photosynthesis.

Light quality is the color or wavelength reaching the plant surface. Sunlight is a compound of red, orange, yellow, green, blue, indigo, and violet colors. Blue light is primarily responsible for vegetative growth or leaf growth. Red light when combined with blue light promotes flowering.

Teacher: What is light duration and how it affects plant growth?

Group learners with respecting gender equality.

Provide manila paper to each group.

Call upon the group representative to present their finding. Together with learners summarize the content.

	Students: Light duration or photoperiod refers to the amount of time that a plant is exposed to sunlight. The ability of many plants to flower is controlled by photoperiod. **Teacher:** How temperatures affect plant growth? **Students:**Temperature directly affects the following processes in plant growth; • Photosynthesis • Flowering • Transpiration • Respiration Sugar storage; Low temperatures reduce energy use and increase sugar storage Absorption of water and nutrients The rate of these processes increases with an increase in temperature. Low temperatures can result in poor growth. **Teacher:** To understand better the factors that affect plant growth, let us perform the following activity: **Materials:** • Beans seeds • 3 small plastic cups, • soil ,	**Provide opportunities for corrective feedback or positive feedback to students.** **Provide all the materials needed and guide learners to setup the activity.**

	• Watering can, • 3 different growing locations: full sun, partial/ some sun, no/little sun **Procedures:** 1. Take three small plastic cups and fill them with soil. 2. put 2 beans in each of three small plastic cups 3. Place a thin layer of soil over the seeds(beans) 4. Water each plant until the soil is moist and start the germination process. 5. Place each cup in a different growing environment. a) Place one of the plant cups in full/direct sunlight. (Example: a window seal that gets full sun all day) b) Place another in a location that gets some sun but not direct/full sun. (Example: a bookshelf that gets some sun indirectly from the kitchen window) c) Place the last cup in a location that gets little to no sun. (Example: a shut drawer in the kitchen so that the plant receives no/little sun throughout the growing process) 6. Observe the plant growth after 6 days **Students: Results of the activity:** a) If a plant get sunlight the photosynthesis process is done, plant grow healthy, and the leaves are green	

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<td></td>
<td>b) If a plant gets limited sunlight, the photosynthesis process slows down and the plant begins to grow upward and stretch their stems to reach for the sunlight
c) Plants deprived of light will lose their color and die.</td>
<td rowspan="2">Use learner’s ideas to formulate the lesson summary.</td>
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<td>4
CONCLUSION
(10 min)</td>
<td>Teacher: In summary who can remind us what we learnt today?
Students: we learnt environmental factors affecting plant growth, which are light energy and temperature
Three aspects of light that affect plant growth are light quantity, light quality and light duration.
Temperature directly affects the following on plant growth:
Photosynthesis, flowering, transpiration, respiration, sugar storage.
Teacher: Assessment:
I) For the following questions, select the most appropriate answers. /5 marks
1. The following are characteristics of light that affect plant growth except
A. Light quality B. Light quantity
C. Light duration D. Refraction of light</td>
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	2. Light duration in plant growth refers to A. The amount of time that a plant is exposed to sunlight. B. Intervals between light bright and dull lights C. Color of light D. The intensity of light 3. Light quality refers to A. The color or wavelength reaching the plants surface B. The amount of time plants is exposed to light C. Color of light D. The intensity of light 4. Light quantity refers to A. Wavelength reaching the plant B. The intensity or concentration of sunlight C. Color of light D. The amount of time plants receive light 5. following are aspects of light affects plant growth except A. Dominance B. Light quantity C. Light duration D. Light quality	**Allow the learners to answer the questions Brainstorming** **provide opportunities for corrective feedback to learners**

	II) Explain what temperature effects on plant growth directly. /5 Marks **Students: Answers** I. 1. D 2. A 3. C 4. B 5. A II. Temperature affects plant growth on the photosynthesis, flowering, transpiration and respiration. ***Thanks to everyone, next time we will discuss on other factors that affect plant growth.***	**Allow the learners to work individually** **Provide pause time to think and say or write their ideas** **Provide opportunities for corrective feedback to learners**

ENVIRONMENTAL PHENOMENA AND RELATED PHYSICAL CONCEPTS

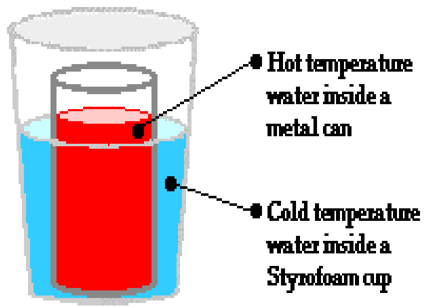
SUBJECT: PHYSICS	**GRADE:** S3	**DURATION:** 40 min

LESSON TITLE: Application of laws of thermodynamic in energy transfer in the environment

LEARNING MATERIALS: Pictures, charts, metal bar, water containers, candle, water, source pan, match box.

SECTION	STEP –BY- STEP INSTRUCTIONS AND CONTENT	NOTICE FOR TEACHER
1 **STUDENTS' READINESS** **(2 min)**	**Teacher: Hello student! Welcome in today's lesson!** We are at unit 15, who can remind us of the title of unit 6 we covered yet? **Student:** The title of unit 6 is laws of thermodynamics **Teacher:** How does the laws of thermodynamics relate to environment phenomena? **Students:** Environmental phenomena are governed by laws of thermodynamics **Teacher:** Who can suggest the title of today's lesson?	**Begin by gaining student's attention**

	Students: The lesson of today is application of laws of thermodynamics in the environment phenomena. **Teacher:** Wow! The lesson of today is Application of laws of thermodynamic in energy transfer in the environment. **Lesson Objectives/Instructional Outcomes:** By the end of this lesson, learner should be able to: • Describe the basic laws of thermodynamics and relate them to the environment. • Apply the basic laws of thermodynamics to environment. • Appreciate the basic laws of thermodynamics to environment.	**Welcoming them in the lesson and communicate the objective of the lesson**
2 **INTRODUCTION** **(5 min)**	**Teacher:** Observe the picture below and answer the questions related to your observations: 	

	Teacher: What do you observe on this picture? **Students:** On the picture, we see burning wood, a metal bar and human hand. **Teacher:** Which object is hotter than other? **Students:** Burning woods are hotter than other object. **Teacher:** To understand the laws of thermodynamics let us perform the following activity.	
3 **LESSON DEVELOPMENT** **(25 min)**	 **Materials:** small container with hot water, large container with cold water **note:** containers must not be insulators Procedures: 1. Take a large container with cold water 2. Put the small container with hot water inside the large container 3. Wait 2 minutes	**At each step, provide a pause time for students to think and say or write their ideas.** **Allow learners to work in groups**

4. Remove the small container inside the large container
5. Touch in water in the large container

Teacher: What is the direction of heat energy between two containers?

Students: Heat moves from hot container to cold container.

Teacher: Can heat flow back from cold container to hot container? explain

Student: When you bring two objects of different temperature together, heat energy will always be transferred from the hotter to the cooler object. The objects will exchange thermal energy, until thermal equilibrium is reached, i.e. until their temperatures are equal.

The reverse process is impossible, i.e. heat energy cannot flow from colder body to hotter body.

Teacher: Who can remind us the first law of thermodynamics?

Students: First law of thermodynamics relates to conservation of energy. It states that the change in the internal energy (ΔU) of a system is equal to the sum of the heat (Q) that flows across its boundaries and the work (W) done on the system by the surroundings.

Teacher: Wow! Correct! As such all the energy transformations in the environment are governed by this law.

Example: Conversion of light energy into chemical energy in plants during photosynthesis.

Can another one reminds us of the second law of thermodynamics?

Students: The Second law of thermodynamics states that "*Heat flows spontaneously from a hotter object to a colder one, but not in the opposite direction; the reverse cannot happen without the addition of energy"*.

Teacher: Wow! Correct! This law is sometimes stated as "**entropy increases**" -- **entropy** being the random, unavailable energy. Whenever energy is converted from one form into another, some of it is given off as heat, which is the most random form of energy.

Teacher: When a hot frying pan is removed from the stove, what happen to its surrounding environment?

	Students: With time, the pan cools to room temperature with the heat radiated throughout the room. **Teacher:** In this state, heat energy is now dispersed and unavailable for cooking; the heat energy flow between the pan and the room has gone towards equilibrium, become more random, and entropy has increased. This is what happens during many heats exchange processes in the environment. **Teacher: Application Activity.** A nursery student carried a plastic container with tea inside in the morning that he/she wanted to drink it in break. In the break it has become cold. a) Explain what happened b) What should he/she do to avoid it to become cold? **Students: Answer**: a) Heat from tea was transferred to the environment (outside the container) as the container was a good conductor of heat b) The student should carry the tea in the insulating container, i.e container which cannot transfer heat to the environment.	**Use different questions to probe students to understand the content.**

	Teacher: As we conclude, can you remind us of what we learnt in this lesson? **Students:** In this lesson we leant two laws of thermodynamics **Teacher:** State laws of thermodynamics. **Students:** **The First law of thermodynamics:** The change in the internal energy (ΔU) of a system is equal to the sum of the heat (Q) that flows across its boundaries and the work (W) done on the system by the surroundings. **The second law of thermodynamics:** Heat flows spontaneously from a hotter object to a colder one, but not in the opposite direction; the reverse cannot happen without the addition of energy'.	**Ask them to work in pairs by respecting gender** **Emphasize to New concepts** **Provide opportunities for corrective feedback to leaners.**
4 **CONCLUSION** **(5 min)**	**Teacher: Assessment:** The second law of thermodynamics states that heat cannot flow from a colder to a hotter temperature unless work is done, and it cannot be converted completely into work. **1. True** **2. False** Use the correct words from the following to answer questions that follows:	

	Decreases, increases, heat, specific heat, insulator, condensation, entropy, internal energy. a. is the process of changing from gas to liquid. b. ______________ is the measure of the average kinetic energy of the particles in a material. c. When an object absorbs heat energy, it entropy _____________. d. ______________ is the name for energy that is transferred only from a higher temperature to a lower temperature object. e. The measure of the amount of disorder in a system is called ______________? **Students: Answer:** **True** a. Condensation b. Internal energy c. increases d. Heat e. Entropy ***Thank you for your participation in this lesson.***	**Allow the learners to work individually** **Provide pause time to think and say or write their ideas**