Republic of Zambia

MINISTRY OF EDUCATION

PHYSICS

TEACHING MODULE

Form 1: TERM 1

DEVELOPED BY THE CURRICULUM DEVELOPMENT CENTRE
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PHYSICS
TEACHING MODULE
FORM 1:TERM 1

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Vision

Quality, life- long education for all which is accessible, inclusive and relevant to individual, national and global needs.

Preface

The **Physics Teaching Module for Form 1** is designed to guide the teachers on how to deliver competence-based lessons to facilitate the understanding of Physics concepts, fostering a deep appreciation of the role Physics plays in everyday life and its applications in various fields. This module aims to develop a solid foundation in Physics, and cultivates critical thinking, analytical skills, and problem-solving strategies among the learners. Subsequently, applying Physics concepts to real-world problems and emerging technologies through the engagement of learners in hands-on, hearts-on and minds-on practical activities and simulations will reinforce understanding of the subject content.

This Physics Teaching Module for Form 1 intends to create a stimulating and supportive learning environment where teachers can prepare lessons with a profound understanding of Physics. The module will help the teachers to support learners grow intellectually and personally by preparing them for professions in science and technology as well as for higher education by encouraging curiosity, critical thinking, and practical skills.

It is hoped that this module will inspire teachers to prepare lessons which are competence based with the fascinating world of Physics and appreciate its significance in shaping the future.

Joel Kamoko, (Mr.)
Permanent Secretary- Educational Services
MINISTRY OF EDUCATION

Acknowledgement

This Physics Teaching Module is designed to provide the teacher with a scope and sequence of topics considered necessary to be offered at Ordinary Secondary School Level in Form 1 of term 1. This is with a view to provide guidance to the teaching and learning of this unique, but yet exiting blend of concepts in Physics for teachers and other experts in the field to appropriately offer relevant lessons at Ordinary Secondary Level.

Many thanks go to individuals, institutions and organisations that participated in the successful development of this module. These include; teachers, lecturers from colleges, public universities in Zambia and in particular, the University of Zambia. Sincere gratitude also goes to the Zambia Education Enhancement Project (ZEEP) for the financial support and Zambia Educational Publishing House (ZEPH) for the technical support towards the development and finalization of the module.

Last but not the least, the commitment and hard work of all the staff at the Curriculum Development Centre in ensuring that this module comes to reality is recognised.

Charles Ndakala (Dr.)
Director – Directorate of Curriculum Development
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Contents

Introduction

This Physics Teaching Module provides guidance to the teacher on how to deliver competence-based lessons on the fundamental principles and concepts of Physics. This module aims to help a teacher develop an understanding of the natural, artificial or technological environment to prepare lessons which help learners develop critical thinking, problem-solving, and analytical skills. This module is committed to providing an enriching and supportive educational environment where teachers can prepare and deliver lessons which stimulate interest in physics for learners. This module seeks to support teachers to prepare lessons for both academic performance and their future roles as knowledgeable and responsible citizens in a scientifically advanced society by encouraging inquiry, curiosity, and a love of science.

It is expected that this Physics teaching module, once implemented successfully, will inspire and empower learners to achieve their full potential, equipping them with the knowledge and skills necessary to navigate and contribute to the world around them. This module is designed to ensure learners develop a deep understanding of physics principles while also acquiring the practical skills and competencies needed for further education and careers in science.

How to use the Module

To effectively use this Physics Teaching Module for Form 1:

- Read and familiarise yourself with the module's content, learning activities, and assessment guides.
- Plan your lessons in advance using the module's suggested teaching and learning activities.
- Use a variety of teaching methods including demonstrations, discussions, group work, and hands-on experiments.
- Encourage active learning by asking open-ended questions, promoting critical thinking, and fostering problem-solving skills.
- Assess learners learning regularly using the module's suggested assessment strategies and tools.
- Provide feedback and support to learners, helping them to identify areas for improvement and develop their skills.
- Integrate technology into your teaching using multimedia resources and interactive simulations to enhance student engagement and understanding.
- Monitor student progress and adjust your teaching strategies as needed, to ensure that all students meet the learning objectives

By following these steps, you can effectively use this Physics Teaching Module for Form 1 to support your teaching and promote learning.

Suggested Teaching and Learning Materials

The study of Physics content requires hands-on experiences, visual aids, and interactive resources to strengthen deep understanding and appreciation. To support the teaching and learning of Physics in Form 1, the suggested teaching and learning materials are meant to:

- Enhance learner engagement and motivation in Physics
- Develop practical skills and laboratory techniques
- Promote critical thinking, problem-solving, and analytical skills
- Support differentiated instruction and inclusive learning

The suggested teaching and learning materials are either artificial or natural. By utilising these suggested teaching and learning materials, teachers can create a dynamic and supportive learning environment that promotes academic excellence, creativity, and scientific literacy in Physics for Form 1 learners.

Learning Environment Set Up

To create an effective learning environment for teaching and learning chemistry in important in deepening understanding of the concepts and application in real life context. The learning environment set-up aims to create a safe, inclusive, and engaging space.

- **Natural Environment**: A natural learning environment is a setting where learners explore and learn naturally, often without explicit instruction or formal teaching, such as in school surroundings
- **Man-Made Environment:** Man-made learning environments are intentionally designed safe spaces, such as classrooms, laboratories, and libraries, designed for formal instruction, hands-on activities, and games and songs
- **Technological Learning Environment:** Access educational apps, and software for learning, including game-based platforms, virtual platforms, and simulations, to engage learners and promote learning

Safety in the learning environment

Safety in the learning environment is a requirement in learning Physics, as learners are exposed to potential hazards during hands-on experiments. Collaboration between teachers, and learners, is important to create a responsible learning environment that promotes scientific inquiry. Guidelines for maintaining a safe learning environment include laboratory safety rules (protocols), risk identification, personal protective equipment, emergency response plans, storage, and disposal, and learner responsibilities. Prioritizing safety minimizes risks, prevents accidents, and ensures a positive learning experience.

Teaching Methodology

The effective teaching methodologies in STEM physics include:

- **Conducting experiments**: Demonstrate key principles and encourage curiosity among learners.
- **Collaborative learning**: Pair learners to work together, promoting peer-to-peer teaching, discussion, and problem-solving.
- **Conceptual learning:** Connect physics concepts to everyday life, industry, or current events, making learning relevant and meaningful.
- **Differentiated instructions:** Tailor teaching to meet diverse learning styles, abilities, and interests of different learners.
- **Feedback and Reflection:** Encourage learners to reflect on their learning, providing constructive feedback to guide improvement.
- **Inquiry-based learning**: Encourage learners to explore, investigate, and discover physics concepts through hands-on experiments and activities.
- **Integration of Technology:** Use digital tools, simulations, and visualisations to enhance engagement, understanding, and analysis.
- **Problem-based learning**: Present real-world problems or case studies, requiring students to apply physics principles to develop solutions.
- **Project-based learning:** Assign open-ended projects, allowing students to design, conduct, and present research or applications of physics concepts.

By implementing these methodologies, a teacher can create an engaging, inclusive, and effective STEM physics learning environment.

Time Allocation

The standard minimum learner-teacher contact time for Physics at Secondary School Level is 4 hours per week, translating into Six (6) periods. The duration for a single period is 40 minutes. The contact time at Secondary School Level is planned in such a way as to give ample time for practical activities.

Key Competences

In physics the following key competences are the fundamental abilities and qualities that will enable individual learners to:

- Manage their own learning and knowledge
- Interact with others and solve problems
- Contribute to society and the economy
- Adapt to change and navigate through emerging issues in the environment

KEY COMPETENCE	DESCRIPTOR

KEY COMPETENCE	DESCRIPTOR
Analytical Thinking	To analyse and interpret data, making evidence-based conclusions.
Collaboration	To work together, promoting peer-to-peer teaching, discussion, and problem-solving.
Communication	To communicate scientific information effectively, both orally and in writing.
Creativity and innovation	To create new ideas and products by applying processes and introducing new techniques that can add value.
Critical Thinking	To enhance learners' ability to think critically and solve problems through logical reasoning based on conclusions.
Digital literacy	Using a broad range of Information and Communication Technologies such as a cell phone, computer, calculator in specific contexts.
Environmental Sustainability	To apply physical principles to understand and mitigate the environmental impact of human activities.
Problem Solving	To use scientific knowledge, critical thinking, and analytical skills to develop a robust problem-solving mindset, enabling learners to tackle complex challenges and drive innovation in various fields.

Topic 1: Introduction To Physics

Introduction: Physics is a branch of science that deals with matter in relation to energy and fundamental laws that govern the behavior of the physical universe. It covers five sub-topics; **Safety Rules** (Laboratory Safety), **Waste Management, Apparatus in Physics, Fundamental Concepts of Physics** and **Applications of Physics in everyday life.**

Key Competence(s):

- Analytical Thinking
- Collaborative
- Digital literacy
- Communication
- Critical Thinking
- Problem Solving
- Real world application
- Environmental sustainability
- Creativity and innovation

Sub-Topic 1.1: Safety rules (Laboratory safety)

Introduction: Safety rules are guidelines or regulations designed to prevent accidents, injuries, and harm to people, property, and the environment. Introducing laboratory safety to Form 1 learners is crucial to ensure they understand the importance of safety protocols and develop good habits from the start.

Specific competence

- Practise laboratory safety rules.

Key terms:

- Laboratory safety: Refers to the practices, procedures and guidelines designed to minimise risks and ensure a safe working environment in the laboratories.

- Hazards: Hazards are situations, conditions, or objects that have the potential to cause harm, injury, illness, or damage to people, property or the environment.
- Laboratory rules: Are guidelines, regulations and protocols established to ensure safe, healthy and efficient working environment in the laboratory.
- Safety protocols: Are systematic procedures and guidelines designed to ensure a safe and healthy environment, prevent accidents and injuries, and minimise risks.

Learning activities

Activity 1.1: Practising laboratory safety protocols

This activity is designed to help learners practice laboratory safety protocols. There are two sub activities which learners will engage in as they explore how to use the laboratory safety protocols.
Activity 1.1.1: Exploring the use of laboratory safety tools.
In this activity, learners will role play the use of laboratory safety tools.

HOOK: In a laboratory, what protocols would you follow to ensure your safety?

Suggested Teaching and Learning Materials

- **Natural Materials**: water, air
- **Artificial Materials**: Personal Protective Equipment (PPE) such as Laboratory coat, gloves, safety glasses, safety googles and face shields, Safety equipment such as fume hoods, bio-safety cabinets, safety showers, fire extinguishers and first aid kits, safety signs such as warnings, caution, biohazard signs and chemical labels and emergency response equipment such as fire alarms, emergency phones and escape routes.

Learning environment set up:

- Natural Environment such as school surroundings.
- Artificial Environment such as the laboratory or any room or place where learners can be (mobile laboratory).

Teacher's role(s):

- Introduce the activity. For example, by showing a safety protocol simulation. "We shall look at the fascinating world of laboratory safety tools" "Why are laboratory safety tools essential?"
- Divide learners into groups
- Provide the materials
- Provide the instructions
- Ask learners to give reasons for every protocol acted out.
- Ask learners to explain the importance of adhering to laboratory safety protocols
- Consolidate the concept of laboratory safety. Ensure that learners can visualise the importance and uses of various laboratory safety tools, are ready to handle and use laboratory safety tools safely and properly, and geared to develop essential skills in laboratory safety and emergency response.

Learners' Tasks:

- Identifying the laboratory safety tools
- Writing laboratory safety protocols (e.g., wearing gloves, using goggles) on slips of paper
- Taking turns acting out the protocols without speaking
- Answering questions from the teacher on the activity acted out
- Discussing the importance of laboratory safety, using examples of potential hazards and consequences of neglecting safety protocols

Assessment Guide:

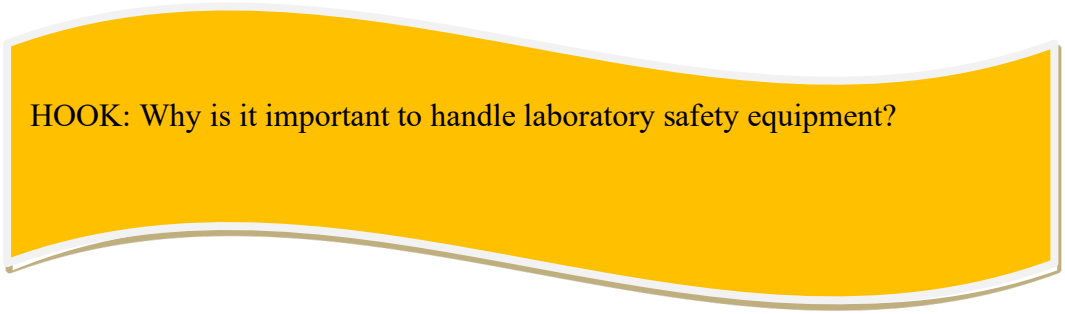
- Observe learners during laboratory activities to assess their adherence to safety protocols and procedures.
- Review learners' actions
- Ask learners open-ended questions to prompt further discussion
- Ask questions such as:
  1. Which laboratory safety tools were easy to act out and why?
  2. Which laboratory safety tools were difficulty to act out and why?
- Ask learners to solve laboratory safety related puzzles to escape within certain time limits
- Administer a quiz or worksheet to assess learners' understanding of laboratory safety concepts

Skills Developed:

- Communication
- Collaboration
- Observation
- Psychomotor
- Problem solving
- Analysing

Activity 1.1.2: Laboratory safety equipment handling

In this activity learners will handle and use the laboratory safety equipment. Learners will explore the essential skills of handling laboratory safety equipment. Laboratory safety equipment is crucial in preventing accidents, injuries, and illnesses in the laboratory. Proper handling and use of this equipment are vital to ensuring a safe working environment.



Suggested teaching and learning materials

- Natural materials: water, air...
- Artificial materials: Laboratory safety manual, Safety videos, Laboratory safety equipment...

Learning environment set up

- Natural environment such as school surroundings
- Artificial environment such as the laboratory or any room or place where learners can be (mobile laboratory)
- Technological environment such as any place where a video or simulation can be done

Teachers' role(s):

- Introduce learners to emergency procedures, such as fire evacuation procedures, chemical spill response and first aid procedures.
- Ask learners why it is important to learn to handle laboratory safety equipment
- Show a safety protocol simulation
- Utilize safety videos and resources, such as the American Chemical Society's (ACS) Laboratory Safety Video Series
- Ensure that the laboratory is equipped with necessary safety equipment, such as fire extinguishers, first aid kits, and PPE
- Show learners how to handle and use laboratory safety equipment correctly
- Divide learners into groups
- Mimic emergency situations like spills, fires, or injuries
- Ask learners to give reasons for every action taken
- Ask learners to develop or obtain a laboratory safety manual that outlines safety protocols and procedures
- Consolidate the concept of response to emergencies. Make sure that the learners can explain the importance and uses of various laboratory safety tools, can handle and use laboratory safety tools safely and properly, and have developed essential skills in laboratory safety and emergency response

Learners' task (s):

- Giving reasons as to why it is important to learn to handle laboratory safety equipment
- Observing simulations depicting various emergencies and how they are handled
- Preparing for emergence actions of safety according to groups
- Practising to respond according to laboratory safety protocols for any of the simulated spills, fires and injuries
- Responding to teachers' questions
- Discussing different types of laboratory safety equipment, their uses, and benefits
- Using laboratory safety equipment correctly, such as gloves, goggles, and fire extinguishers
- Developing the skills and confidence to handle laboratory safety equipment correctly and safely

Assessment Guide.

- Observe learners during laboratory activities to assess their ability to respond to emergencies
- Review learners' actions
- Ask learners open-ended questions to prompt further discussion
- Ask questions such as:
    1. Which group responded professionally and why?
    2. Which group had difficulties to respond and why?
- Ask learners to solve laboratory safety related puzzles to escape within certain time limits

- Administer a quiz or worksheet to assess students' understanding of laboratory safety concepts

Assessment guide

Knowledge and Understanding (40 points)
1. Tool identification: Can identify and name different laboratory safety tools (10 points)
2. Tool uses and benefits: Understands the uses, benefits, and limitations of each laboratory safety tool (15 points)
3. Safety procedures: Knows proper handling and safety procedures for each laboratory safety tool (10 points)
4. Emergency response: Understands emergency response procedures for laboratory accidents (5 points)

Practical Skills (30 points)
1. Tool handling: Demonstrates proper handling and use of laboratory safety tools (15 points)
2. Safety protocols: Follows proper safety protocols when using laboratory safety tools (10 points)
3. Emergency response simulation: Participates in emergency response simulation and demonstrates understanding of procedures (5 points)

Critical Thinking and Problem-Solving (20 points)
1. Risk assessment: Can assess risks associated with laboratory safety tools and procedures (10 points)
2. Problem-solving: Demonstrates ability to think critically and solve problems related to laboratory safety (5 points)
3. Communication: Effectively communicates laboratory safety information and procedures to others (5 points)

Collaboration and Teamwork (10 points)
1. Group work: Participates effectively in group work and contributes to team discussions (5 points)
2. Peer feedback: Provides constructive feedback to peers on laboratory safety procedures and tool use (3 points)
3. Team presentation: Participates in team presentation on laboratory safety tools and procedures (2 points)

Assessment Rubric
Exemplary (90-100%)
- Demonstrates exceptional knowledge and understanding of laboratory safety tools and procedures.
- Exhibits outstanding practical skills in handling and using laboratory safety tools.
- Shows exceptional critical thinking and problem-solving skills in assessing risks and solving problems related to laboratory safety.

Proficient (80-89%)
- Demonstrates good knowledge and understanding of laboratory safety tools and procedures.
- Exhibits good practical skills in handling and using laboratory safety tools.
- Shows good critical thinking and problem-solving skills in assessing risks and solving problems related to laboratory safety.

Developing (70-79%)
- Demonstrates some knowledge and understanding of laboratory safety tools and procedures, but may lack some details.
- Exhibits some practical skills in handling and using laboratory safety tools, but may require some guidance.
- Shows some critical thinking and problem-solving skills in assessing risks and solving problems related to laboratory safety, but may require some support.
Emerging (Below 70%)
- Demonstrates limited knowledge and understanding of laboratory safety tools and procedures.
- Exhibits limited practical skills in handling and using laboratory safety tools.
- Shows limited critical thinking and problem-solving skills in assessing risks and solving problems related to laboratory safety.

Skills developed

- Communication
- Collaboration
- Observation
- Psychomotor
- Problem solving
- Analysing

Activity 1.3: Identifying potential hazards and taking necessary precautions

Introduction: In this activity, learners will take a tour of the laboratory where they will be pointing out potential hazards, such as chemicals and reagents, electrical equipment, sharp objects and broken glass ware, and open flames and heat sources. In the process learners will identify potential hazards in a laboratory setting, assess the risks associated with each hazard and develop precautions to minimize or eliminate each hazard.

HOOK: When you inspect your laboratory or your work environment, what are some of the things that are likely to lead to accidents?

Suggested teaching and learning materials

- Natural materials: Eyes, hands, noise...
- Artificial materials: Chemical, physical and biological safety data sheets (SDS), chemical, biological, physical and warning hazard identification labels, laboratory warning, caution and biohazard signs, personal protective equipment (PPE) and safety manuals and guidelines

Learning environment set up

- Natural environment such as school surroundings
- Artificial environment such as the laboratory or any room or place where learners can be (mobile laboratory).

Teachers' role(s):

- Introduce learners to the activity on potential hazards and precautions. e.g. why is identifying potential hazards and taking necessary precautions, a necessary aspect of laboratory safety?
- Divide learners into groups
- Provide clear instructions
- Ask learners in groups to take a tour of the laboratory
- Encourage them to be critical as they identify the hazards and discuss the precautions
- Ask learners to explain a hazard that they feel very few members of the class have seen
- Consolidate the concept of hazards. The learners are expected to understand the importance of identifying potential hazards in a laboratory setting and assess risks and develop precautions to minimize or eliminate hazards

Learners' task (s):

- Identifying the hazards in the laboratory
- Explaining the identified hazards
- Suggesting precautions for every hazard identified.
- Discussing each hazard
- Explaining the potential risks and consequences of each hazard

Assessment Guide.

- Observe learners during laboratory activities to assess their ability to identify hazards
- Review learners' actions
- Ask learners open-ended questions to prompt further discussion
- Ask questions such as: which group identified the best hazard and why?
- Administer a quiz or worksheet to assess students' understanding of hazard concepts in chemical safety, electrical safety, fire safety, personal protective equipment and general laboratory cleanliness

Observation Checklist

1. Personal Protective Equipment (PPE): Are students wearing lab coats, gloves, goggles, and closed-toe shoes?
2. Chemical Handling: Are learners handling chemicals carefully, using tongs or gloves, and disposing of waste properly?
3. Equipment Usage: Are learners using laboratory equipment correctly, following manufacturer instructions, and reporting any malfunctions?
4. Fire Safety: Are learners aware of fire evacuation procedures, using fire extinguishers correctly, and keeping flammable materials away from heat sources?
5. Cleanliness and Organisation: Are learners maintaining a clean and organized workspace, disposing of waste properly, and storing equipment and chemicals correctly?

Student Survey

1. Safety Knowledge: Do learners understand laboratory safety rules and procedures?
2. Safety Attitudes: Do learners perceive laboratory safety as important and take responsibility for their own safety?
3. Safety Behaviors: Do learners report following laboratory safety rules and procedures consistently?

Assessment Rubric

1. Excellent: learners consistently demonstrate safe laboratory practices, and teachers provide comprehensive safety instruction and supervision.

2. Good: learners generally demonstrate safe laboratory practices, but some areas for improvement are identified.

3. Fair: learners demonstrate some safe laboratory practices, but significant areas for improvement are identified.

4. Poor: learners consistently demonstrate unsafe laboratory practices, and teachers fail to provide adequate safety instruction and supervision.

By using this comprehensive approach, you can assess the practice of laboratory safety rules and identify areas for improvement to ensure a safe and healthy learning environment.

Sample questions

Chemical Safety

1. Chemical Spill: A learner accidentally knocks over a container of sulphuric acid, spilling it on the counter. What should they do?

Answer: Immediately alert the teacher, put on gloves and safety goggles, and carefully clean up the spill with a neutralizing agent.

2. Chemical Storage: A learner is asked to store a new shipment of chemicals in the laboratory. What should they consider?

Answer: They should check the labels for compatibility, store chemicals in their designated areas, and ensure that the storage area is well-ventilated and away from heat sources.

Electrical Safety

1. Electrical Equipment: A learner needs to use a hot plate to heat a solution. What should they check before turning it on?

Answer: They should check that the hot plate is in good working condition, that the cord is not damaged, and that the plate is placed on a heat-resistant surface.

2. Electrical Shock: A learner notices that a piece of electrical equipment is malfunctioning and sparking. What should they do?

Answer: They should immediately turn off the equipment, unplug it, and alert the teacher or laboratory supervisor.

Fire Safety

1. Fire Extinguisher: A small fire breaks out in the laboratory. What should a learner do?

   Answer: They should alert others, turn off any electrical equipment, and use a fire extinguisher rated for the type of fire (e.g., Class B for flammable liquids).

2. Flammable Materials: A learner is working with flammable materials, such as ethanol or acetone. What precautions should they take?

   Answer: They should work in a well-ventilated area, away from heat sources, and use a fume hood or other ventilation system if necessary.

Personal Protective Equipment (PPE)

1. Gloves: A learner is handling a chemical that can cause skin irritation. What should they wear?

   Answer: They should wear gloves made of a material resistant to the chemical, such as nitrile or latex.

2. Goggles: A learner is working with a chemical that can splash or spray. What should they wear?

   Answer: They should wear goggles or safety glasses with a splash guard to protect their eyes.

General Laboratory Safety

1. Cleanliness: A student notices that the laboratory is cluttered and messy. What should they do?

   Answer: They should clean up their workspace, dispose of waste properly, and alert the teacher or laboratory supervisor if the mess is hazardous.

2. Emergency Procedures: A student is unsure of what to do in case of an emergency. What should they do?

   Answer: They should familiarize themselves with the laboratory's emergency procedures, such as the location of fire extinguishers, first aid kits, and emergency exits.

Skills developed

- Communication
- Collaboration
- Observation
- Psychomotor
- Problem solving
- Analysing

Activity 1.4: Creating posters to communicate safety information

Introduction: In this activity learners will design posters which shall convey safety information.

HOOK: Have you ever thought of the importance of communicating safety information on a poster?

Suggested teaching and learning materials

- Natural materials: Wood, sand, seeds...
- Artificial materials: Markers, posters or chart paper, stickers or graphics, safety icons and images, digital tools, laminator, scissors, glue, poster display materials,

Learning environment set up

- Natural environment such as school surroundings
- Artificial environment such as the laboratory or any room or place where learners can be (mobile laboratory).
- Technological environment computer room

Teachers' role(s):

- Introduce the activity
- Put learners into groups
- Provide clear instructions
- Demonstrate safety concepts
- Assist with design and content
- Encourage creativity
- Facilitate group work
- Provide feedback and guidance
- Assess poster content
- Evaluate poster design
- Provide feedback and suggestions
- Promote critical thinking by asking thought provoking questions in connection with communicating safety information. e.g. How effective is your poster?

Learners' task (s):

- Researching on laboratory safety topics
- Creating poster content.
- Selecting visual aids
- Come up with a design and layout of the poster

- Engage in critical thinking and problem-solving. e.g. analyse the importance and relevance of the safety message being created. Identifying the target audience. Solving design challenges like limited space or complexity of the information
- Engage in self-assessment and reflection. e.g. how effective is the poster? What learning has taken place during the activity? What areas would require improvement?

Assessment Guide

Content (40 points)

1. Accuracy: Does the poster accurately convey laboratory safety information? (10 points)

2. Completeness: Does the poster cover all essential laboratory safety topics? (10 points)

3. Clarity: Is the safety information clear and easy to understand? (10 points)

4. Relevance: Is the safety information relevant to the target audience? (10 points)

Design and Visuals (30 points)

1. Visual appeal: Is the poster visually appealing and engaging? (10 points)

2. Organization: Is the poster well-organized and easy to follow? (10 points)

3. Use of images: Are images used effectively to support the safety messages? (5 points)

4. Color scheme: Is the color scheme effective in conveying the safety messages? (5 points)

Communication and Presentation (20 points)

1. Clear message: Does the poster clearly communicate the laboratory safety message? (10 points)

2. Target audience: Is the poster tailored to the target audience? (5 points)

3. Presentation: Is the poster presented in a clear and concise manner? (5 points)

Collaboration and Teamwork (10 points)

1. Group work: Did the group work effectively together to create the poster? (5 points)

2. Roles and responsibilities: Were roles and responsibilities clearly defined and executed? (3 points)

3. Conflict resolution: Was conflict resolved effectively within the group? (2 points)

Assessment Rubric

Exemplary (90-100%)

- Poster demonstrates exceptional understanding of laboratory safety concepts.
- Design and visuals are engaging, clear, and effective.
- Communication and presentation are clear, concise, and tailored to the target audience.

Proficient (80-89%)

- Poster demonstrates good understanding of laboratory safety concepts.
- Design and visuals are good, but may lack some clarity or effectiveness.
- Communication and presentation are clear, but may lack some concision or tailoring to the target audience.

Developing (70-79%)

- Poster demonstrates some understanding of laboratory safety concepts, but may lack some accuracy or completeness.
- Design and visuals are fair, but may lack some clarity or effectiveness.
- Communication and presentation are fair, but may lack some clarity or concision.

Emerging (Below 70%)

- Poster demonstrates limited understanding of laboratory safety concepts.

- Design and visuals are poor, lacking clarity and effectiveness.

- Communication and presentation are poor, lacking clarity and concision.

Skills developed

- Communication
- Collaboration
- Observation
- Psychomotor
- Problem solving
- Analysing

Example posters

Chemical Safety

1. Chemical Spill: Illustrate a learner accidentally knocking over a chemical container, with a red "X" symbol over the spill to indicate danger.
2. Chemical Labeling: Show a learner properly labeling a chemical container with its name, hazard symbols, and handling instructions.
3. Personal Protective Equipment (PPE): Illustrate a learner wearing gloves, goggles, and a lab coat while handling chemicals.

Electrical Safety

1. Electrical Equipment: Depict a learner using a hot plate or other electrical equipment with a warning symbol (e.g., a lightning bolt) to indicate potential electrical shock.
2. Cord Safety: Show a learner properly storing electrical cords and avoiding tangled or damaged cords.
3. Ground Fault Circuit Interrupter (GFCI): Illustrate a GFCI outlet with a learner plugging in electrical equipment, highlighting the

importance of using GFCI-protected outlets.

Fire Safety

1. Fire Extinguisher: Depict a learner properly using a fire extinguisher to put out a small fire, with a green check mark symbol to indicate correct procedure.
2. Fire Drill: Illustrate learner evacuating the laboratory during a fire drill, highlighting the importance of knowing emergency procedures.
3. Flammable Materials: Show a student handling flammable materials (e.g., ethanol, acetone) with caution, using a fume hood or other ventilation system.

General Laboratory Safety

1. Cleanliness: Illustrate a learner cleaning up their workspace, disposing of waste properly, and storing equipment and chemicals neatly.
2. Emergency Procedures: Depict a learner familiarising themselves with the laboratory's emergency procedures, such as the location of fire extinguishers, first aid kits, and emergency exits.
3. Safety Rules: Show a learner reading and following laboratory safety rules, such as wearing PPE, not eating or drinking in the laboratory, and not horse playing.

Additional Ideas

1. Infographics: Create infographics highlighting laboratory safety statistics, tips, and best practices.
2. Comic Strips: Develop comic strips illustrating laboratory safety scenarios, such as a learner properly handling a chemical spill or responding to an electrical emergency.
3. Posters: Design posters promoting laboratory safety, featuring eye-catching visuals and clear, concise messages.

Sub-Topic .1.2: Waste management

Introduction: Waste management refers to the activities and actions needed to manage waste from its origin to its final disposal. Practicing waste management is essential for maintaining a clean and healthy working environment in the laboratory, preventing unnecessary accidents, and minimizing the impacts of climate change.

Specific competence:

- Practise waste management principles.

Key terms

- Waste: Refers to unwanted or unusable materials
- Management: Is the process of planning, organising, leading and controlling resources to achieve specific goals and objectives
- Waste materials: Refers to materials that are no longer useful or wanted and are discarded after being used
- Hazards: Hazards are situations, conditions, or objects that have the potential to cause harm, injury, illness, or damage to people, property or the environment
- Non-hazardous: Refers to a situation, condition, or substance that does not pose a significant risk of harm, injury, illness, or death to people, animals, or the environment

Learning activities

Activity 2.1: Identifying waste materials
This activity is formulated to help learners identify waste materials. There is one learning activity in which learners will engage in as they identify waste materials.

Activity 2.1.1: Identifying, sorting and labelling different types of waste.

In this activity, learners will identify, sort and label waste materials into their correct categories (e.g., hazardous, non-hazardous, recyclable).

HOOK: What steps would you take in identifying waste materials to ensure a

friendly learning environment?

Suggested Teaching and learning Materials

- **Natural Materials**: Leaf litter, wool and silk, sand, feathers, flower trimmings, food waste, fur and hair, stones, water...
- **Artificial Materials**: Chemical waste, plastic waste, electronic waste, glass waste, lab coats, gloves, face masks, glassware, chemical containers, metal waste, fabric waste, used batteries...

Learning environment set up:

- Natural Environment such as school surroundings
- Artificial Environment such as classroom and laboratory (mobile laboratory)
- Technological environment (virtual laboratory, videos)

Teacher's role(s):

- Introduce the activity
- Divide learners into small groups
- Provide the instructions
- Provide learners with various waste samples (e.g., paper, broken glassware, used batteries, chemical containers, …)
- Provide PPE such as lab coats, gloves, face masks
- Provide waste labels (e.g., hazardous, non-hazardous, recyclables)
- Ask leaners to identify, sort and label waste materials into various categories

Learners' Tasks:

- Setting up a waste sorting station
- Identifying, sorting and labelling the waste materials as hazardous, non-hazardous, recyclable...
- Presenting findings and explain why you categorized your waste sample in a particular way
- Writing the steps to follow in identifying waste materials (e.g., labelling, material composition, origin of waste, regulations …)

Assessment Guide:

- Check if learners are correctly and safely conducting the activity
- Monitor learners' participation and engagement during the activity
- Ask learners open-ended questions to prompt further discussion

- Provide feedback to address any gaps
- Ask questions such as:
  1. Which laboratory waste materials were easy to identify, why?
  2. Which laboratory waste materials were difficult to identify, why?

Skills Developed:

- Communication
- Collaboration
- Observation
- Psychomotor
- Problem solving
- Analysing

Learning activity2.2: Classifying waste materials according to physical state, properties, source and material type.

This activity is designed to help learners classify different types of waste materials into their respective categories.

Suggested Teaching and learning Materials

- **Natural Materials**: Leaf litter, wool and silk, sand, feathers, flower trimmings, food waste, fur and hair, stones...
- **Artificial Materials**: Chemicals, plastic waste, electronic waste, broken glassware, metal waste, fabric waste, used batteries...

Learning environment set up:

- Natural Environment such as school surroundings
- Artificial Environment such as classroom and laboratory (mobile laboratory)

Teacher's role(s):

Introduction

Classifying waste refers to the process of categorising waste into different types based on its origin, properties and potential risks. Waste is classified by identifying its origin, composition, and properties. Waste classification is important because it helps determine how to dispose of waste and how to manage it.

Exploration

- Divide learners into small groups
- Provide them with a set of waste materials to classify
- Ensure that learners work collaboratively to classify waste materials into their respective categories
- Provide classification guidelines and resources to help learners make informed decisions.

Explanation

Classifying waste materials allows for the safe and effective management of different waste types, minimising environmental pollution, protecting public health, and maximizing resource recovery through recycling. Chemical and physical characteristics determine the criteria for classifying waste because some materials (liquid, gaseous and powder waste) require special treatment by default to avoid the dispersal of waste.

Synthesis

Help learners to improve on their newly acquired competence regarding classifying waste materials according to physical state, properties, source and material type.

Evaluation and Reflection

Waste classification is a critical component of effective waste management. It involves categorizing waste into different types based on its characteristics, composition, and potential risks. Practicing proper waste classification ensures the safe and efficient management of waste, reducing environmental pollution and health risks.

Learners' Tasks:

- Working in groups to classify the provided samples of laboratory waste into designated categories
- Creating a simulation activity to practice waste classification. e.g., roleplaying myths and misconceptions
- Creating a poster that discusses classification of waste materials

- Writing down the steps to follow in identifying waste materials (e.g., labelling, material composition, origin of waste, regulations …)
- Labeling waste bins for designated waste materials

Assessment Guide:

- Check if learners are correctly and safely conducting the activity
- Evaluate learners' ability to work in groups to classify waste materials
- Evaluate the accuracy of waste classification by assessing their completed posters or presentations.
- Ask learners open-ended questions to prompt further discussion
- Ask questions such as:
  1. Why is it important to classify waste materials?
  2. Which laboratory waste materials were difficult to classify, why?
  3. How did you and your group come to a consensus on the classification of a particular waste material?
- Provide feedback on their responses during discussions and presentations

Skills Developed:

- Communication
- Collaboration
- Observation
- Psychomotor
- Problem solving
- Analysing

Sub-Topic 1.3: Apparatus in Physics

Introduction: Physics is an experimental science that relies on the use of various apparatus to measure, observe and analyze physical quantities. In this topic we will explore the different types of apparatus used in physics, develop skills required to use them effectively and the importance of improvising apparatus.

Specific Competence

- Use apparatus in Physics

Key terms:

- Apparatus: Equipment, instrument or device used to conduct experiments in various fields such as engineering
- Measure: To determine the size, extent or degree of a substance using a standard instrument
- Observe: To watch carefully and gather information using senses
- Analyse: To interpret the relationship and meaning of the data collected after measuring
- Effectively: Achieving a desired outcome in a successful manner
- Scavenger hunt: A fun and interactive activity where participants are given a list of items, clue or challenge to complete within a given time
- Experimental: Scientific investigation that involves manipulating one or more variables to test the hypothesis.
- Physical quantities: Properties of physical objects that can be measured, quantified and expressed using numerical values and units.
- Effectively: Ability to produce desired results
- Improvising: Creative and resourceful use of available materials to design apparatus in physics.
- Creative: Ability to generate new and original ideas.
- Resourceful: Ability to find and utilize available resources.
- Equipment: Tools, devices and apparatus used to perform a specific function.

Learning activities:

Learning activity 3.1: Identifying apparatus in Physics.

This activity in physics will help the learners to identify the apparatus used in physics. Learners will be engaged in three learning activities for them to develop the skills on identification of apparatus used in physics, how to use the physics apparatus correctly and the importance of improving apparatus.

Activity 3.1.1: Exploring the apparatus used in physics.

In this activity learners will do scavenger hunt to identify the apparatus used in physics

HOOK: Mention any apparatus which are found in a physics laboratory?

Suggested Teaching and Learning Materials:

- **Artificial Materials:** Rulers, balances, thermometers, ammeters, voltmeters, prisms, lenses, telescopes, microscopes, speakers, microphones, compasses, bar magnets...
- **Natural Materials**: Water, wood, air, stones, sand...

Learning Environment set up:

- Artificial Environment: Physics laboratory or any other room that is conducive for learning physics
- Natural Environment: School surrounding or any other place in the environment.

Teacher's role

INTRODUCTION

Physics is the study of the natural world around us and it involves using tools and equipment to measure, observe and experiment. In this lesson we will explore, identify the different types of apparatus used in physics and their functions.

EXPLORATION:

Put leaners in small groups and guide them on how to do scavenger hunt to identify the apparatus in physics. The learners will communicate back to their peers the names and functions of the identified apparatus.

EXPLAINATION:

Name of some common apparatus and their functions

S/N	NAME	FUNCTION
1	Ruler	Measures length, width and height
2	Pulley	Changes direction of force
3	Telescope	Observes distant objects
4	Ammeter	Measures electrical current
5	Stop watch	Measures time

6	Switch	Controls electrical circuits
7	Prism	Separates white light into colours

Checks the learners' books to clear the myths and misconceptions.

SYNTHESIS:
Recognize and classify the apparatus identified into different categories depending on how they are used. The categories of apparatus are;
1. Measuring devices - stopwatch, ammeter, voltmeter ruler...
2. Electrical components - wire, capacitor, switch, resistor...
3. Mechanical equipment - pulley, lever, gear, spring...
4. Optical instruments - lens, prism, telescope...
5. Thermodynamic apparatus - thermal conductor, thermocouple, insulator...
6. Wave and sound apparatus - oscilloscope, signal generator, sound lever meter...
7. Radiation Detection apparatus – Geiger counter, radiation spectrometer, scintilator...

EVALUTION AND REFLECTION:
Discuss on the key points:

KEY LEARNING POINTS:

- Scientific name of physics apparatus identified
- The functions of the physics apparatus identified
- Recognise and classify the physics apparatus identified in different categories

Learner' task:

ENGAGEMENT:
Paying attention to the instructions about the scavenger hunt on identifying the apparatus used in physics in small groups.

EXPLORATION:

Playing the scavenger hunt in groups as they identify the apparatus used in physics and their functions.
Presenting their exploration to identify the apparatus used in physics according to their understanding and clear the misconception if any.

EXPLANATION:

Writing in their books the table showing the scientific names of the identified apparatus.

SYNTHESIS:
Recognizing and classifying the apparatus identified into different categories depending on how they are used.

EVALUATION AND REFLECTION:

Discussing the key points

KEY LEARNING POINTS:

- Scientific names of physics apparatus identified
- The functions of the physics apparatus identified
- Recognize and classify the physics apparatus identified into different categories.
- Wring the answers to the questions given

Assessment Guide:

- Check their books as they identify the apparatus and their use by filing in a table
- Provide guidance and clear misconception if any
- Review learners' discussion as they report back to other groups
- Ask learners open-ended questions to prompt further discussion

SAMPLE QUESTIONS:

1. Give reasons why identification of physics apparatus is important.

2. The HOD of expressive arts was in a hurry to mark a running track for inter zone competitions. Which physics instruments can he use to mark the ground in a quickest possible time? Give reasons for your answer.

EXPECTED ANSWERS:

1. -For conducting experiment
   - For data collection
   -For analyzing results
   - For effective communication
2. – 100m tape measure
   - A protractor for measuring angles

Skills Developed:

- Communication
- Collaboration
- Observation
- Psychomotor
- Problem solving
- Analyzing

Learning activity 3.2: Using apparatus in physics

Introduction: Physics is an experimental science that relies heavily on the use of various apparatus to measure, observe and analyze physical quantities. In this lesson learners will develop skills required to use different apparatus in physics effectively. Learners will explore and develop skills required to use apparatus effectively in the laboratory and in everyday life.

Specific Competence:

- Use apparatus in physics

Learning activities:

Learning activity 3.2.1: Using apparatus in Physics.

In this activity learners will use the apparatus that are available in the physics laboratory to collect data using the worksheets. This activity will help the learner develop psychomotor skills and use the physics apparatus effectively in everyday life.

HOOK: Why are the desks of the same size and shape?

Suggested Teaching and Learning Materials:

- **Artificial Materials:** Common physics laboratory apparatus, table, chairs, source of heat, phone, computer, projector
- **Natural Materials**: Water

Learning Environment set up:

- Artificial Environment: Physics laboratory or any other room that is conducive for learning physics and computer laboratory
- Natural Environment: School surrounding

Teacher's role

INTRODUCTION:

Physics is the study of the natural world around us and it involves using tools and equipment to measure, observe and experiment. In this lesson, learners will develop skills on how to use the apparatus both in the physics laboratory and in everyday life. A short video showing the correct use of physics apparatus will be played.

EXPLORATION:
Put learners in small groups and guide them on how to use a worksheet to collect date using the identified apparatus used in physics.
Go round to check the learners' involvement in the activity and clear the misconceptions. Prepare a worksheet in order to measure the volume of water and increase in temperature with time.

EXPLANATION:

A worksheet to be used to deepen the understanding of using apparatus in physics. Ask learners to report their findings.

SYNTHESIS:

Provide learners with any other physics apparatus to collect data with such as ammeter, voltmeter, cells...

EVALUATION AND REFLECTION:
Discuss the key points

KEY LEARNING POINTS:

- Correct use of apparatus in physics and develop scientific skills that can be used in everyday life
- Correct method of using the apparatus

Learner' task:

ENGAGEMENT:
Paying attention to the short video on the correct use of physics apparatus.

EXPLORATION:

Performing experiments using a worksheet. Collecting data with correct use of physics apparatus.
Developing the skills of using apparatus in physics.

EXPLANATION:

-Reporting back to the peers the data collected.
-Correct use of a measuring cylinder on a flat surface in order to have a correct meniscus.
-The eye must be at 90^{o} to the measuring cylinder at the meniscus.
-The correct units for volume
- Read the temperature of the thermometer while it's still in the water to get the correct readings.
-The correct units for time.

-Writing in their books the correct use of cylinder and how to read the volume of water with correct units.

SYNTHESIS:
Collecting data with any other physics apparatus such as ammeter, voltmeter, cells, and different types of rulers

EVALUATION AND REFLECTION:

Discussing the key points

KEY LEARNING POINTS:

- Correct use of apparatus in physics ensures accuracy and reliable results, it also maintains safety, develop scientific skills that can be used in everyday life.
- Correct method of using the apparatus with units.
- With the measuring cylinder always use a flat surface.
- The reading of the temperature must always be taken with the thermometer still in water.
  -Wring the answers to the question given questions.

Assessment Guide:

- Observe the correct use of the apparatus
- Review learners' findings
- Assess on the actual outdoor activities how the instruments in physics are being used
- Ask learners open-ended questions to prompt further discussion

  SAMPLE QUESTIONS

  1. What are the potential consequences of using physics apparatus incorrectly or improperly?

  POSSIBLE ANSWERS:

  1. - Physical harm due to electrical shocks or broken glass
     - Explosions or fire
     - Damage to apparatus
     - Environmental contamination

Skills Developed:

- Communication
- Collaboration
- Observation
- Psychomotor
- Problem solving
- Analysing

Learning Activity 3.3: Improvising apparatus in Physics

Introduction: Physics is an experimental science that relies on the use of various apparatus to measure, observe and analyse physical quantities. Improvising apparatus in physics refers to the creative and resourceful use of available materials and equipment to design and build apparatus for conducting physics experiments. This activity will help the learners develop problem solving skills, enhance learning experiences and prepare them for real world challenges.

Specific Competence

- Use apparatus in Physics.

Learning Activities:

Learning activity 3:3 Improvising apparatus in Physics.

This activity will help the learner to develop the skill of using the available materials from the environment to design and build apparatus in physics. Learners will also appreciate to work with minimal resources and importance of improving apparatus in physics.

Activity 3.3.1 Exploring the environment to collect the resources to be used for improvising of the physics apparatus

In this activity learners will explore the environment to collect for resources for improvising the apparatus.

HOOK: Imagine you are a teacher of physics and has been given to teach physics in a laboratory without a single apparatus. What would you do?

Suggested Teaching and Learning Materials:

- **Artificial Materials:** Used empty bottles, strings...
- **Natural Materials**: Clay, wood, water...

Learning environment set up:

- Artificial Environment: Physics laboratory or any other room that is conducive for learning physics
- Natural Environment: School surrounding or any other place in the environment where resources can be found.

Teacher's role

INTRODUCTION:

Physics apparatus plays a crucial role in facilitating experiments, demonstrations and investigations in the field of physics. Improvising apparatus in physics involves identifying areas of limitation or efficiency and implementing modification or upgrades.

EXPLORATION:

- Use PhET, open-source Physics or MATLAB to show improvised apparatus in physics

- Remind the learners on safety protocols and guidelines during the walk into the nearby surrounding to collect the local materials to be used for improvising apparatus in physics
- Ask learners to come up with physics improvised apparatus

EXPLANATION:

- Work with the learners from the start for them to come up with a functional improvised apparatus
Learners to:
- Identify limitations
- Research on new technologies
- Design details of the improvised apparatus considering safety
- Select materials that can be modified to meet the experimental need
- Consult from colleagues and experts.

SYNTHESIS:

- Learners to conduct experiments and gather data to test the improvised apparatus, refining the design as needed
- Learners to implement the improvised apparatus in experimental procedures and share with the scientific community

EVALUATION AND REFLECTION:
Discuss the key points

KEY LEARNING POINTS:

- Five steps to improvise apparatus in physics.
  1.Define the problem
  2.Research ideas and information from various sources.
  3.Select material.
  4.Design and build and
  5.Test and refine.
- Benefits of improvising are cost effective, encourages innovation, flexibility, enhanced understanding of scientific principles.

Learner' task:

ENGAGEMENT:
Paying attention to simulations from a software showing improvising apparatus on physics.

EXPLORATION:

Using PhET, open- source Physics or MATLAB to view improvising apparatus in physics. While following safety protocols and guidelines during a walk into a nearby surrounding to collect the local materials to be used for improvising apparatus in physics. A project to come up with an improvised physics apparatus.

EXPLANATION:

- Working with peers from the start for them to come up with a functional improvised apparatus.
- Identifying limitations
- Researching on new technologies
- Designing details of the improvised apparatus considering safety.
- Selecting materials that can be modified to meet the experimental need.
- Consulting from colleagues and experts.

SYNTHESIS:

- Conducting experiments and gathering data to test the improvised apparatus, refining the design as needed.
- Implementing the improvised apparatus in experimental procedures and sharing with the scientific community.

EVALUATION AND REFLECTION:

Discussing the key points

KEY LEARNING POINTS:

- Five steps to improvising apparatus in physics.
  1. Defining the problem or limitation
  2. Researching on ideas and information from various sources.
  3. Selecting local material.
  4. Design and build
  5. Testing and refining.
- Benefits of improvising are
  - Cost effective
  - Encourages innovation
  - Flexibility
  - Enhanced understanding of scientific principles.

Assessment Guide:

- Monitoring learners progress by observing their ability to improvise apparatus and assess their understanding of physics concepts.
- Assess the learners' finished and functional improvised apparatus.
- Ask learners open-ended questions depending on the improvised apparatus to prompt further discussion and promote critical thinking.

Skills to be developed:

- Communication
- Collaboration
- Observation
- Psychomotor
- Problem solving
- Analysing

Sub-Topic 1.4: Fundamental Concepts of Physics

Introduction: This topic covers some concepts of physics categorised into five (5) sections, Mechanics, Properties of Matter, Heat and Temperature, Light and Sound, and Basic Electrical Concepts. This introduces learners to basic concepts of physics such as space and time, motion, forces, energy, density, states of matter, heat, temperature, light, sound, electricity and circuits. These basic concepts provide a solid foundation for further study in physics and help learners develop problem solving skills and critical thinking in everyday life.

Specific Competence(s):

- Demonstrate curiosity and inquiry when exploring fundamental concepts of physics

Key Terms:

- Distance: space between two fixed points
- Displacement: distance covered in a specified direction
- Speed: rate of change of distance.
- Velocity: speed in a specified direction or rate of change of displacement.
- Acceleration: rate of change of velocity.

- Scalar quantities: quantities with magnitude only.
- Vector quantities: quantities with both magnitude and direction
- Projectile motion: motion under influence of gravity only.
- Newton's Laws of Motion: Laws of motion as postulated by Sir Isaac Newton
- Normal force: force acting at right angle to the surface
- Static friction: friction experienced by a stationary object
- kinetic friction: friction experienced by an object in motion
- Gravitational Force: weight
- Centripetal Force: force towards centre of rotation experienced by an object
- Kinetic Energy: energy an object possesses due to motion.
- Potential Energy: energy an object possesses due to position or orientation.
- Power: rate at which energy is used.
- Momentum: product of mass and velocity

Sub-Topic 4.1: - Fundamental Concepts of Physics

Introduction: Physics is a branch of Science that deals with matter in relation to energy and fundamental laws that govern the behavior of the physical universe.

Learning Activities:

Activity 4. 1: **Introduction to Physics**
Introduction: This activity is designed to help learners explore the importance of Physics. There are three sub activities which learners will engage in as they explore.

Activity 4.1.1: Exploring the importance of Physics in everyday life.
In this activity, the teacher will introduce learners to the concepts of physics and its importance in everyday life. The learners will discuss fundamental concepts of Physics such as motion, forces, energy, momentum, work, and efficiency.

HOOK: What are the fundamental concepts of physics and their importance to our everyday life?

Suggested Teaching and learning Materials

- **Natural Materials**: spherical fruits, learners and trees.
- **Artificial Materials**: Wooden trolleys, motor car, springs, and optical pins

Learning environment set up:

- Natural Environment such as school surroundings
- Artificial Environment such as classroom and laboratory

Teacher's role(s):

Introduction

Physics is a branch of science that deals with matter in relation to energy and fundamental laws that govern the behavior of the physical universe. At this level we restrict ourselves to Mechanics, thermodynamics, electromagnetism and wave optics and acoustics.

Exploration

Divide learners in small groups and give them a scenario to figure out the physics concepts at play, e.g., for a car running from point A to B, what are the fundamental concepts of physics at play? Provide a running car to conceptualize the fundamentals of physics to deepen learners' understanding of knowledge/subject matter. Facilitate a discussion of the fundamental concepts on how they are connected e.g., how motion links to energy. Consolidate what the fundamental concepts of physics are in summary form to improve learners' understanding.

Explanation

- Provide a running car to conceptualise the fundamentals of physics to deepen learners' understanding of knowledge/ subject matter.
- Discuss the fundamental concepts on how they are connected e.g., how motion links to energy.
- Consolidate the fundamental concepts of physics in summary form to improve learners' understanding.

summary

1. **Motion;** qualitative description of an object's position, velocity, and acceleration.
2. **Forces:** pushes or pulls that cause change in motion
3. **Energy**: ability to do work, including kinetic energy, potential energy, and thermal energy.
4. **Momentum:** product of object's mass and velocity.
5. **Newton's laws;** qualitative description of laws of motion as postulated by Sir Isaac Newton
6. **Temperature;** measure of objects thermal energy (degree of coldness or hotness)
7. **Heat;** transfer of thermal energy between objects.
8. **Thermodynamic system**; qualitatively passively describe thermodynamics as a study of energy interactions between systems and their surroundings.
9. **Electromagnetism;** qualitatively and passively explain the terms, electric charge, electric field, electric potential, magnetism, and electromagnetic waves.
10. **Wave motion**; disturbance in a medium. Explain to the learners passively the types of waves e.g., light waves, sound waves in terms of reflection and refraction.

Synthesis

Assist learners to connect between motion, forces, and energy to further their understanding of fundamental concepts of physics.

Evaluation and reflection

Discuss the following as;

Motion is how objects move, including speed, velocity and acceleration.

Force is a push or pull on an object

Their different **forms of energy**, for example kinetic energy and potential energy.

Heat transfer is transfer of heat energy through conduction, convection, and radiation.

Electric Circuit is a complete path followed by a charge.

Light and Sound are different types of waves, light is electromagnetic wave whereas sound is a mechanical wave.

Learners' Tasks:

Engagement:

Learners divide into small groups and study the scenario discussing basic physics concepts as picked from the scenario.

Exploration:

Learners discuss the physics concepts that affect our daily life.

Explanation

Learners state the motion, sound and thermal changes observed from operating a motor car.

Synthesis

Making a product that employs fundamental physics concepts.

Evaluation and Reflection

The fundamental concepts of physics are mechanics, thermodynamics, electromagnetism, wave optics and acoustics.

Assessment Guide:

- Check if learners are correctly conducting the discussion and understand the concepts of physics.
- Ask questions such as:
    1. What are physics concepts?
    2. Explain the importance of each fundamental physics concept learners identify.

Skills to be developed:

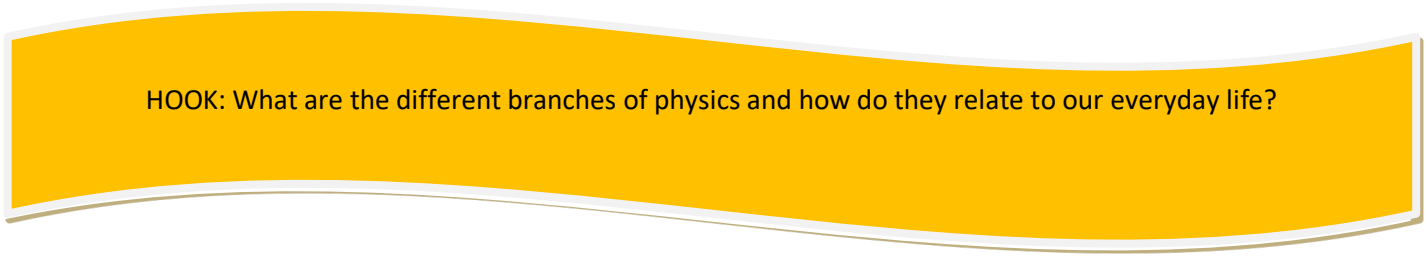
- Communication
- Collaboration
- Observation
- Psychomotor
- Problem solving
- Analysing

Activity 4.2: Classifying branches of Physics

Introduction: This activity is designed to help learners familiarise themselves with different branches of Physics, be able to show the classification of branches of Physics as well as conduct Physics research activities.

Activity 4. 2.1: Branches of Physics

In this activity, learners will discuss the branches of Physics.



Suggested Teaching and learning Materials

- **Natural Materials**: Rocks and stone, water, wooden blocks, and magnets (lodestone)
- **Artificial Materials**: Spring balances, pulleys, levers, mirrors, prisms, lenses, electric circuits and components, thermometers and heat source

Learning environment set up:

- Natural Environment such as school surroundings
- Artificial Environment such as classroom and laboratory, online simulations, you tube etc.

Teacher's role(s):
Introduction

There are many branches of physics some of which are mechanics, thermodynamics, electromagnetism, waves optics and acoustics etc. Under mechanics, space and time, motion, forces, energy and momentum and newton's laws as topics are studied. Thermodynamics looks at temperature and heat, whereas electromagnetism looks at static electricity, electric potential and circuits, as well as magnetism and electromagnetic induction. Besides, wave optics and acoustics deals with wave motion, optics and acoustics.

Exploration

Divide learners in small groups to discuss various branches of Physics in order to clear some misconceptions.

Explanation

Give a sound but brief description/explanation of the branches of Physics and how they relate to our everyday life**.**

Synthesis

Allowing learners classify some Physics concepts according to the branches.

Evaluation and Reflection

The fundamental concepts underlying the branches of Physics are space and time, motion, forces, energy and momentum, Newton's laws, temperature and heat, static electricity, electric potential and circuits, magnetism and electromagnetic induction, wave motion, optics and sound.

Learners' Tasks:

Engagement:

Learners divide into small groups and discuss branches of Physics.

Exploration:

Learners discuss the branches of Physics and how they affect our everyday life.

Explanation

Learners present their understanding of what lies in the branches of Physics.

Synthesis

Designing a system that employs concepts of branches of Physics.

Evaluation and Reflection

The branches of physics are mechanics, thermodynamics, electromagnetism, wave optics and acoustics.

Assessment Guide:

- Allow learners to do a presentation from the discussion of branches of Physics to correct the misconceptions that might arise.
- Review learners' actions
- Ask open ended questions to prompt further discussions
- Ask questions such as:

1. What are physics concepts?
2. How do branches of physics differ from each other?

Skills to be developed:

- Communication
- Collaboration
- Observation
- Psychomotor
- Problem solving
- Analyzing

Activity 4.3: Scientific Methods in Physics

This activity is designed to introduce the scientific methods used in physics, such as observation, experimentation, data analysis, interpretation, scientific reporting, questioning, hypothesis and presentation. The learners will do an experiment to demonstrate scientific methods.

Activity4.3.1: Scientific Methods in Physics

In this activity, learners will design an experiment that requires them to apply the scientific methods in Physics.

HOOK: What are scientific methods?

Suggested Teaching and learning Materials

- **Natural Materials**: Rocks and stones, water, wooden blocks, trees, sand, and magnets(lodestone)
- **Artificial Materials**: Spring balances, pulley, levers, mirrors, prisms, lenses, electric circuits and components, thermometers and heat source

Learning environment set up:

- Natural Environment such as school surroundings
- Artificial Environment such as classroom and laboratory, online simulations, you tube...

Teacher's role(s):
Introduction: There are many various forms of scientific methods though the most important in the study of Physics are as follows:

1. **Observation**; physicist make observations about the natural world. They use their senses, instruments, and experiments to collect data.
2. **Question;** based on observations, Physicists ask questions that are specific, testable, and relevant to what they observe.
3. **Hypothesis**; this is an educated guess that attempts to explain the observation. Hypotheses should be specific, testable, and falsifiable. Hypotheses can be based on existing knowledge, theories, or models.
4. **Prediction**; based on the hypotheses physicists make predictions about what they expect to happen. These predictions must be specific, measurable and testable.
5. **Experimentation:** physicists design and conduct experiments to test their hypotheses and predictions. Experiments must be controlled, repeatable, and precise. Data is collected from the experiment.
6. **Data Analysis**: physicists analyse the data collected during the experiment. Data analysis involves identifying patterns, trends, and correlation. Data analysis is using statistical methods and mathematical modeling.

7. **Conclusion:** based on the data analysis, physicists draw conclusions about their hypotheses and predictions. The conclusion is based on evidence and data and it can lead to new questions, hypotheses and experiments.
8. **Communication**: physicists communicate their findings through reports, papers, and presentations. Communication should be clear, concise, and accurate. It leads to peer review, criticism, and reinforcement of ideas.

Exploration

Divide learners into small groups to discuss various scientific methods in Physics.

Explanation

Give a sound but brief description/explanation of the individual scientific methods in physics and how they relate to our everyday life**.**

Synthesis

Allowing learners to conduct an experiment and apply scientific methods.

Evaluation and Reflection

Physics scientific method is a systematic process used to develop and test scientific knowledge through observations, formulating hypotheses, and testing these hypotheses through experimentation and data analysis.

Learners' Tasks:

- Using their senses, instruments, and experiments to collect data.
- Identifying the scientific methods used in our everyday life.
- Designing an experiment that employs scientific methods in Physics.

Assessment Guide:

- Check if learners are correctly applying the scientific methods to understand the concepts of Physics.
- Check if learners write the scientific report correctly.
- Check how learners do the analysis of their experimental results.

Review learners' actions

- Ask open ended questions to prompt further discussions
- Ask questions such as:
  1. What are scientific methods in Physics?

2. Do scientific methods differ for each and every branch of Physics?

Skills Developed:

- Communication
- Collaboration
- Observation
- Psychomotor
- Problem solving
- Synthesising
- Analysing

Sub-Topic 1.5: Applications of Physics in Everyday Life

- **Introduction:** Physics plays a vital role in our lives influencing the world around us. In this lesson learners will explore the applications of physics in everyday life and gain a deeper appreciation for the importance of Physics in shaping our world. Learners will be engaged in two learning activities: identifying applications of Physics in everyday life and demonstrating the applications of Physics in everyday life.

Specific Competence

- Apply concepts of Physics to real-world contexts

Key terms:

- Career - A journey that one takes to achieve their professional goals and aspiration.
- Research – A Structured process of investigation and inquiry aimed at discovering, interpreting and revising knowledge on a particular topic or problem.
- Design – A creation of a concept of an idea that aim to solve a problem.
- Device – A machine or apparatus that perform a specific function often involving conversion of energy.
- Sustainability – Ability to maintain a system without depleting the natural resources.
- Public health –A science of and practice of preventing diseases in the society.
- Climate change – Long term warming of the planet due to increase in temperatures.

Learning activities:

- **Learning activity 5.1: Identifying applications of Physics in everyday life.**

These activities in physics will help the learner explore the real – world applications of Physics. Learners will appreciate the relevance of Physics in their everyday lives.

Activity 5.1.1 Exploring the applications of Physics in everyday life.
In this activity learners will research on Physics-based careers and present their findings. For example, in engineering, medical Physics, transportation, communication, construction, energy production and consumption, agriculture. Learners will develop collaboration and communication skills as well as preparation for future careers.

HOOK: Suppose there were no means of any form of transport in the world, what could have happened to mankind?

Suggested Teaching and Learning Materials:

- **Artificial Materials:** Wires, plastics, Cardboards, wire nails...
- **Natural Materials**: Water, soil, wind, wood, sun...

Learning Environment set up:

- Artificial Environment: Physics laboratory or any other room that is conducive for learning physics, Construction site, Power plant, mining site, hospitals...
- Natural Environment: The school surrounding.

Teacher's roles

INTRODUCTION:

Physics plays a vital role in many aspects of our daily lives. Understanding its application can enrich our appreciation for the natural world. This is the reason as to why a smart phone can recognize the voice and respond to your command. Plays a talking Tom application to attract the attention of learners.

EXPLORATION:

- Prepares a research guide for the learners to explore real world application of Physics in Physics based career like: engineering, medical physics, communication, transport...
- Visits any site where they can explore the application of Physics in everyday life such as a farm, construction site, mining site, hospitals...
- Design a device, in small groups that uses the application of Physics.

EXPLANATION:

- Physics is used to create strong magnetic fields which are used for MRI scanning, in aerodynamics Physics is used to study the behavior of air and its interaction with vehicles, cars and airplanes to design more efficient and stable vehicles.
- Physics is used in the construction of farm machinery, GPS to provide accurate location and mapping, Sensors and monitoring used to monitor moisture and temperature.
- Application of Physics at a construction site is seen with mechanics of materials which discusses properties of building material and the instruments being used.
- In power plants Physics is used in the conversion of energy to produce electrical energy.
- A device that that uses a range of Physics principles which is functional and can be applied in everyday life.

SYNTHESIS:

More other application of Physics can be discussed under synthesis more especially cross cutting issues on:

- Nuclear Physics is used to understand the behavior of atomic nuclei to generate nuclear energy
- Physics is used to understand the behavior of light and its interaction with materials for solar energy.

EVALUATION AND REFLECTION:

Discuss the key points

KEY LEARNING POINTS:

- Application of Physics inspires and educates future generations promoting stem education.
- Application of Physics plays a vital role in emerging technologies such as quantum computing and renewable energy systems.
- Application of Physics in everyday life improves quality of life, economic growth, and environmental sustainability.

Learner' task:

ENGAGEMENT:

Paying attention as they play with any software gadgets where they will identify the application of Physics in everyday life like a smart phone can recognize the voice and respond to its command.

EXPLORATION:

- Preparing a research paper to explore real world application of Physics in physics based career like engineering, medical Physics, communication....
- Visiting any site where they can explore the application of Physics in everyday life such as a farm, construction site, mining site ,hospitals...
- Designing a device, in small groups that uses the application of Physics.

EXPLANATION:

- On their research papers learners to discuss the application of Physics in physics related careers like medical field which uses strong magnetic fields in MRI scanning, in aerodynamics Physics is used to study the behavior of air and its interaction with vehicles, cars and airplanes to design more efficient and stable vehicles.
- From the visit at the farm is Physics used in the construction of farm machinery, GPS to provide accurate location and mapping, Sensors and monitoring used to monitor moisture and temperature.
- Application of Physics at a construction site is seen with mechanics of materials which discusses properties of building material and the instruments being used.
- In power plants Physics is used in the conversion of energy to produce electrical energy.
- A device that that uses a range of Physics principles which is functional and can be applied in everyday life.

SYNTHESIS:

- Following the cross cutting issues learner can discuss on how to mitigate climate change challenge such as dependency on hydroelectric power station by analyzing Nuclear physics is uses the behavior of atomic nuclei to generate nuclear energy. Physics also uses behavior of light and its interaction with materials for solar energy.

EVALUATION AND REFLECTION:

Discussing the key points

KEY LEARNING POINTS:

- Application of physics inspires and educates future generations promoting stem education and careers
- Application of physics plays a vital role in emerging technologies such as quantum computing and renewable energy systems.
- Application of physics in everyday life improves quality of life, economic growth, and environmental sustainability.

Assessment Guide:

- Assess the learners on their research work on application of Physics in everyday life.
- Observe their curiosity on application of Physics in everyday life during the visit.
- Assesses the originality and functionality of the designed device if it applies the concept of physics in everyday life.
- Ask open ended questions during research, trip and the process of designing a devise that applies physics in everyday life

Skills to be developed:

- Communication
- Collaboration
- Observation
- Psychomotor
- Problem solving
- Analyzing

Learning activity 2: Demonstrating the application of Physics in everyday life.

Introduction: Physics is a practical science that is not complex and not abstract but it plays a vital role in our lives. This learning activity will help the learners explore skills on how to demonstrate the application of Physics in everyday life, develop problem – solving skills and foster curiosity and interest.

Specific Competence

- Apply concepts of Physics to real-world context

Learning Activities:

Learning activity 1: Demonstrating the application of Physics in everyday life.

This activity in physics will help the learners to demonstrating the application of Physics in everyday life. Learners are more likely to remember concepts when they are demonstrated. Demonstrating the application of Physics in everyday life will raise curiosity, interest and develop critical thinking.

Activity 1.1 Demonstrating the application of Physics in everyday life

In this activity learners will demonstrate the application of Physics in everyday life such as charging the phone, measuring mass, riding a bicycle, using the solar panels, car features to protect the passengers...

HOOK: How does the bicycle operations demonstrate the application of Physics in everyday life?

Suggested Teaching and Learning Materials:

- **Artificial Materials:** Bicycle, car ,phone, solar panel, masses, balances
- **Natural Materials**: Water,air,sunlight

Learning Environment set up:

- Artificial Environment: Physics laboratory or any other room that is conducive for learning Physics
- Natural Environment: The school surrounding.

Teacher's role

INTRODUCTION:

Physics is a practical science that is not complex and not abstract but it plays a vital role in our lives. Demonstrating the application of Physics in everyday life will enhance learner' understanding of Physics concepts and develop critical thinking. Learner will analyze charging a phone, bicycle motion and relate them to application of Physics in everyday life.

EXPLORATION:

Put learners in small groups outside the classroom to demonstrate the application of Physics in everyday life by using a bicycle in motion, charging phone, measuring mass and any other equipment available.

EXPLANATION:

- The bicycle in motion demonstrates the application of physics by using forces applied to a pedal, frictional force and the force of gravity.
- The charging phone demonstrates the application of physics by using electrical current which flows through a charger and is converted to usable form
- Measuring mass demonstrates the application of physics by using a balance or scale which compares the weight of an object to a known standard in kg or g

SYNTHESIS:

Identify cross cutting issues in our area and challenge the learners demonstrate the application of Physics to come up with solutions.

- Demonstrate application of Physics to solve the problem of climate change and reduce dependency on hydroelectric power.
  Such as Nuclear power station the uses the nuclear reactions to generate heat which is converted to electricity and solar power plants that uses solar panels to maximizes the heat from the sun and convert it to electrical energy.

EVALUATION AND REFLECTION:

Discuss the key points

KEY LEARNING POINTS:

- Nuclear power: Energy released from splitting of atomic nuclei that is converted to electricity.
- Solar power: Energy released by converting energy from sunlight into electricity.
- Demonstration of application of Physics in everyday life improves understanding of physics concepts, critical thinking and increase learners motivation for future science careers.

Learner' task:

ENGAGEMENT:

Demonstrating the application of Physics in everyday life will enhance learner' understanding of Physics concepts and develop critical thinking. Learner will analyze charging a phone, bicycle in motion, measuring mass ...and demonstrate how Physics principles are being applied.

EXPLORATION:

Demonstrating in small outside the classroom, application of Physics in everyday life by using a bicycle in motion, charging phone, measuring mass and any other equipment available.

EXPLANATION:

- Demonstrating the application of Physics by using forces applied to a pedal, frictional force and the force of gravity for the bicycle to move.
- Demonstrating the application of Physics by using electrical current which flows through a charger and is converted to usable form when a phone is charging.
- Demonstrates the application of Physics by using a balance or scale which compares the weight of an object to a known standard in kg or g when measuring mass.

SYNTHESIS:

Identifying cross cutting issues in our area and challenge the learners demonstrate the application of physics to come up with solutions.

- Demonstrating application of Physics to solve the problem of climate change and reduce dependency on hydroelectric power. Such as Nuclear power station the uses the nuclear reactions to generate heat which is converted to electricity and solar power plants that uses solar panels to maximizes the heat from the sun and convert it to electrical energy.

EVALUATION AND REFLECTION:

Discussing the key points

KEY LEARNING POINTS

- Nuclear power: Energy released from splitting of atomic nuclei that is converted to electricity.
- Solar power: Energy released by converting energy from sunlight into electricity.
- Demonstration of application of Physics in everyday life improves understanding of Physics concepts, critical thinking and increase learners motivation for future science careers.

- Writing the principles of Physics applied during the demonstrations of how a bicycle and other devices operates in their books.

Assessment Guide:

- Assess on demonstration of applying Physics in everyday life with different devises.
- Assess learners on critical thinking by using scientific terms and principles.
- Check their books on how they analyze the demonstration of application of Physics in everyday life to solve the challenges of climate change and reduce the dependency on hydro power.

Skills to be developed:

- Communication
- Collaboration
- Observation
- Psychomotor
- Problem solving
- Analysing

Topic 2: General Physics

Introduction: General Physics refers to the fundamental principles and concepts that underlie the study of Physics. It encompasses the basic laws, theories, and principles that govern the behavior of the physical universe, from the smallest subatomic particles to the vastness of the cosmos. General Physics provides a broad foundation for understanding the natural world and is essential for pursuing advanced studies in Physics, engineering, and other scientific fields. It covers four sub-topics; basic principles of scientific investigations, physical quantities, precision and accuracy, and equilibrium**.**

General Competence(s):

- Collaboration,
- Analytical Thinking,
- Communication,
- Critical Thinking
- Problem Solving
- Scientific Skills

Sub-Topic 2.1: Basic Principles of Scientific Investigations

Introduction: Scientific investigation is a systematic and structured process used to explore and understand a physical phenomenon or problem. This subtopic examines the basic principles that form the foundation of the scientific method in Physics and are essential for conducting experiments, collecting data, and drawing meaningful conclusions.

Specific Competence(s):

- Apply principles of scientific investigations

Key Terms:

Investigate: To conduct a systematic and thorough inquiry into a phenomenon or problem, often involving research, experimentation, and data collection.

Collect data: To gather and record information, often in numerical or quantitative form, to help answer a question, test a hypothesis, or understand a phenomenon.

Analysing data: Involves examining and interpreting the data collected during an experiment or investigation to extract meaningful information and draw conclusions.

Observe: To carefully watch, listen, or otherwise perceive a phenomenon or event, often to gather information, identify patterns, or note changes.

Explore: To investigate or examine a phenomenon, system, or process in order to gain a deeper understanding of its properties, behavior, or underlying principles.

Hypothesis: An educated guess or tentative explanation for a phenomenon or problem, often based on prior knowledge, research, or observation, and tested through experimentation or further investigation.

Examine: To carefully inspect, scrutinize, or analyze something, often to gather more detailed information, identify characteristics, or understand relationships.

Conclusion: Summarize findings and determine if hypothesis is supported.

Learning Activities

Activity 2.1: **Exploring the basic principles of scientific investigations.**
This activity is designed to help learners explore the basic principles of scientific investigations. There are two sub activities which learners will engage in as they explore.

Activity 2.1.1: Designing an experiment that involves basic principle of scientific investigations.
In this activity, learners will design and conduct an experiment on magnetism that involves basic principles of scientific investigations.

HOOK: How does the distance between magnets affects the magnetic force?

Suggested Teaching and learning Materials

- **Natural Materials**: Wood
- **Artificial Materials**: Magnets, plastic, glass. ruler, spring balance or force sensor

Learning environment set up

- Natural environment such as school surroundings
- Artificial environment such as classroom
- Technological environment: Video, computer simulation

Teacher's role(s)

Introduction

Magnetism is a physical phenomenon resulting from the interaction between magnetic fields, which are created by the motion of charged particles, and magnetic materials, which are capable of being magnetized. Magnetic fields also exert forces on other magnets, causing them to attract or repel each other.

Magnetic force is the force exerted by a magnetic field on a moving charge, such as an electron, or on another magnet.

Exploration

- Put learners in small groups
- Provide them with the materials
- Facilitate the learning process by guiding the learners through a process of discovery, rather than simply transmitting knowledge

Explanation

The stronger the magnetic field, the greater the magnetic force. The magnetic force will decrease as the distance between magnets increases and vice versa.

Synthesis

Help learners integrate and connect new information about magnetism to their existing knowledge, creating a deeper and more meaningful understanding.

Evaluation and Reflection

Help learners reflect on their learning, identify areas for improvement, and develop a growth mindset regarding magnetic force.

Learners' Tasks

- Formulating a hypothesis: Make an educated guess about what you expect to happen in your experiment. For example: "I predict that the magnetic force will decrease as the distance between magnets increases."
- Designing the experiment
- Conducting the experiment
- Analysing the data
- Drawing a conclusion

Assessment Guide

- Check if learners are correctly designing and conducting an experiment
- Ask questions such as:
    3. What happened to the magnetic force when the distance between the magnets;

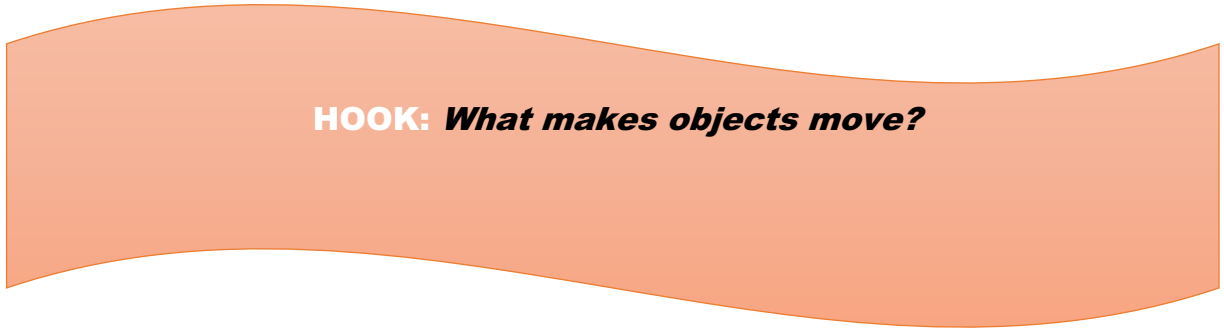
i. Increased
ii. Decreased?

4. What is the conclusion of the activity?

Skills to be developed

- Communication
- Collaboration
- Observation
- Psychomotor
- Problem solving
- Analysing

Activity 2.1.2: Writing scientific reports to disseminate scientific ideas.
A scientific report in physics is a written document that presents the results of a scientific investigation or experiment in a clear, concise, and systematic manner. In this activity, learners will write a scientific report to disseminate scientific ideas by investigating the relationship between force and acceleration.



Suggested Teaching and learning Materials

- **Natural Materials**: Wood, stones…
- **Artificial Materials**: Trolley, Spring balance, Stopwatch…

Learning environment set up

- Natural environment such as school surroundings
- Artificial environment such as classroom
- Technological environment: Force and motion simulation

Teacher's role(s)

Introduction

An essential part of learning physics is to communicate findings from a scientific investigation. Thus, preparation of a laboratory report in the form of a scientific paper is regarded as an important part of learning. A formal laboratory report is utilised either for writing up a given laboratory that you performed or for designing and conducting your own laboratory exercise.

Scientific papers are written in a standard format with the following sections;

1. Title

Each piece of scientific work should include a concise but descriptive title. While it is important to be short and concise (essentially one sentence) you do not want to be vague or incorrect.

2. Abstract

The abstract is usually the last section one writes, and acts as a short paragraph summary of the contents of the entire report. A reader should be able to glean the essentials of what the rest of the report is going to cover, from reading the abstract.

3. Introduction

The introduction should provide the background for a reader unfamiliar with the field of the experiment, to jump into it. It should describe the scientific question you are looking to probe in the experiment, and motivate why you (and the reader) should be interested in it.

4. Methodology

Students often start with this section as it is straight-forward. In writing a materials and methods section, you need to describe what you **did** in such a way that a fellow scientist can follow and duplicate your experiment.

5. Results

You should present the results of your measurements and analysis here. A clear and concise presentation of the data collected, including any tables, graphs, or charts.

6. Discussion

In this section, you should demonstrate your grasp of the experiment by discussing the statistical significance of your measurements. Comment on whether or not your observations differ significantly from your expectations.

7. Conclusion

In the conclusion, you quickly summarize for the reader your results, the precision and accuracy of these results relative to expectations, and the possibility of improving your measurements

8. References

A list of sources cited in the report, formatted according to a consistent citation style.

9. Appendices

Any additional information that supports the report, such as raw data, extra graphs, or photographs.

Exploration

- Put learners in small groups
- Provide them with the materials
- Facilitate the learning process by guiding the learners how write a scientific report to disseminate scientific ideas by investigating between force and acceleration.

Explanation

Newton's Second Law of Motion states that the acceleration of an object is directly proportional to the force applied and inversely proportional to its mass (F = ma). This law is fundamental to understanding how objects move and respond to forces.

Synthesis

Help learners integrate and connect new information about the relationship between force and acceleration to their existing knowledge, creating a deeper and more meaningful understanding.

Evaluation and Reflection

Help learners reflect on their learning, identify areas for improvement, and develop a growth mindset regarding the relationship between force and acceleration.

Learners' Tasks

- Setting up the trolley on a smooth surface
- Attaching the spring balance to the trolley
- Applying a force of 50g to the trolley and measure the acceleration using the stopwatch
- Repeating step 3 for forces of 100g and 150g
- Recording the data in a table

Force (N)	**Acceleration (m/s^2)**

Assessment Guide

- Check if learners are correctly conducting the activity and collecting the data accordingly.
- Ask questions such as:

1. What was the relationship between force and acceleration?
2. What is the conclusion of the activity?
3. Check if the learners can write a scientific report on the relationship between force and acceleration.

Skills to be developed

- Communication
- Collaboration
- Observation

- Psychomotor
- Problem solving
- Critical thinking

Sub-Topic 2.2: Physical Quantities

Introduction: Physics is concerned with measurement of physical quantities and classifying them into groups according to their nature. Physical quantities are measurable features or properties of objects. A physical quantity is one that can be measured and consists of a magnitude. Every physical quantity is expressed using more than one unit. For instance, length is measured in millimeters, centimeters, kilometers, miles... Similarly, mass is measured in milligrams, centigrams, grams, kilograms, tonnes... This subtopic categorises physical quantities into two types: basic and derived, and explores their respective units.

Specific Competence(s)

- Classify physical quantities as basic and derived

Key Terms

Measure: To find the value of a physical quantity using a scientific instrument with a standard scale.

Magnitude (Size): Is the numerical value and the unit.
SI unit: Is the standardized system of measurement units used universally in Physics and other scientific fields.
P**refixes:** Are letters or symbols added to the beginning of a unit to indicate a multiple or fraction of that unit.
Scavenger hunt: Is a fun and interactive activity where participants are given a list of items or challenges to find or complete within a specific time frame or area.

Learning Activities

Activity 2.2: Classifying physical quantities as basic and derived.
This activity is designed to help learners classify physical quantities as basic and derived. There are six sub activities which learners will engage in as they classify.

Activity 2.2.1: Identifying basic quantities and their units.
In this activity, learners will discuss in small groups, basic quantities and their units.

HOOK: ***Consider the process of building a house, what basic quantities are involved (e.g. length, mass)?***

Suggested Teaching and learning Materials

- **Natural Materials**: Rocks and stones, water, wooden rule, leaves and branches, sand and soil…
- **Artificial Materials**: Metal rods, glass beakers, spring scales, rubber bands, plastic containers…

Learning environment set up

- Natural environment such as school surroundings
- Artificial environment such as classroom and laboratory

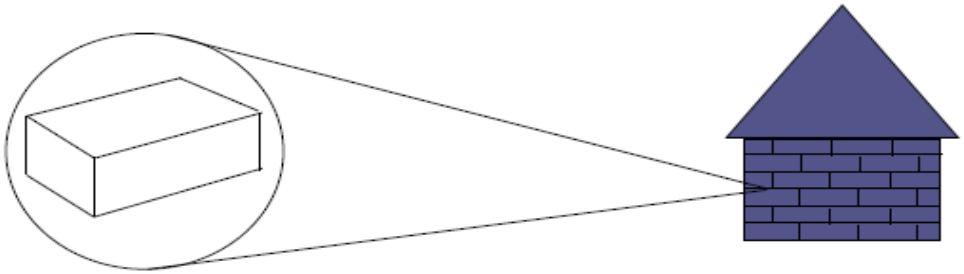
Teacher's role(s)

Introduction

Basic quantities are quantities from which all other quantities are obtained. The SI units used to express the basic quantities are called **basic units.** The figure below shows an illustration for a basic quantity.

Basic quantity
For example: is like the brick was
the basic building block of a house

Derived quantity
for example: is the house that
was built up from a collection of bricks
(basic quantity)



Exploration

- Put learners in small groups
- Provide them with a set of problem
- Ask groups to work together to solve the problems
- Facilitate the learning process by guiding the learners as they explore and discuss basic quantities and their units.

Explanation

They are seven basic quantities and their respective SI units. The table below shows the basic quantities with respective SI units.

Basic quantity	S.I unit	Symbol
1. Length	Metre	m
2. Mass	Kilogram	kg
3. Time	Second	S
4. Thermodynamic temperature	Kelvin	K
5. Electric Current	Ampere	A
6. Amount of substance	Mole	mol
7. Luminous Intensity	Candela	cd

Synthesis

Help learners integrate and connect new information about basic quantities and their unis to their existing knowledge, creating a deeper and more meaningful understanding.

Evaluation and Reflection

Help learners to reflect on their learning, identify areas for improvement, and develop a growth mindset regarding basic quantities and their units.

Learners' Tasks

- Discussing and identifying basic quantities and their units
- Presenting their findings

Assessment Guide

- Evaluate learners' participation and engagement in the discussions about physical quantities and their units
- Apply understanding of basic quantities to real world scenarios such as building a house, cooking recipe …
- Ask questions such as:
  1. What can you say aboutyour findings? What have you learned?
  2. How are you going to present your findings of basic quantities and their units in the most elaborate way?

Skills to be developed

- Communication
- Collaboration
- Observation
- Psychomotor

Activity 2.2.2: Discussing derived quantities and their units.
In this activity, learners will design a laboratory investigation that involves measuring derived quantities and their units.

HOOK: ***How fast is fast enough? How do derived quantities like speed and acceleration affect our daily lives?***

Suggested Teaching and learning Materials

- **Natural Materials**: Air or gas, wood, water, sand…
- **Artificial Materials**: Motion sensor, spring scales, force sensors, inclined planes, thermometers…

Learning environment set up

- Natural Environment such as school surroundings
- Artificial Environment such as classroom and laboratory

Teacher's role(s)

Introduction

Derived quantities are physical quantities which are formed as a result of the combination of other physical quantities. The SI units used to express the derived quantities are referred to as derived units.
A derived quantity has an equation which links to other quantities. It enables us to express a derived unit in terms of base-unit equivalent.
Example: F = ma; Newton = kg m/s^2

$P = \frac{F}{A}$; Pascal = $Kgm^{-1}s^{-2}$

Exploration

- Put learners in small groups
- Provide them with the materials
- Ask learners to design a laboratory investigation that involves measuring derived quantities
- Facilitate the learning process by guiding the learners as they design a laboratory investigation that involves measuring derived quantities and their units
- Ask learners to conduct the investigation and record their measurements and units
- Ask learners to analyze and present their findings

Explanation

The symbols for derived units are obtained by means of the mathematical signs for multiplication, division, and use of exponents.

Synthesis

Help learners integrate and connect new information when designing laboratory investigations involving derived quantities and their units.

Evaluation and Reflection

Help learners reflect on their learning, identify areas for improvement, and develop a growth mindset regarding derived quantities and their units.

Learners' Tasks

- Designing a laboratory investigation that involves measuring derived quantities
- Conducting the investigation and recording their measurements and units
- Analysing and presenting their findings

Assessment Guide

- Monitor learners' participation in laboratory investigation
- Apply understanding of derived quantities to real world scenarios such as building a house, designing a roller coaster…
- Provide learners with a case study that involves derived quantities and ask them to analyze and present their findings. Provided is the sample of the case study.

Case Study: Designing a Fish Pond

A local farmer wants to build a fish pond to raise tilapia for food. The farmer needs to design the pond to ensure it's efficient, safe, and productive.

Derived Quantities

1. Volume: The farmer needs to calculate the volume of the pond to determine how many fish it can hold.

2. Surface Area: The farmer must consider the surface area of the pond to ensure adequate oxygenation and sunlight penetration.

3. Depth: The farmer needs to determine the optimal depth for the pond to ensure healthy fish growth and easy harvesting.

4. Flow Rate: The farmer must calculate the flow rate of water into and out of the pond to maintain water quality and prevent waste buildup.

Questions to Investigate:

1. How does the shape and size of the pond affect its volume, surface area, and depth?

2. What is the optimal flow rate for the pond to maintain healthy water conditions?

3. How can the farmer ensure adequate oxygenation and sunlight penetration in the pond?

Skills to be developed

- Communication
- Collaboration
- Observation
- Psychomotor
- Problem solving

Activity 2.2.3: Applying prefixes, multiples, sub-multiples on basic and derived units.
In this activity, learners will play a prefix sorting game to apply their knowledge of prefixes, multiples, and sub-multiples to basic and derived units.

HOOK: ***Why do we need prefixes?***

Suggested Teaching and learning Materials

- **Natural Materials**: Rocks or stones, plants, wood, water, sand…
- **Artificial Materials**: Tape measure, thermometers, stopwatches, micrometers, oscilloscopes, multimeters, calipers…

Learning environment set up

- Natural environment such as school surroundings
- Artificial environment such as classroom and laboratory

Teacher's role(s)

Introduction

The units often have **prefixes**, indicating the power(s) of 10 by which a unit may be multiplied (for example, the prefix kilo in kilometer indicates that the unit kilometer is 1000 times larger than the meter). They are attached to an SI unit name or symbol to form what are properly called "multiples" and "sub-multiples" (i.e., positive or negative powers of 10) of the SI unit.

Exploration

- Put learners in small groups
- Prepare a set of cards with prefixes (e.g., kilo-, centi-, milli-) and units (e.g., meter, gram, second)
- Ask learners to sort the cards into correct combinations
- Facilitate the learning process by guiding the learners as they play a prefix sorting game to apply their knowledge of prefixes, multiples, and sub-multiples to basic and derived units.

Explanation

These prefixes are helpful when referring to very small or very large quantities. Instead of creating a new unit, a prefix is added. For example, when measuring short lengths such as 1/1000th of a meter, we simply write **milli**meter; milli denotes 1/1000 th**.** Prefixes simplify the writing of very large or very small quantities.

Synthesis

Help learners integrate and connect new information about prefix sorting games, applying their knowledge of prefixes, multiples, and sub-multiples to basic and derived units.

Evaluation and Reflection

Help learners reflect on their learning, identify areas for improvement, and develop a growth mindset about applying prefixes, multiples, and submultiples to basic and derived units through the prefix sorting game.

Learners' Tasks

- Sorting cards with prefix and units
- Sorting the cards into correct combinations

Assessment Guide

- Walk around the room to observe learners sorting cards and provide verbal feedback
- Assess learners understanding of relationships between prefixes, multiples, and sub-multiples.

- Collect the sorted cards and review them to assess learners' understanding
- Evaluate learners' ability to apply prefixes, multiples, and sub-multiples to real-world scenarios

Skills to be developed

- Communication
- Collaboration
- Observation
- Psychomotor
- Problem solving

Activity 2.2.4: Using scientific notations.
In this activity, learners will participate in a scientific notation scavenger hunt, finding and recording measurements expressed in scientific notation.

HOOK: ***How Many atoms are in a typical grain of sand? Express your answer in scientific notation?***

Suggested Teaching and learning Materials

- **Natural Materials**: Rocks or stones, leaves, water, sand, fruits or vegetables…
- **Artificial Materials**: Ruler or meter sticks, balls or marbles, pencils or pens, books, electronic devices…

Learning environment set up

- Natural environment such as school surroundings
- Artificial environment such as classroom and laboratory

Teacher's role(s)

Introduction

Scientific notation is also called standard form. Scientific notation is a method of expressing a number in the form: $a \times 10^n$, where $1 \leq a < 10$ and n is an integer. This is where numbers are expressed in the power of ten.

Exploration

- Put learners in small groups
- Give each group a copy of the scavenger hunt clues, and ask them to find and solve each clue
- Ask learners to write down the correct answer in scientific notation
- Facilitate the learning process by guiding the learners as they participate in a scientific notation scavenger hunt, finding and recording measurements expressed in scientific notation.

Explanation

Scientists frequently deal with very large numbers or small numbers as they carry out their measurements. For example, the speed of light in air is 300 000 000 m/s and the mass of the earth is about 5 972 000 000 000 000 000 000 000 kg. These figures are inconvenient to write and difficult to read. Therefore, scientific notation is used for writing down very large and very small measurements.

Synthesis

Help learners integrate and connect new information as they participate in a scientific notation scavenger hunt, finding and recording measurements expressed in scientific notation.

Evaluation and Reflection

Help learners reflect on their learning, identify areas for improvement, and develop a growth mindset regarding finding and recording measurements expressed in scientific notation.

Learners' Tasks

- Finding and solving each clue
- Writing down at each location the correct answer in scientific notation

Assessment Guide

- Ensure that the scavenger hunt does not pose any safety risks to learners
- Monitor learners' progress and encourage team work and collaboration

- Ask learners to research and present on a real-world application of scientific notation, such as:

    1. How scientists use scientific notation to express large or small numbers in their research.
    2. How engineers use scientific notation to design and build structures or systems.

Skills to be developed

- Communication
- Collaboration
- Observation
- Critical thinking
- Problem solving

Activity 2.2.5: Using significant figures in numerical problems.
In this activity, learners will analyse and solve problems using significant figures, based on a real- world case study provided.

HOOK: ***A car travels 456.7 metres in 23.45 seconds. Calculate the speed of the car and express the answer to the correct number of significant figures?***

Suggested Teaching and learning Materials

- **Natural Materials**: Wooden block, rock sample…
- **Artificial Materials**: Steel block, steel block, Calculators, pencils or pens, beam balance…

Learning environment set up

- Natural environment such as school surroundings
- Artificial environment such as classroom and laboratory

Teacher's role(s)

Introduction

Significant figures are digits or numbers which are regarded to be important in a measurement i.e., they predict the accuracy of a measurement made by a particular instrument. The following rules are considered when writing significant figures:

- All non-zero digits are significant
- All zeros trailing a non-zero digit are not significant
- All zeros between non-zero digits are significant
- All zeros leading a non-zero digit in a decimal point are not significant
- All zeros trailing a non-zero digit and a decimal point are significant

Exploration

- Put learners in small groups
- Provide learners with real-world case study such as measuring the density of a metal block
- Assign specific roles or tasks to each group member to ensure everyone contributes
- Establish a timeline and check-in points to keep the group on track
- Evaluate individual contributions and the group's overall performance

Explanation

Significant figures are the digits in a measurement that are known to be reliable and accurate. They indicate the precision of a measurement. By following these rules and using significant figures correctly, you can ensure that the measurements and calculations are accurate, precise, and reliable.

Synthesis

Help learners integrate and connect new information as they analyse and solve problems using significant figures, based on a real- world case study provided.

Evaluation and Reflection

Help learners reflect on their learning, identify areas for improvement, and develop a growth mindset regarding analysing and solving problems using significant, based on a real-world case study provided.

Learners' Tasks

- Determining the number of significant figures in each of the measurements from the case study shown below.
  Case Study: Measuring the density of a metal block

A student measures the mass of a metal block to be 456.78 grams using a balance with a precision of 0.01 grams. The student then measures the length, width, and height of the block to be 10.23cm, 5.12 cm, and 2.56 cm, respectively, using a ruler with a precision of 0.01 cm.

- Explaining why each measurement has the determined number of significant figures

Assessment Guide

- Ensure learners understand what is expected of them and what they need to accomplish
- Note areas where pupils are struggling and provide targeted support
- Pose open-ended questions that encourage pupils to think critically and explore different perspective

Skills to be developed

- Communication
- Collaboration
- Observation
- Critical thinking
- Problem solving

Activity 2.2.6: Converting basic and derived units.
In this activity, learners will research and present on real-world applications of unit conversions, such as in science, engineering, or medicine.

HOOK: A container holds 5000 mL of a liquid. What is the volume in cubic decimeters***?***

Suggested Teaching and learning Materials

- **Natural Materials**: Human tissue, soil, wood, air, water…
- **Artificial Materials**: Steel, concrete, plastics, metals, plastics…

Learning environment set up

- Natural environment such as school surroundings
- Artificial environment such as classroom and laboratory

Teacher's role(s)

Introduction

Conversion of units in Physics involves changing the units of a physical quantity from one unit to another, while keeping the quantity itself unchanged. This is often necessary when working with different systems of units such as the International System of Units (SI).

Exploration

- Put learners in small groups
- Choose a scenario from science, engineering, or medicine that requires unit conversions, such as calculating medication dosages or converting energy units
- Outline clearly what learners should learn from the activity, including specific unit conversion skills and real-world applications
- State clearly the unit conversions required to solve the problem, such as converting from milligrams to grams.
- Allow learners to work individually or in groups to complete the unit conversions and solve the problem.

Explanation

Conversion is a multi-step process that involves multiplication or division by a numerical factor, selection of the correct number of significant digits, and rounding.

Synthesis

Help learners integrate and connect new information as they research and present on real-world applications of unit conversions, such as in science, engineering, or medicine.

Evaluation and Reflection

Help learners reflect on their learning, identify areas for improvement, and develop a growth mindset regarding researching and presenting on real-world applications of unit conversions, such as in science, engineering, or medicine

Learners' Tasks

- Researching and presenting on real-world applications of unit conversions, such as in science (Temperature Control: Converting temperature from Celsius (°C) to Kelvin (K) to understand the behavior of materials at different temperatures), engineering (Electrical Engineering: Converting units of energy from kilowatt-hours (kWh) to joules (J) to calculate the energy efficiency of electrical systems), or medicine (Medication Dosage: Converting medication dosages from milligrams (mg) to grams (g) or micrograms (µg) to ensure accurate administration).
- Working individually or in groups to complete the unit conversions

Assessment Guide

- Create guiding questions to help learners navigate the scenario and focus on the learning objectives
- Collect learners' work and review it to assess their understanding of unit conversions and real-world applications
- Provide feedback to learners on their work, highlighting strengths and weaknesses, and offering suggestions for improvement
- Discuss the scenario and solutions as a class, addressing any common misconceptions or challenges

Skills to be developed

- Communication
- Collaboration
- Observation
- Critical thinking
- Problem solving

Topic 3 Precision and Accuracy

Introduction: Accuracy and Precision are critical factors in the evaluation of measuring equipment. However, both terms are often used synonymously, although they are clearly defined technically. This topic gives you an overview of the two terms and how different quantities such as length, area, mass, volume and density can be measured with accuracy and precision. Accuracy refers to how close a measurement is to its true or expected value while Precision refers to the consistency of two or more measurements namely how close these measurements are to each other. There are 9 learning activities in this topic.

General Competence(s):

- Analytical Thinking,
- Communication,
- Critical Thinking
- Problem Solving
- Real world application
- Creativity and innovation

Sub-Topic 3.1 Precision and Accuracy

Introduction: Accuracy and Precision are critical factors in the evaluation of measuring equipment. However, both terms are often used synonymously, although they are clearly defined technically. This topic gives you an overview of the two terms and how different quantities such as length, area, mass, volume and density can be measured with accuracy and precision. Accuracy refers to how close a measurement is to its true or expected value while Precision refers to the consistency of two or more measurements namely how close these measurements are to each other. There are 9 learning activities in this topic.

Specific competence:

- Demonstrate precision and accuracy in measurements.

Key terms:

- **Length**: distance between two points
- **Area**: measure of the size of a two-dimension shape or region
- **Volume**: amount of space occupied an abject
- **Mass**: amount of matter contained in a thing
- **Density**: mass per unit volume
- **Time**: measure of duration between events
- **Oscillation**: repeated back-and-forth motion of an object or system

- **Period**: time taken for a complete oscillation or revolution
- **Frequency**: number of complete oscillations made per second

Learning activities

Activity 3.1: Measuring Length.

This activity is designed to help learners acquire skills knowledge on how to measure length with accuracy and precision using a meter rule, calipers, and micrometer screw gauge.

Activity 3.1.1: The meter rule.
In this activity, learners will role play the use of the use of meter rule to measure lengths of different objects with precision and accuracy.

Suggested Teaching and learning Materials

- **Natural Materials**: school ground, sticks, tree, people…
- **Artificial Materials**: desks, chalk board, books, glass blocks, work sheets**…**

- **Learning environment set up:**
- Natural Environment such as school surroundings (mobile laboratory)
- Artificial Environment such as classroom and laboratory
- Technological learning environment such as virtual lab

Teacher's role(s):
Introduction: Length refers to the distance between two point. In this lesson, learners will use a meter rule and a measuring tape to measure different lengths of different objects which are natural or artificial.

- Introduce the activity
- Divide learners into groups
- Provide the materials
- Provide the instructions on how to conduct the activity
- Ask learners to report their findings

Learners' Tasks:

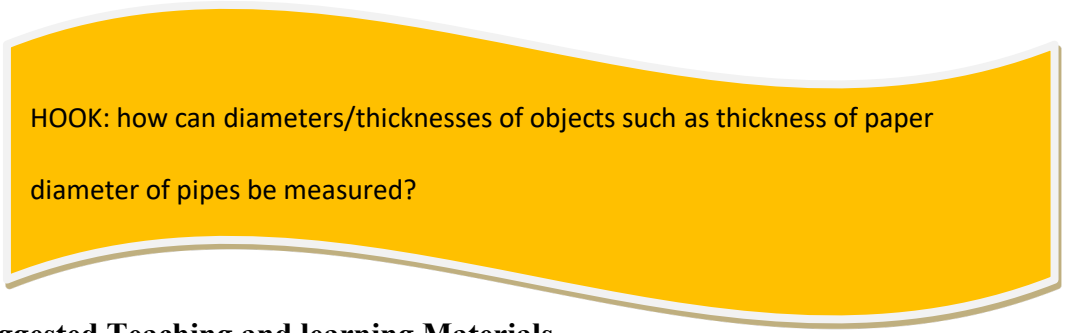
- Learners getting into groups and receiving materials
- Measuring lengths of different objects accurately within the given period of time and the group that measured correctly wins
- Reporting the findings.

Assessment Guide:

- Check if learners are correctly using the meter rule and measuring tape to measure accurately and precisely
- Ask learners questions on how they could use a broken mete ruler or measuring tape to measure lengths.

Activity 3.1.2: vernier calipers/ micrometer screw gauge

In this activity, learners will explore how a vernier calipers can be used to measure internal and external diameter including depths of hollow objects and how a micrometer screw gauge can measure the thickness of thin objects with accuracy and precision.



Suggested Teaching and learning Materials

- **Natural Materials**: small sticks, planks, metallic pipes…
- **Artificial Materials**: vernier calipers, micrometer screw gauge, plastic/metallic pipes, sticks…

- **Learning environment set up:**
- Natural Environment such as school surroundings
- Artificial Environment such as classroom and laboratory
- Technological learning environment such as virtual lab, PhET Interactive Simulations.

Teacher's role(s):

Introduction: Some objects are too small such that their length or diameters cannot be measured using a meter rule. Learners will be introduced to new measuring instruments called vernier caliper and micrometer screw gauge.

- Introduce the activity
- Divide learners into groups
- Provide the materials
- Provide the instructions on how to conduct the activity
- Ask learners to measure Internal and External Dimensions of different objects, such as a pipe or a hole…. Ensuring precision and accuracy
- Ask learners to report their findings on how accurately and precisely they determined the diameter.
- Clarify on the reports given to learners and provide content
- In a case of vernier caliper and micrometer screw gauge, explain to learners how the readings are taken when measuring length since most of them may be using them for the first time

Learners' Tasks:

- Learners getting into groups and receiving materials
- Learners working in groups to measure diameters and thickness of different objects as they consider precision and accuracy
- Reporting the findings.

Assessment Guide:

- Check if learners are correctly using the vernier calipers and micrometer screw gauge as accurately and precisely as possible.
- Ask learners questions on how they could use a broken meter or measuring tape to measure

Summary/key points

- Vernier calipers and micrometer screw gauges enable precise measurements of lengths, widths, and depths of objects
- These instruments help reduce measurement errors, ensuring more accurate results
- Vernier calipers and micrometer screw gauges are essential tools in engineering, manufacturing, and quality control
- These instruments are used in various scientific fields, such as physics, chemistry, and biology, for precise measurements
- Vernier calipers and micrometer screw gauges are used in medical fields, such as dentistry and surgery

- Studying vernier calipers and micrometer screw gauges helps develop measurement skills, including reading scales, estimating measurements, and converting units
- Using these instruments requires critical thinking and problem-solving skills to obtain accurate measurements

Skills developed

- Analytical Thinking,
- Communication,
- Critical Thinking
- Problem Solving
- Real world application

Activity 3.1.3: AREA.
In this activity, learners will do role play to determine the area of different objects accurately and precisely. They will also calculate area of different shapes.

Suggested Teaching and learning Materials

- **Natural Materials**: school ground, school environment …
- **Artificial Materials**: chalk board, books, work sheets, flower or garden beds**…**

- **Learning environment set up:**
- Natural Environment such as school surroundings (mobile laboratory)
- Artificial Environment such as classroom and laboratory
- Technological learning environment such as virtual lab

Teacher's role(s):

Introduction: Area is a measure of size of a flat surface, such as square, rectangle, triangle e.t.c. Area mostly applies to two dimensional shapes. It is measured in square meter. In this activity, learners will determine and calculate areas of different shapes.

- Introduce the activity
- Divide learners into groups
- Provide the materials
- Lead learners to find formulas on how to calculate areas of different regular shapes such as square, rectangle, triangle, trapezium….
- Help learners to obtain squares, rectangles, triangles, trapeziums… shapes and ask them to measure the lengths and widths to calculate the area.
- Help learners to find irregular shapes and let them do the game in which they divide irregular shaped objects into smaller rectangles or triangles to calculate the total area. The group that finishes first wins.
- *Real-World Applications*: Ask students to measure and calculate the area of real-world objects, such as a room, a table, or a book
- Ask learners to report their findings

Learners' Tasks:

- Learners getting into groups and receiving materials
- Learners working in groups to determine areas of different regular shaped as they consider precision and accuracy
- Cutting irregular shaped objects into shapes and calculating area (other alternatives in calculating area of irregular shaped objects may be employed here)
- Reporting the findings.

Assessment Guide:

- Check if learners are correctly measuring length, height breadth… in determination of area.
- Check if learners are cutting pieces such that they have smooth edges.
- Check if learners are accurate and precise
- Check for correct calculations of area

Summary/ key points

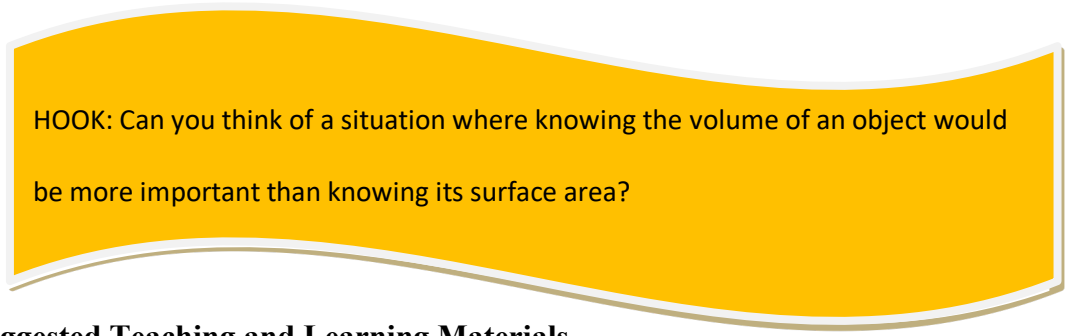
- Understanding area is crucial for designing and building structures, such as houses, bridges, and buildings
- Area calculations are essential in various engineering fields, including mechanical, electrical, and civil engineering
- Accurate area calculations are necessary for land surveying, property development, and urban planning

- Area calculations are used to model real-world phenomena, such as population growth, resource allocation, and optimization problems
- Understanding area is essential for data analysis, particularly in fields like geography, economics, and environmental science
- Accurate area calculations help optimize resource allocation, such as in agriculture, forestry, and urban planning

Skills to be developed

- Analytical Thinking,
- Communication,
- Critical Thinking
- Problem Solving

Activity 3.1.4: Volume of Regular Shaped Objects
In this activity, learners will design objects with specific volumes.



Suggested Teaching and Learning Materials

- **Natural Materials**: ice cubes, rectangular planks planks, metallic pipes, …
- **Artificial Materials**: gas jar, glass block, prism, class room block,…

NOTE: The materials suggested here should have the following shapes: cube, cuboid, prism, cone, pyramid, sphere…

- **Learning environment set up:**
- Natural Environment such as school surroundings
- Artificial Environment such as classroom and laboratory
- Technological learning environment such as virtual lab, PhET Interactive Simulations.

Teacher's role(s):
Introduction: volume is a fundamental concept in Mathematics and in Physics. It refers to the amount of three-dimensional space occupied by an object or substance. It is measured in cubic meters.

- Introduce the activity
- Divide learners into groups
- Provide the materials
- Provide formulae for calculating volume of different regular objects
- Set up stations with various objects such as cubes, spheres, cylinders and have learners measure and calculate their volumes
- Ask learners to explore how volume is used in cooking and recipes such as measuring ingredients.

- Ask learners to make objects with specific volumes for a real-world application such as storing liquids...
- Ask learners to report their findings
- Clarify on the reports given to learners and provide content

Learners' Tasks:
- Learners getting into groups and receiving materials
- Learners working in groups to measure and calculate volumes of different objects
- Making objects with specific volume for storing liquids and/or solids such as sugar, salt…
- Reporting the findings.

Assessment Guide:
- Check if learners are correctly taking the measurements of dimensions
- Check if learners are correctly calculating volumes of the given objects
- Check that the learners have made correct objects with correct volumes
- Check at each stage that learners are accurate and precise

Summary/key points

- Volume calculations are essential in fluid dynamics, particularly in the design of pipes, pumps, and hydraulic systems
- In engineering and Architecture, understanding volume is crucial for designing and building structures, such as bridges, buildings, and canals
- Accurate volume calculations are necessary in chemical engineering, especially in the design of reactors, tanks, and pipelines
- Volume calculations are used to model real-world phenomena, such as population growth, resource allocation, and optimization problems.

- Accurate volume calculations help optimize resource allocation, such as in the storage and transportation of liquids and gases
- Studying volume is essential for monitoring environmental phenomena, such as ocean currents, water quality, and climate change.

Skills to be developed

- Analytical Thinking,
- Communication,
- Critical Thinking
- Problem Solving
- Creativity and innovation

Activity 3.1.5: Volume of Irregularly shaped objects
In this activity, learners will determine the volume of irregularly shaped objects.

HOOK: What do you think can be done to find the volume of an object whose sides are not well defined?

Suggested Teaching and Learning

- **Natural Materials**: sand, soil, rice, stones …
- **Artificial Materials**: measuring cylinder, overflow can, thin string, …
- **Learning environment set up:**
- Natural Environment such as school surroundings
- Artificial Environment such as classroom and laboratory
- Technological learning environment such as virtual lab, PhET Interactive Simulations.

Teacher's role(s):

- Introduce the activity
- Divide learners into groups
- Provide the materials and work sheets

- Have learners measure the volume of an object by displacing water in a container (measuring cylinder).
- Ask learners to fill containers with **sand or rice** and have learners estimate and measure the volume.

- Ask learners to report their findings.
- Clarify on the reports given to learners and provide necessary content

Learners' Tasks:

- Learners getting into groups and receiving materials
- Learners working in groups to determine volume of irregular shaped objects by displacement
- Learners working in groups to estimate the volumes of rice, salt, sugar, sand…
- Reporting the findings.

Assessment Guide:

- Check if learners are correctly reading the meniscus of a measuring cylinder
- Check at each stage that learners are accurate and precise

Summary/key points

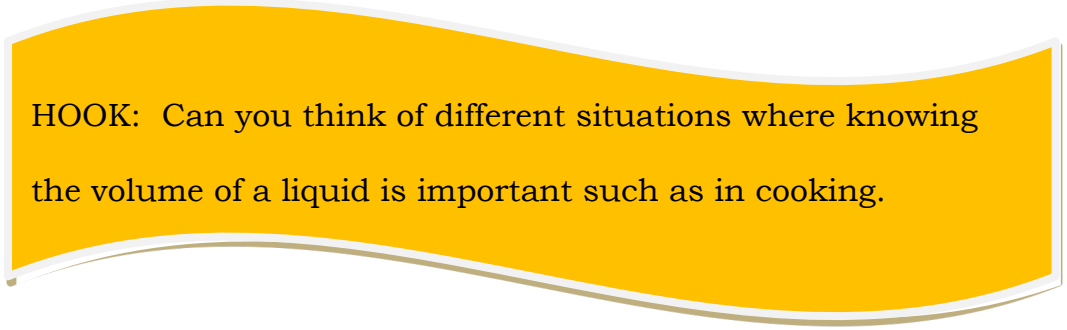
- In engineering and Architecture irregular shapes are common in real-world structures, such as buildings, bridges, and tunnels. Accurate volume calculations are crucial for design, construction, and maintenance.
- In Geology and Mining understanding the volume of irregular shapes is essential for calculating ore reserves, modeling geological formations, and optimizing mining operations
- Irregular shapes are common in medical imaging, such as tumors, organs, and bones
- Accurate volume calculations are critical for diagnosis, treatment planning, and monitoring
- In Real-World Problem-Solving calculating the volume of irregular shapes is critical for solving optimization problems, such as minimizing material usage or maximizing storage capacity
- Accurate volume calculations help optimize resource allocation, such as in the storage and transportation of irregularly shaped objects

Skills to be developed

- Analytical Thinking,
- Communication,
- Critical Thinking

- Problem Solving
- Real world application
- Creativity and innovation

Activity 3.1.6: Volume of Liquids
In this activity, learners will determine the volume of any liquid.



Suggested Teaching and learning Materials

- **Natural Materials**: water, cooking oil …
- **Artificial Materials**: measuring cylinder, burette, pipette…

- **Learning environment set up:**
- Natural Environment such as school surroundings
- Artificial Environment such as classroom and laboratory
- Technological learning environment such as virtual lab, PhET Interactive Simulations.

Teacher's role(s):
- Introduce the activity
- Divide learners into groups
- Provide the materials and work sheets
- Have learners measure the volume of liquids provided using a measuring cylinder, burette and pipette
- Ask learners to report their findings.
- Clarify on the reports given to learners and provide necessary content

Learners' Tasks:

- Learners getting into groups and receiving materials
- Learners working in groups to determine volume of liquids using appropriate apparatus given
- Reporting the findings.

Assessment Guide:

- Check if learners are correctly reading the meniscus of the apparatus
- Check at each stage that learners are accurate and precise

Summary/key points

- Accurate measurements of liquid volumes is crucial in chemical reactions, as it affects the reaction rate, yield, and safety
- Liquid volumes are critical in pharmaceutical applications, such as medicine production, dosing, and administration
- Liquid volumes are essential in food and beverage production, processing, and packaging.
- Studying liquid volumes helps understand density and buoyancy, which are fundamental concepts in physics and engineering
- Liquid volumes are essential in fluid dynamics, which studies the behavior of fluids in motion
- Liquid volumes are critical in water treatment processes, such as filtration, sedimentation, and disinfection
- Studying liquid volumes develops mathematical literacy, including concepts like measurement, conversion, and calculation

Skills to be developed

- Analytical Thinking,
- Communication,
- Critical Thinking
- Problem Solving
- Real world application

Creativity and innovation

Activity 3.1.7: Mass

In this activity, learners will measure the masses of different substances with accuracy and precision.

HOOK: have you ever helped measure mass or weigh objects such as

ingredients for cooking or packages for trucks or car?

Suggested Teaching and learning Materials

- **Natural Materials**: water, cooking oil, stones…
- **Artificial Materials**: electronic/beam balance scale, spring balance, beaker standard masses juice…

- **Learning environment set up:**
- Natural Environment such as school surroundings
- Artificial Environment such as classroom and laboratory
- Technological learning environment such as virtual lab, PhET Interactive Simulations…

Teacher's role(s):
Introduction: Mass is a fundamental quantity that describes the amount of matter contained in a substance or object. Mass is a conserved quantity. Which means it can not b created or destroyed.

- Introduce the activity
- Divide learners into groups
- Provide the materials and work sheets
- Prepare a set of solid objects with different masses/weight and ask students to sort them from lightest to heaviest.
- Have students compare the mass/weight of different solid objects using a balance or scale.
- Provide students with various liquids (e.g., water, juice) and have them measure the mass/weight using a balance or scale.
- Have students transfer a known volume of liquid from one container to another and measure the mass to demonstrate that mass remains constant
- Conduct an experiment to demonstrate the difference between weight and mass.
- Investigate how weight is affected by gravity through experiments, such as dropping objects
- Explore how weight is affected by buoyancy through experiments, such as measuring the weight of objects in water
- Use a balloon or a syringe to allow learners to demonstrate that gases have mass, even though they are invisible.
- Have students measure the mass of a gas-filled container (e.g., a balloon) and compare it to the mass of an empty container
- Ask learners to report their findings.

- Clarify on the reports given to learners and provide necessary content

Learners' Tasks:

- Learners getting into groups and receiving materials
- Learners working in groups to sort out masses from lightest to heaviest
- Learners comparing masses of different solid objects using balance or scale
- Learners measuring mass of different liquids
- Learners confirming that mass remains the same
- Learners working in groups to investigate the differences between mass and weight
- Investigating how weight is affected by gravity
- Exploring how weight is affected by buoyancy
- Learners proving that gases have mass
- Learners comparing the mass of a gas to that of empty container
- Reporting the findings.

Assessment Guide:

- Check if learners are correctly reading the mases to correct units and correct significant figures
- Check that students make correct subtractions when determining the volume of a liquid and that of a gas
- Check at each stage that learners are accurate and precise

Summary/key points

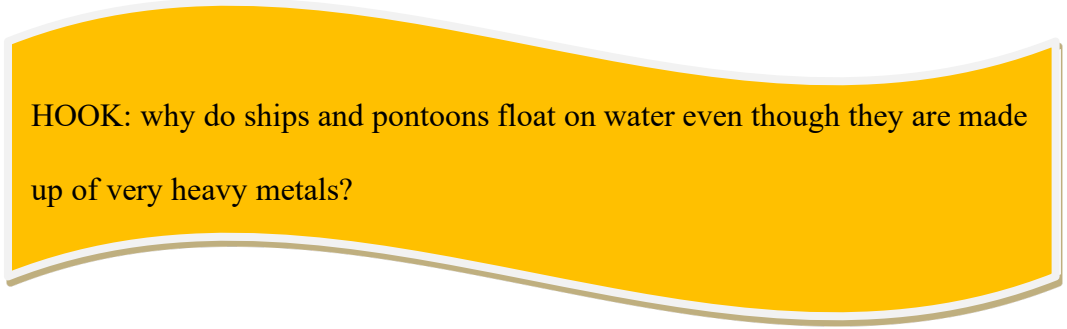
- Studying mass helps understand density, which is essential for understanding the behavior of solids, liquids, and gases
- Understanding the mass of solids, liquids, and gases helps understand the properties and behavior of each state of matter
- Accurate calculation of mass is crucial in engineering and architecture for designing and building structures
- Understanding mass helps in environmental science for calculating quantities of pollutants and monitoring environmental changes
- Accurate calculation of mass requires problem-solving skills, critical thinking, and analytical reasoning

Skills to be developed

- Analytical Thinking,
- Communication,
- Critical Thinking
- Problem Solving

- Real world application

Activity 3.1.8: Density
In this activity, learners will determine density of different objects.



Suggested Teaching and Learning Materials

- **Natural Materials**: stone, water, natural fiber, soil…
- **Artificial Materials**: electronic/beam balance, measuring cylinder, glass block, prism, cone,…
- **Learning environment set up:**
- Natural Environment such as school surroundings
- Artificial Environment such as classroom and laboratory
- Technological learning environment such as virtual lab, PhET Interactive Simulations…

Teacher's role(s):
Introduction: density is a physical property that describes the amount of mass per unit volume. It is measured in kilograms per cubic meter. It is a property that helps describe the behavior of materials under different conditions

- Create a density column using different liquids such as vegetable oil, water, corn syrup and solids such as beads, pebbles e.t.c and let the learners observe the floating and sinking
- Have students predict whether various objects will sink or float in a container of any liquid
- Divide students into teams and ask them to design an experiment to measure the density and relative density of a given object (solids, liquids and gases)
- Utilize online simulations to demonstrate density and relative density concepts, such as PhET Interactive Simulations.
- Discuss how density is important in shipbuilding, as ships need to be able to float
- Have students research and calculate the density of different minerals
- Clarify on the reports given by learners and provide necessary content

Learners' Tasks:

- Learners observing floating and sinking from the density columns
- Learners predicting whether different objects will float or sink in a given liquid
- Getting into groups
- Working in groups to design an experiment to determine density and relative density of given objects
- Using PhET interactive simulation to demonstrate density and relative density
- Working in groups to discuss how density is important in shipbuilding and how ships and pontoons float on water
- Researching and calculating density of different minerals

Assessment Guide:

- Check if learners understand density
- Check that learners understand the relationship between density mass volume and density
- Check that learners are familiar with units of density
- Check that learners apply density to solve problems
- Ensure that learners convert density units correctly
- Check that learners follow correct steps in determining density of solids, liquids and gases
- Ensure that learner identify and address common misconceptions about density

Summary/key points

- Density is crucial in designing and building structures, such as bridges, buildings, planes, ships…
- Understanding density helps develop new materials and optimize existing ones for various applications
- Density plays a key role in understanding ocean currents, water quality, and climate change
- Density is related to fundamental physical laws, such as the law of buoyancy and the ideal gas law
- Density is a key property of substances, helping identify and characterize materials

Skills to be developed

- Analytical Thinking,
- Communication,
- Critical Thinking
- Problem Solving
- Real world application
- Creativity and innovation

Activity 3.1.9: TIME
In this activity, learners measure time.

HOOK: Can you think of different situations where knowing the time is crucial, such as catching a bus or meeting a deadline?

Suggested Teaching and learning Materials

- **Natural Materials**: sun…
- **Artificial Materials**: stop watch, stop clock…
- **Learning environment set up:**
- Natural Environment such as school surroundings
- Artificial Environment such as classroom and laboratory
- Technological learning environment such as virtual lab, PhET Interactive Simulations…

Teacher's role(s):
Time is a fundamental concept that governs our experience of the world. It is a measure of duration between events, allowing us to understand the sequence and progression of occurrences.

- Introduce the activity
- Divide learners into groups
- Provide the materials and work sheets
- Create a set of cards with different times (analog and digital) and have students match them
- Cut out pictures of daily activities (e.g., waking up, eating breakfast) and have students put them in order from morning to night.
- Hide clocks or pictures of clocks around the classroom or school, and have students find them and read the time
- Ask learners to record time of any event such as time taken to move from one point to another using a stop watch or clock
- Ask learners to convert different units of time
- Clarify on the reports given to learners and provide necessary content

Learners' Tasks:

- Learners getting into groups and receiving materials
- Students matching times using cards
- Students putting daily activities in order
- Students finding clocks and reading times
- Recording times of given event
- Converting units of time to given units
- Reporting the findings.

Assessment Guide:

- Check that the learners read the time correctly
- Check that learners convert times at each stage to correct SI units

Summary/key points

- Time is a fundamental physical quantity that governs our experience of the universe
- Studying time helps understand physical laws, such as the laws of motion, thermodynamics, and relativity
- Understanding time helps develop clocks and calendars, which are essential tools for modern society.
- Accurate timekeeping is crucial for scheduling, organization, and time management
- Time is essential for transportation and navigation, including aviation, maritime, and space exploration
- Time is essential for computer systems, including operating systems, software applications, and network synchronization
- Time is critical for GPS technology, which relies on precise timekeeping to provide location and navigation services

Skills to be developed

- Analytical Thinking,
- Communication,
- Critical Thinking
- Problem Solving
- Real world application
  Creativity and innovation

Activity 3.1.10: Simple Pendulum

In this activity, learners will assemble a simple pendulum and determine its period and frequency. They will also investigate the factors that affect the period of the pendulum.

HOOK: How do you think the concept of a simple pendulum relate to more complex systems, like a child's swing or roller coaster?

Suggested Teaching and learning Materials

- **Natural Materials**: natural fiber, stone, stick, plank …
- **Artificial Materials**: stop watch, stop clock, clamp and stand, strings…
- **Learning environment set up:**
- Natural Environment such as school surroundings
- Artificial Environment such as classroom and laboratory
- Technological learning environment such as virtual lab, PhET Interactive Simulations…

Teacher's role(s):
Introduction: A simple pendulum is a device that consists of a weight, called a bob, attached to the end of a string or rod, called the pendulum arm. The pendulum arm is fixed at the other end, allowing the bob to swing backward and forth.

- Introduce the activity
- Divide learners into groups
- Provide the materials and work sheets
- Ask students to design and build their own simple pendulum using different materials such as strings, wires, metal rod, natural fiber, stop watch…
- Have students measure the period of the pendulum
- Explore how the period of the pendulum changes with different variables such as length, mass angular displacement
- Have students work in teams to design and build a simple pendulum that meets specific criteria such as maximum period, minimum length…
- Provide students with problems that involve calculating the period, and frequency, of a simple pendulum
- Clarify on the reports given to learners and provide necessary content

Learners' Tasks:
- Learners getting into groups and receiving materials

- Students building their own pendulum using the provided materials
- Learners to work in groups to determine the period of the pendulum
- Exploring the factors that affect the period of the pendulum
- Building pendulums that meet specific criteria (this can be done by using the following equation: $\mathbf{T= 2\pi\sqrt{L/g}}$)
- students solving problems that involve calculating period and frequency of a pendulum
- Reporting the findings.

Assessment Guide:

- Check that the learners construct the pendulum correctly
- Ensure that learners determine the period of the pendulum with accuracy and precision
- Check that the learners show that only length affects the period of the pendulum
- Check that learners use the pendulum equation to build the pendulum with correct specifications
- Check that learners are able to calculate period and frequency of a pendulum with precision and accuracy
- Ask learners to cite as many examples as possible, where the concept of the period of a pendulum is applied.

Summary/key points

- Simple pendulums demonstrate the fundamental concept of oscillations, which are crucial in understanding many natural phenomena such as studying earthquakes
- Simple pendulums exhibit periodic motion, which helps students understand the relationship between time, frequency, and amplitude
- Simple pendulums were used in clocks and timekeeping devices, making them a crucial component in the development of modern timekeeping
- Simple pendulums are used in seismology to measure earthquake waves, helping scientists understand the Earth's internal structure
- Studying simple pendulums involves collecting and analyzing data, which helps students develop essential skills in data analysis and interpretation

Skills to be developed

- Analytical Thinking,

- Communication,
- Critical Thinking
- Problem Solving
- Real world application
- Creativity and innovation

Sub-Topic 3.2: Equilibrium

Introduction: Equilibrium refers to a state where the net force acting on an object is zero, resulting in no change in the object's motion or position.

Specific competence:

- Apply equilibrium concepts to design systems to solve real world problems.

Key Terms:

- Static Equilibrium: A state where an object is at rest and the net force acting on it is zero.
- Dynamic Equilibrium: A state where an object is moving with a constant velocity and the net force acting on it is zero.
- Net Force: The vector sum of all forces acting on an object.
- Torque: A measure of the rotational force that causes an object to rotate.
- Equilibrium Force: A force that acts to restore an object to its equilibrium position.
- Zero Net Force: The net force acting on an object must be zero for it to be in equilibrium.
- Zero Net Torque: The net torque acting on an object must be zero for it to be in rotational equilibrium.
- Stability: The ability of an object to return to its equilibrium position after being disturbed.
- Metastable Equilibrium: A state where an object is in equilibrium, but any small disturbance will cause it to move to a more stable equilibrium position.
- Neutral Equilibrium: An object in neutral equilibrium will remain in its new position after being disturbed, without returning to its original position or moving away.

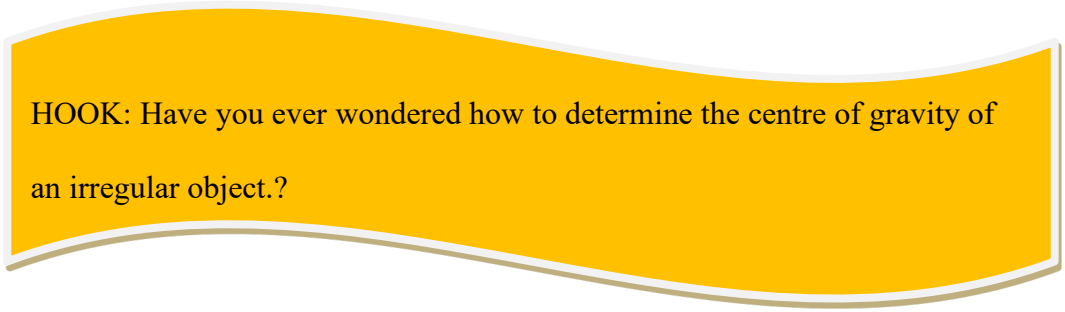
- Stable equilibrium: An object in stable equilibrium will return to its original position after being disturbed.
- Unstable equilibrium: An object in unstable equilibrium will move away from its original position after being disturbed.

Activity 4.1: Applying equilibrium concepts to design systems to solve real world problems

This activity is designed to help learners apply equilibrium concepts to design systems to solve real-world problems. There are three sub activities which learners will engage in as they apply the concepts.

Activity 4.1.1: Locating the center of mass

In this activity, learners will locate the centre of mass of an irregular object using the method of suspension.



Suggested Teaching and Learning Materials

- **Natural Materials**: air
- **Artificial Materials**: Meter stick or ruler, Object with an irregular shape (e.g., a wooden or plastic shape), String or thread, Weights (e.g., washers or small rocks), Pencil or marker,

Learning environment set up:

- Natural Environment such as school surroundings .
- Artificial Environment such as the laboratory or any room or place where learners can be (mobile laboratory).

Teacher's role(s):

- Introduce the activity. For example, Today, we're going to explore the concept of center of mass through a laboratory practical. The center of mass is a fundamental concept in physics that helps us understand how objects behave under different forces.

- Divide learners into groups
- Provide the materials
- Provide the instructions
- Ask learners to give reasons for every step undertaken.
- Ask learners to explain the importance of the centre of mass
- Consolidate the concept of centre of mass. Ensure that learners can visualise the importance and uses of centre of mass

Learners' Tasks:

- Identifying the apparatus and materials required to determine the centre of mass.
- Carrying out the experiment to locate the centre of mass of an irregular object
- Working as a group to accomplish the task.
- Answering questions from the teacher on the activity done.
- Discussing the significance of determining the centre of mass of an irregular object.

Assessment Guide:

- Observe students during laboratory activities to assess their application of appropriate skills. E.g. cutting. Observation, timing, dexterity in handling every apparatus used …
- Review learners' actions
- Ask learners open-ended questions to prompt further discussion
- Ask questions such as:
  Conceptual Understanding

  1. What is the centre of mass, and why is it important in physics?

  2. How does the shape of an object affect its centre of mass?

  3. What would happen if the object were rotated or flipped?

  Practical Application

  1. How did you use the suspension method to locate the centre of mass?

  2. What were some challenges you faced when using the balance method?

  3. How did you ensure accuracy in your measurements?

Critical Thinking

1. How does the centre of mass relate to the concept of equilibrium?
2. What are some real-world applications of locating the centre of mass?
3. How would you adapt this experiment to find the centre of mass of a more complex object?

Problem-Solving

1. If you were given an object with a different shape, how would you modify the experiment?
2. What would you do if you obtained inconsistent results between the suspension and balance methods?
3. How would you use the concept of centre of mass to solve a problem involving a rotating object?

Communication and Reflection

1. How did you communicate your results to your partner or group?
2. What did you learn from this experiment, and how can you apply it to future experiments?
3. What would you change or improve if you were to repeat this experiment?

- Administer a quiz or worksheet to assess students' understanding of how to locate the centre of mass.

Skills to be developed:

- Communication
- Collaboration
- Observation
- Psychomotor
- Problem solving
- Analysing

Activity 4.1.2: Designing systems in equilibrium to demonstrate stable, unstable and neutral equilibrium.
In this activity, learners will be creating marble runs to demonstrate stable, unstable, and neutral equilibrium.

HOOK: Build a simple seesaw using a ruler and weights. Demonstrate how it can remain stable when weights are evenly distributed

Suggested Teaching and Learning Materials

- **Natural Materials**: Wood, rocks…
- **Artificial Materials**: Ruler, marbles, cardboard, tape, scissors, rulers, protractors, pencils, paper…

Learning environment set up

- Natural environment such as school surroundings
- Artificial environment such as classroom
- Technological environment: Video, computer simulation

Teacher's role(s)

Introduction

Equilibrium is a state where the net force acting on an object is zero, resulting in no change in the object's motion or position. Equilibrium is a condition of an object in which the sum of all forces acting on it is zero e.g. resultant force is zero. Objects which are in equilibrium are; those that are stationary i.e.at rest, and those that are moving with constant velocity.

Exploration

- Ensure pupils understand equilibrium concepts, such as stable, unstable, and neutral equilibrium
- Prepare necessary resources
- Create questions to facilitate pupils' creativity
- Encourage pupils to think critically as they design systems in equilibrium to demonstrate stable, unstable and neutral equilibrium

Explanation

Understanding equilibrium is crucial for designing and building stable structures, such as bridges and buildings. Equilibrium is essential for designing and optimizing mechanical systems, such as engines and gears. Equilibrium concepts are used to solve problems in physics, engineering, and other fields.

Types of Equilibrium

Stable Equilibrium: An object returns to its original position after being slightly displaced.

Unstable Equilibrium: An object moves away from its original position after being slightly displaced.

Neutral Equilibrium: An object remains in its new position after being slightly displaced.

Synthesis

Help learners integrate and connect new information as they are creating marble runs to demonstrate stable, unstable, and neutral equilibrium.

Evaluation and Reflection

Help learners reflect on their learning, identify areas for improvement, and develop a growth mindset regarding creating marble runs to demonstrate stable, unstable, and neutral equilibrium.

Learners' Tasks

- Gather materials
- Understand equilibrium concepts
- Sketch a basic design, considering the equilibrium concepts to be demonstrated
- Create a section with a flat surface or a slight incline, allowing the marble to come to rest in a stable position.
- Create a section with a steep incline or a curved surface, allowing the marble to roll away from its initial position.
- Create a section with a flat, horizontal surface, allowing the marble to maintain its position or move with a constant velocity.

Assessment Guide

- Check if learners are correctly designing systems in equilibrium to demonstrate stable, unstable and neutral equilibrium
- Ask questions such as:
    1. Release the marble at the starting point and observe its motion through each section.

2. Make adjustments to the marble run as needed to achieve the desired equilibrium characteristics.
3. Continue testing and refining until the marble run demonstrates the desired stable, unstable, and neutral equilibrium characteristics.
4. Observe and record the marble's motion through each section, noting the equilibrium characteristics demonstrated.
5. Summarize the findings, explaining how the marble run demonstrates stable, unstable, and neutral equilibrium.

Skills to be developed:

- Communication
- Collaboration
- Observation
- Creativity and innovation
- Problem solving
- Analytical thinking

Activity 4.1.3: Analyzing the bridge design how they are constructed to maintain equilibrium under various loads.
In this activity, learners will be analysing the bridge design how they are constructed to maintain equilibrium under various loads.

HOOK: How do bridge designers ensure that their structures can withstand strong winds, heavy traffic, and other external forces while maintaining equilibrium?

Suggested Teaching and learning Materials

- **Natural Materials**: Wood, rocks, sand…

Artificial Materials: Metal rods, wires, PVC pipes, tape, calculators, pencils, paper…

Learning environment set up

- Natural environment such as school surroundings
- Artificial environment such as classroom
- Technological environment: Video, computer simulation

Teacher's role(s)

Introduction

Analysing equilibrium in real-world situations helps learners develop a deeper understanding of the concept and its practical applications. Analysing equilibrium in real-world situations involves examining how objects or systems balance and stabilize under various forces and conditions.

Exploration

- Ensure pupils understand fundamental concepts, such as types of bridges, materials, and structural components.
- Prepare necessary resources
- Create questions to facilitate pupil discussion
- Encourage pupils to think critically about bridge construction and equilibrium.

Explanation

Bridges are designed to be at stable equilibrium. A stable equilibrium ensures that the bridge can withstand various loads such as traffic, wind, and earthquakes, without collapsing or experiencing excessive deflections.

Synthesis

Help learners integrate and connect new information as they analyse the bridge design how they are constructed to maintain equilibrium under various loads.

Evaluation and Reflection

Help learners reflect on their learning, identify areas for improvement, and develop a growth mindset regarding analysing the bridge design how they are constructed to maintain equilibrium under various loads

Learners' Tasks

- Collecting relevant data on the bridge design, including:
    a. Dimensions (length, width, height)

    b. Materials used (type, strength, weight)
    c. Load capacity (expected traffic, weight limits)
    d. Environmental factors (wind, water, earthquakes)
- Determining the forces acting on the bridge, including: Gravity, tension, Compression, friction, external forces…
- Creating free-body diagrams to visualize the forces acting on the bridge
- Determining whether the bridge is in equilibrium, considering:
    a. Stable equilibrium (bridge returns to original position)
    b. Unstable equilibrium (bridge moves away from original position)
    c. Neutral equilibrium (bridge remains in new position)
- Evaluating the stability of the bridge

Assessment Guide

- Check if learners are correctly analysing the bridge design.
- Ask questions such as:
    1. What forces act on a bridge?
    2. How do bridges maintain equilibrium?
    3. What factors affect bridge stability?
    4. Design structures that apply equilibrium on their own.

Skills to be developed:

- Communication
- Collaboration
- Observation
- Psychomotor
- Problem solving
- Analytical thinking

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