Initial Primary Teacher Education

Science and Technology

Module 1

Malawi Institute of Education

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Foreword

Education is the lifeblood of the nation. It is a prerequisite for individual, community and national development. Education prepares learners to play their roles effectively in efforts to promote and sustain a country's socio-economic development. Parents or guardians desire that their children develop into adults with sound minds and healthy bodies, through the acquisition of appropriate knowledge, skills and desirable attitudes to enable them to live productive and happy lives.

Education should, therefore, help learners to develop high standards of conduct, attitudes, judgment and a sense of responsibility. Student teachers have to be well prepared in order to be able to take this responsibility of teaching children effectively.

The provision of quality education is based on many factors and a good quality of teachers is one of them. Teachers play a central role because they are the key source of knowledge, responsible for facilitating the learning process and act as role models for the learners.

The function of initial teacher education in Malawi is to prepare student teachers in their aspiration of becoming teachers of high quality. This is achieved by helping the student teachers to acquire the right knowledge, skills and competences to enable them to effectively teach children. In view of this, the Initial Teacher Education curriculum has been reviewed to ensure that student teachers who graduate from this programme are well trained and prepared for their profession.

The process and implementation of this review has been guided by the Teacher Education Philosophy which states as follows:

'To produce a reflective, autonomous, lifelong learning teacher, able to display moral values and embrace learners' diversity.'

It is therefore hoped that Teacher Training Colleges will find this curriculum effective in helping the student teachers to build a solid foundation in their teaching profession.

Executive Director
Malawi Institute of Education

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Contents

Introduction

The purpose of primary teacher education is to produce and continually develop competent and responsive teachers who effectively deliver quality education to all learners under prevailing conditions and demands in primary schools and promote their desire for life-long learning. IPTE endeavors to educate teachers in sufficient numbers, continually develop their professionalism so that they are able to effectively and efficiently deliver quality and relevant education to primary school learners.

National goals for primary teacher education

The national goals of primary teacher education in Malawi are to produce teachers who are:

- academically well-grounded and professionally competent
- flexible and capable of adapting to the changing needs and environment of the Malawian society
- capable of adhering to and maintaining the ethics of the teaching profession imaginative in adapting, creating and utilising locally available resources suitable for the needs of their learners

Rationale

Foundation studies will equip student teachers with the necessary knowledge, skills and attitudes to carry out their role of facilitating learning of the primary school child. To teach effectively, student teachers must study the origins and development of the primary school curriculum and understand their role in its implementation through appropriate management of the teaching, learning and assessment processes at school level.

Teacher education philosophy

The following has been the guiding principle during the design, development and implementation of the IPTE curriculum.

To produce a reflective, autonomous, lifelong learning teacher, able to display moral values and embrace learners' diversity has been designed.

IPTE programme structure

The duration of the teacher education is two years. The general outlook of the two years is as follows:

Year 1			**Year 2**		
Term 1	**Term 2**	**Term 3**	**Term 1**	**Term 2**	**Term 3**
In college, learning subject content with a special focus on methods for lower classes	In college, learning subject content with special focus on methods for upper classes	Out in teaching practice schools, practising teaching mainly in the lower classes	Out win teaching practise schools, practising teaching mainly in the upper classes	In college, with special emphasis on reflection, inclusion and further practice on teaching methods	In college, with special emphasis on subject content, policies and frameworks

Unique features

The features of the reviewed curriculum are as follows:

- The curriculum design is based on reflective and practice principles.
- Early grade teaching methodologies are distinct.
- The delivery of the subject content follows the modular approach.
- Student teachers will be allowed to practise teaching both in the lower classes (Standards 1 to 4) as well as in upper classes (Standards 5-8).
- Cross cutting issues such as Assessment for Learning, ICT, IE and CT are integrated.

IPTE subject matrix

The new curriculum has adopted the reflective practitioner model of teacher education which connects practice and theory and integrates content and pedagogy in teaching and learning. In this structure, student-teachers will be in college for two terms of year 1 and be in primary schools for teaching practice in the third term of first year and first term of the second year. Student teachers will be back to colleges in terms 2 and 3 of year 2 to continue learning subject content, reflecting on their experiences of teaching practice and then wind up their studies.

This curriculum is designed in a modular structure and contains eleven subjects. These are Chichewa, English, Mathematics, Education Foundation Studies, Agriculture, Social Studies, Life Skills, Science and Technology, Expressive Arts, Religious Studies and Human Ecology. In this modular design, a set of topics forms a module in a subject. A module consists of 40 hours contact time.

Summary of topics for the term and time allocation

Term 1		
Topic	**Allocated time in hours**	**Core element**

TOPIC 1 Introduction to the teaching of science and technology in primary schools

Time: 2 hours

Introduction

Science and Technology is the hub for all human inventions, sustainability and excellence. It has helped to shape the world through human creativity, imagination, critical thinking and manipulation of natural resources. These have made life on earth more relevant, meaningful, attractive and enjoyable.

Today, science and technology advances are changing at a fast rate. A lot of new things such as; phones, entertainment gadgets, medicine, electricity, food, vehicles are being introduced into our lives almost every day. Teachers and learners are faced with challenges of adapting to the ever-changing technologies. As such, student teachers should understand the basic concepts about science and technology so that they help learners to understand the world around them.

Further, specific concepts in science and technology are particularly important in the development of children's early thinking and learning. Such concepts not only build a basis for future scientific understanding but also build important skills and attitudes for future learning. In line with this view, it is imperative that student teachers should understand the concepts about 'science' and 'Technology' so that they can help learners to become future scientists and technologists.

Success criteria

By the end of this topic, student teachers must be able to:

- explain the importance of science and technology
- describe the rationale for teaching and learning science and technology in the primary school
- identify skills and attitudes that can be developed from science and technology

Background information

Science is the way in which learners develop an understanding of themselves through observation and exploration of the world around them. Technology is the application of scientific knowledge.

The understanding of the close relationships between science and technology and how they impact on development is critical. Science helps us to know what exists and why it does or behaves that way while technology gives us the know-how and capability to achieve our human needs and wants. Both science and technology have basic knowledge, skills, attitudes and values that are necessary for development.
The main purpose of science and technology education should be to

enable every individual to take informed decisions and appropriate actions that affect their own wellbeing and that of the environment. Therefore teachers should build on what learners already know about Science and technology.

History of Science and Technology

People have been producers and users of technology for thousands of years. They developed their knowledge of the environment around them and organised it in order to hunt, gather wild fruits, collect seeds, farm, build, convert raw materials and fabricate tools and equipment. Technological activities have therefore existed since time immemorial but perfected through experience, craft, apprenticeship and entrepreneurship. In the developing world, not many villagers have been to school to learn science but live and practice technological activities. For example, **figure 1.1** shows a sledge drawn by a team of eight oxen carrying two women and firewood. This was in Botswana many years ago.

Figure 1.1 *Source: Postcard by Sandy Grant,ODI, Botswana*

Therefore from the above illustration, it can be shown that technology existed even without any form of classroom based knowledge. Using this perspective science and technology can be offered with a focus on what the learners already know and do. This knowledge will facilitate the development of new scientific and technological ideas. Student teachers should explore the distinction between scientific and technological knowledge in order to understand how that could be taught to primary school learners using ICT and other resources. .

Misconceptions

Many students have misconceptions about what science is and how it works. . The following are some of the common misconceptions:

- Science is a collection of facts.
- Experiments are a necessary part of the scientific process Without an experiment, a study is not scientific
- Scientific ideas are absolute and unchanging
- Scientific Investigations that don't reach a firm conclusion are useless and unpublishable
- Science and technology can solve all our problems

Activity 1 Reflecting on own knowledge about science and technology

Student teachers have knowledge on science and technology acquired from primary and secondary education as

such it is important to start from what they already know.

For student teachers

1 In groups, copy the following table and fill the first and second columns.

Table 1.1: K.W.L

What I know about Science and Technology (K)	What I want to know about Science and Technology (W)	What I have learnt about Science and Technology (L)

2 Display the table in class for other student teachers to see. Keep the table until the next lesson whereby you shall fill the third column.

3 Look at the definitions of science provided below.

i. the system of knowing about the universe through data collected by observation and controlled experimentation

ii. knowledge of ourselves and the world around us and also the method, involving observation and experiment, of finding out more of this kind of knowledge

iii. a group of *processes* through which one can systematically gather information about the natural world; *knowledge* gathered through the use of such processes; *values and attitudes* possessed by people who use scientific processes to gather knowledge

iv. the systematic study of natural phenomena that helps us to understand and relate better to nature and the universe at large.

4 Which definition do you think is most appropriate? Share with a friend giving reasons why it is appropriate.

5 Write an individual personal definition of science on piece of paper, read to the class.

6 Explain some of the ways people interact with science and technology in everyday life.

Tips

- Students should write as many ideas as possible. At this moment, discourage criticism of ideas so that misconceptions may be captured.
- Paired brainstorming may be used to generate as may ideas as possible.

Activity 2 Analysing the importance of science and technology using examples from everyday life

This activity involves investigating the importance of science and technology. Start from the classroom and think of how science and technology is promoting people's lives.

For student teachers.

a. Using quick write discuss the importance of the hand washing technology in **Figure 1.2**

Fig 1.2 *Hand washing technology*

b. Using author's chair report your answers
c. Read an extract from forbes.com - Wadhwa V (2012): (*https://www.forbes.com/sites/singularity/2012/06/25/most-innovative-decade-in-history/#5f7377f135ae*)
d. List any five importance of science and technology according to the extract
e. Use authors chair to report.
f. In groups explore and identify the scientific and technological items in the college.
g. Record all the things that have scientific and technological ideas in them.
h. Design a table which will be used to collect data. It should include columns for the identified item, the scientific and technological ideas used in making and using the technology.
i. Organize your group so that each person investigates 3 or 4 items. Afterwards, share the findings with each other and report to the whole class for discussion.
j. What could happen to people if the technologies explored around the college were not discovered? Share your ideas with another student teacher.

Tip

When teaching about the importance of science and technology focus on how the use of scientific knowledge has been used to produce the technology and how that particular technology is contributing to make people's lives better.

Activity 3 Discussing the relationship between science and technology

The two terms, science and technology are distinct but very closely related. In this activity you shall explore the relationship between science and technology.

For student teachers

a. Read the relationships between science and technology presented at the end of the activity.
b. In groups explain with example each of the points presented.
c. Discuss with a friend how technology is connected to the scientific ideas presented in **Table**

1.2 below. Let two pairs join together and share their ideas.

Table 1.2 ***Relationship between science and technology***

Technology item	Scientific ideas	Relationship between the technology item and the ideas.
Cell Phone	Sound, radio and electromagnetic waves, electricity	

d. Individually make a table similar to the one **above** and list any three technologies and their scientific ideas in them.
e. In groups, summarize the relationship between science and technology by giving any three points. Report your points to the whole class for discussion.

Tips

- In the course of teaching it is important to use a variety of examples of how scientific knowledge is applied to produce technology
- Use a lot of ICT
- Modify the teaching to accommodate learners with special education needs
- The student teachers should also find out the relationship between science ang areas

Activity 4 Explaining the rationale for teaching science and technology

Many learners wonder why they need to learn science and technology so early in life. Others just fail to understand the importance of including it in the primary school years.

For student teachers

a. Read the following rationale for teaching and learning science and technology in primary schools.
   i. Science and technology contributes to the intellectual and hands-on development of the learners.
   ii. Science and technology enables the learners acquire the basic knowledge, skills, values and attitudes.
   iii. The learners will use the acquired knowledge, skills, values and attitudes to understand the relationships *among things*
b. In pairs explain each of the rationale stated above using ball bearing game.
c. Using hot seat let some students clarify the rationale above.

Activity 5 Summarizing scientific and technological skills, attitudes and values that can be developed in science and technology

Learners can acquire scientific and technological skills, attitudes and values through carrying out scientific investigations. In this activity student teachers will explore scientific and technological skill, attitudes and values

Figure 1.3: *A learner observing*

a. Watch a presentation from: https://www.youtube.com/watch?v=9cHGqAMuRuU or https://www.youtube.com/watch?v=OMPuU5K9EtY on scientific skills and attitudes. After watching the videos, summarize the meanings of the following: observing, measuring, experimentation, predicting, hypothesizing, curiosity, honesty, humility, open mindedness, objectivity, creativity, innovation, design.

b. Alternatively, perform scientific and technological investigation and identify scientific skills, attitudes and values.

c. Record the results in **Table 1.3.** below

Table 1.3: skills, attitudes and values

Skills	Attitudes	Values

Tips

- The video clips may be downloaded in advance and kept in a storage device.
- to emphasize the correct use of terminologies in science and technology.

Summary of key concepts

- **Meaning of science:** knowledge, skills and attitudes about ourselves, the environment and the universe
- **Meaning of technology:** is a human activity for improving the quality of life through the manipulation of the environment using scientific knowledge.
- **Importance of science and technology**
  i. promotes critical thinking, creativity, imagination and resourcefulness in the learner
  ii. provides, the learner with knowledge, skills, values and attitudes for solving everyday problems
  iii. provides career opportunities
  iv. improves the standard of living through an understanding of the environment
  v. helps the learners discard taboos and superstitions which retard development
  vi. helps the learners understand other subjects or learning areas
  vii. helps learners develop scientific and technological literacy

- **Relationship between science and technology**
  Technology uses information from science like results of investigations, research and experiments. Science uses technologies like chemicals apparatus and instruments.
- **Rationale for teaching science and technology**
  i. Helps learners to explain events in nature
  ii. Enables learners to think and reasons in a logical manner
  iii. Teach learners to solve simple problems they encounter on a daily basis.
  iv. Help learners to develop social skills e.g. establishing friendship while working co-operatively in groups.
  v. Help learners satisfy their natural curiosity through opportunities in carrying out scientific investigations.
  vi. Help learners to employ scientific knowledge and concepts to improve their environment
  vii. Help learners to develop positive attitude towards work.
  viii. Encourage critical thinking and creativity.
- **Scientific and technological skills, attitudes and values**
  Some of the scientific and technological skills are observing, measuring, experimenting, predicting, hypothesizing, innovating and designing.
  The following are some examples of scientific and technological attitudes and values: curiosity, honesty, humility, open mindedness, objectivity, and creativity, integrity patience, dedication, commitment.

Reflection and assessment

Answer the following questions on a piece on paper and share your thoughts with a friend.

1 What is the most important/interesting/useful/relevant idea about Science and Technology that you have learnt in this unit?
2 What new things have you learnt about science and technology; record your answers in **Table 1.1**?
3 How do you think science and technology will benefit you as an individual?
4 What do you understand by the following:
  a. Scientific skills?
  b. Scientific attitudes?
  c. Scientific values?
  i. What is the difference between seeing and observing?
  ii. Design an activity you would perform in which learners will develop the following skills, attitudes and values: observing, open mindedness, recording, experimenting, honesty, cooperation, be well informed, stay focussed and seek precision.

Glossary

Hands on activities: activities that involves doing.

Rationale: the justification or reasons for doing something

Science: knowledge, skills and attitudes about ourselves, the environment and the universe

Scientific attitudes: the way one feels, thinks or behaves towards something in science

Scientific skills: processes that are used to acquire scientific knowledge

Scientific values: is an adherence to an informal set of rules that save as the basis of ethical conduct in science and technology

Technology: the application of science

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Further readings

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TOPIC 2 Teaching of scientific and Technological processes

Time: 2 hours

Introduction

In order to develop a better understanding of science and technology processes, scientists observe the environment. In the course of observing, they identify problems that may require solutions. They achieve this by developing ways through a process called scientific investigation. Scientific investigation is at the heart of every scientific and technological endeavor and discovery. As such, learners require the development of scientific skills and attitude in order to behave and work as scientists, see **figure 2.1** below. Scientific investigations encourage learners to test ideas. It is through scientific investigations that learners modify their misconceptions about things they observe in the environment.

Figure 2.1: *Learners doing scientific investigations*

In primary schools learners will learn both inside and outside the classroom depending on the type of investigation. In all these circumstance safety, must be a priority.

Success criteria

By the end of this topic, student teachers must be able to:

- create resources for developing learners' conceptualisation of scientific and technological processes
- develop strategies for teaching scientific investigations and technological processes
- assess learners' skills in scientific investigations and technological processes

Background information

Scientific and technological processes are important in generating scientific and technological knowledge. This is because, it helps scientists to observe and understand the cause and effect of a particular phenomenon. In the same way, learners are always curious with what is happening in the environment. They therefore ask questions like. *'Why can't my toy car carry much load? Which type of wire is best used for toy making*? See figure 2.2.

Figure 2.2: ***Toy making: Can my toy car carry much load?***

Such questions need to be answered and in science, it is through scientific investigations.
Scientific investigations are structured ways that follow an organized and step by step process in order to find an answer. The process deploys measurable observations to formulate, test or modify a hypothesis.
Scientific investigation is what people use to develop better models and explanations for the world around them. Teaching of scientific investigations aims at developing the understanding of concepts, knowledge, the nature of science and its usefulness in life. In teaching about scientific investigations, draw learners' attention to as many examples from their everyday experiences such as toy making, planting crops soon after the first soaking rains, why bicycle taxi operators (kabaza) prefer certain tyre brands? In this way they will be able to appreciate the relevance of the scientific investigations from the perspective of daily experiences.

Misconceptions

- Science is an expending subject
- There is only one method of conducting scientific investigation
- Scientific theories cannot be replaced.

Activity 1 Safety in the laboratory, classroom and outside for students

A science and technology class will involve the use of various materials, equipment and chemicals. Therefore safety in teaching and learning science and technology in the classroom, laboratory, or outside must be the FIRST PRIORITY for students and learners. To ensure safer classroom, laboratory and outside class experiences, follow **Science Rules and Regulations** for the protection and safety of all at all times. .

For the student teachers

a. Using quick write, ask student teachers to list any ten safety rules in the laboratory and exchange the list with a partner.
b. Surf the internet to find what the science laboratory safety rules are.
c. In pairs identify the laboratory safety rules that may be applicable to your context.
d. Draw safety symbols and give their meanings
e. Follow the link and read about how to conduct fire exit drills "http://www.uwosh.edu/ehs/campus-health-and-safety/general-safety/fire-safety-1/fire-exit-drills.
f. In pairs list ways according to the article on how to conduct fire exit drills
g. Use the authors chair to report your findings.

Tips

- Scientific and technological investigations will be conducted in laboratories, classrooms and outside the classrooms. In all cases safety rules will have to be observed when conducting experiments.
- Regularly conduct fire exit drills. Develop a fire exit plan and display i all learners to be familiar with

Activity 2 Preparing to teach Scientific Investigation

Scientific investigations are practical, problem-solving activities for which detailed instructions are not given and ones in which the learner does not know the result before the investigation. It is important to conduct scientific and technology investigations because the method enables learners to test their hypothesis. In addition, it is a way of developing scientific and technological skills, attitudes and values. In doing investigations, learners' original ideas and cognitive processes such as observing, classifying and inferring are used.

For student teachers

a. Visit http://study.com/academy/lesson/what-is-scientific-investigation-definition-steps-examples.html and read the account of science fair and watch http://www.physicslovers.com/investigation on steps about scientific investigation and outline the steps

b. Use quick write to find out from the story what the boy might have observed prior to formulation of the question or to asking the question, '***How does the angle of a ramp affect how fast a toy car will roll down?***'

c. Use authors chair to share your responses.

d. Research the key steps that must be followed in solving technological processes. Present your findings during plenary.

e. In groups study the following sample scheme of work and lesson plan that have been derived from the Malawi Primary school syllabus.

Week & Dates	**Success criteria**	**Planned activities**	**Teaching, learning and assessment methods**	**Teaching, learning and assessment resources**	**References**
1 12/06/17 to 23/06/17	Learners must be able to: • distinguish different types of mixtures • explore forms of mixtures • Investigate factors affecting the rate of dissolving solutes. • design	**Core element**: Basic scientific knowledge, skills and attitudes **Topic**: Mixtures <u>Lesson 1: definition and types of mixtures</u> • defining the term mixture • describing types of mixtures <u>Lesson 2: forms of mixtures</u> • naming forms of mixtures • collecting locally available examples of forms mixtures <u>Lesson 3: factors affecting rate of dissolving of solutes</u> • investigating factors that affect the rate of dissolving of solutes <u>Lesson 4: investigations</u> • designing	• peer teaching • group work • oral and written questions • demonstration • experimentation • explanation • question and answer	• salt • sugar • source of heat • containers • spatula • filter funnels • filter paper • magnet • winnowers • sieve • internet	Malawi Institute of Education (2008). *Syllabuses for standard 8.* Domasi: MIE Malawi Institute of Education (2009). *Science and technology teacher's guide for standard 7.* Domasi pp 25-28 Malawi Institute of Education (2009). *Science and technology learners' book*

	investigations to find out how the factors affect the rate at which solutes dissolve in water. • describe methods of separating components of mixtures • investigate application of methods of separating mixtures in everyday life.	investigations to find out how each factor affects the rate of dissolving. • explaining how each factor affect the rate of dissolving <u>Lesson 5: separation of mixtures</u> • investigate methods of separating component of different mixtures • experimenting on the separation of component of various mixtures <u>Lesson 6: application of separation of mixtures in daily lives</u> • exploring uses of mixtures • explaining how methods of separation of mixtures are applied in daily life.			*for standard 8*. pp 25-28 Domasi: MIE

Sample lesson plan

Standard : 8
Learning area : Science and Technology
Topic : Mixtures
Date : 14th June, 2017
Time : 7:30 – 8:40 a.m.

Success criteria

By the end of the lesson, learners must be able to:

- describe mixtures and solutions

Teaching, learning and assessment resources

Water, paraffin, salt, sugar, soda, maize flour, containers, stirring rods, checklist

Teacher Activities	Learner activities
Introduction • Ask learners in pairs to describe how the following food are prepared: - Tea - Porridge - Bread • Let few pairs present their discussions to the class. • Tell the class that they are going to learn about mixtures	• Describing how the following food is prepared: Tea is formed by boiling water, add tea leaves and sugar. Porridge is made by boiling water, adding salt, maize flour. Let the mixture boil until it becomes thick and add sugar, margarine, groundnut flour. Bread is prepared by adding yeast, sugar, salt to warm water then mixing the ingredients to make a dough. The mixture is baked in an oven. • Presenting their discussions • Listening

Developmental Steps. **Step 1** • Ask learners to make 4 groups • Provide the groups with the following materials: Group A; water salt, soda, maize flour, containers Group B: Water, sugar, fertilizer, containers Group C: Paraffin, salt, soda, maize flour, containers Group D: Paraffin, sugar, fertilizer, containers • Ask the learners to brainstorm what will happen if each substance is mixed with the given liquids. • Ask the learners to mix each substance with the given liquid. • Check whether the learners have mixed the substances correctly	• Forming groups • Collecting the materials • Brainstorming what will happen if each substance is mixed with the given liquid either dissolving or not dissolving • Mixing the substances with water • Working in their groups
Step 3 • Let the learners in groups give the meaning of the following terms in reference to the activities done above **a.** Mixtures **b.** Solvent **c.** Solute **d.** Dissolve **e.** Insoluble **f.** Solution • Let the learners present using mix-freeze method • Consolidate the activity by explaining the meanings of the	• Giving the meaning of the following terms as a. Mixtures- combination of two or more substance not chemically combined b. solvent- a liquid in which a solid dissolves c. solute – a solid which dissolves in a solvent d. dissolve – disappearing of a solid in a liquid e. insoluble – not dissolving in a liquid f. solution – a mixture of a solvent and a solute • Presenting using mix-freeze method • Listening to the meanings of terms and taking notes

terms.	
Conclusion • Ask learners to define the following terms a. mixture b. solvent c. solution d. dissolve	• Defining the following terms a. mixture b. solvent c. solution d. dissolve.

Lesson evaluation

f. Compare the sample scheme and lesson plan with those provided from the demonstration school. Discuss the differences and similarities you have provided.
g. Present the observations to the class for discussion.
h. In groups, write a lesson plan on a mixtures basing on the following question: Does the size of particles affect the rate at which a solute dissolve? Remember to follow stages of a scientific investigation. Show how learners will control and manipulate the variables.
i. Undertake a microteaching to deliver the lesson.
j. Evaluate the lesson focusing on the, variables, results and whether the conclusion relates to the hypotheses.
k. Use ICT to summarize the scientific investigation in the lesson by following the link:

https://mymission.lamission.edu/userdata/liviodl/docs/Bio%207%20MC1%20Scientific%20Investigation%208e.pdf.

Tips

- Identify the right methodologies and resources for scientific investigations
- Link all the practical activities to the steps of scientific investigation.
- The actyivities and lesson plans from the demonstration school should be collected before the activity.

Activity 4 Developing an understanding of the importance of scientific and technological processes for social economic development

Science and technology is the hub for social and economic development of any nation. For a nation to manufacture and add value to the products, scientific and technological processes are followed. It is important to develop an understanding of the importance of scientific and technological processes in all areas of

development such as health, education and industries.

For student teachers

a. Visit https://ieet.org/index.php/IEET2/more/chetty20121003 and read an article about the role of science and technology in the developing world in 21st Century.
b. Use quick write to list the importance of scientific and technological advancement for social economic development according to the article.
c. Use authors chair to report your findings.
d. Use card clustering to list the examples of scientific and technological advances under economic advances, improvements in health systems, education and infrastructure.
e. In groups carry A PROJECT to find out from the community the contributions of scientific and technological advances to social economic development.

Tips

- Use critical methods such as KWL, silent participant, debates
- Ensure that the choice of resources and learning tasks are tailored to meet the needs of learners with learning difficulties

Activity 5 Producing materials for teaching scientific and technological investigations

There is need for production of materials for teaching scientific and technological investigations. The resources produced will be used to teach different topics.

For student teachers

a. In groups, collect standard seven science and technology teacher's guides and learners' books.
b. Identify the topics from the books and state the resources that can be used to teach the topics.
c. Record the results in the following table.

Table 2.1. Topics and resources

Topic	Materials	Resources to be produced

d. Choose one resource from the table and produce it. Present to the lecturer for assessment.

Tips

- The lecturer must be familiar with the topics and how the resources can be produced
- Use card clustering, one stay and three astray, analytical teams and other methods in addition the methods used to ensure that the diversity of learners is well taken care of
- Making of resources should be done outside class

Activity 6 Teaching Different strategies that are gender responsive

Teaching methodologies have a significant impact on academic access, retention and performance of learners. Yet many teachers employ teaching methods that do not provide equal opportunity to participation for girls and boys. Neither do these methods take into account the individual needs of learners, especially girls. It is important that when teaching scientific and technological investigations, teachers provide equal opportunities for all learners in all the stages of scientific and technological investigation.

For student teachers

a. Visit http://www.wikigender.org/wp-content/uploads/2015/08/GRP-Booklet.pdf and read about gender responsive pedagogy.
b. Analyze the strategies listed in 'Gender Responsive Pedagogy: A Teacher's Handbook'.
c. Use quick write to generate a list of teaching strategies that are gender responsive and apply to the teaching of scientific investigations.
d. Use the authors chair to present your findings.
e. In groups explain how issues of assessment can be incorporated into the teaching strategies.

Tips

- Ensure that boys and girls participate equally in their learning
- Teachers should ensure that they are aware and understand gender responsiveness which is key to the effective participation of boys and girls in the teaching and learning process

Summary of key concepts

- Scientific investigation is the scientific method which involves making an observation, stating a question, formulating a hypothesis, conducting an experiment and analyzing the results to form a conclusion.
- Science and technology is important for social and economic development. Sectors of health, education, agriculture and manufacturing all produce and use products that have gone through scientific processes.
- In the process of conducting scientific and technological investigations, resources are required. Since most of our primary schools are large and under resourced, teachers should be resourceful. In their choice of resources, they are supposed to select and produce resources that are gender sensitive
- The choice of methods in the stages of scientific and technological investigation must be gender

responsive and teachers must understand and respond to the specific needs of both boys and girls.

Reflection and assessment

1. In your primary and secondary school days, you were involved in doing scientific investigations. Do you remember to have been involved in all the stages of scientific investigation? What were your contributions? What new things have you learnt in this topic?
2. Visit http://gse.buffalo.edu/fas/shuell/cep564/Science.htm and read the article about the nature of science. Compare it with your own understanding of the nature of scientific investigation and the way you think it should be taught.
3. What challenges will be faced when teaching scientific investigations in primary schools?
4. Develop safety rules that can be used in the primary schools during scientific investigations.
5. Give any two contributions that scientific and technological processes have made to the following

a. Health
b. Agriculture
c. Mining.

Glossary

Scientific investigation: It is a practical, problem-solving activity to find a solution for which the learners do not have an answer.

Hypothesis: In science, a **hypothesis** is an idea or explanation that is tested through study and experimentation.

Variable: is any factor, trait, or condition that can exist in differing amounts or types or that can be changed to affect the results.

Technology: It is the application of scientific knowledge.

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TOPIC 3 Teaching and learning resources for science and technology

Time: 2 hours

Introduction

Some of the most, interesting and relevant science teaching and learning take place when local resources are involved. Learning conducted in the real world is relevant and motivating than learning presented out of books in the classroom. The natural world outside the classroom is full of useful teaching and learning resources. For instance, a natural forest area has diverse natural resources for teaching and learning a range of scientific and technological topics. Therefore teachers should use the local resource base to teach science and Technology lessons.

Success criteria

By the end of this topic, student teachers must be able to:

- prepare teaching and learning resources for science and technology
- utilize a science corner and nature table to teach aspects of science and Technology

Background information

Opportunities are available to use the local environment as a base to teach science and technology. The school surrounding provides an ideal context in which to teach about the structure, physiology, and ecology of plants and animals, their interaction and their relationship with people.

The Environment is the richest source of teaching materials Courtesy of MIE

In both school and community environment, there are many things, both manmade and natural that are more readily accessible and familiar to learners.

The physics and technology of tools such as, traps (diwa), buildings and machinery; and the chemistry of brewing, cooking; and the use of local herbs are some of the examples of the underexploited teaching opportunities available in school and environment.

Diwa a trap for mice or logic trap

For instance, the bead maker, the herbalist, the hunter and the brewer have rich knowledge in their fields on the use of local resources. It is also important that the teacher should use the local environment because the resources are familiar and available to both the teacher and learners.

Misconceptions

- Government is the sole provider of teaching and learning resources to schools
- Female teachers cannot produce science and technology teaching and learning resources
- Improvisation requires special skills and knowledge of materials

Activity 1 Identifying challenges in teaching and learning resources

Many of our primary school classes are large and under resourced. Most teachers teach without any teaching and learning resources in their lessons. The thinking is that, government is the sole provider of teaching and learning resources. It is therefore important to explore the challenges that teachers face in mobilizing and producing teaching and learning resources.

For student teachers

a. In pairs develop a list of challenges that you too are likely to encounter in producing the resources.
b. Exchange the list with another pair and ask them to develop solutions to the challenges.
c. During plenary, use the authors chair to report the findings.
d. Conduct a research at a nearby primary school to find out challenges the teachers are facing with regard to inadequate teaching and learning resources.
e. In the same way, find out what the teachers are doing to address (If any) the challenge of inadequate teaching and learning resources.

Tip

The lecturer must be exemplary in producing and using teaching, learning and assessment resources.

Activity 2 Getting student teachers to identify resources from the school environment

The primary school syllabus for science and technology has a list of topics and suggested teaching and learning resources. The suggested teaching and learning resources can be used to guide the teacher what materials to produce. As a teacher, it is important to note that the skill of producing teaching and learning resources develops with time.

For student Teachers

In groups

a. Familiarize yourselves with the science and technology syllabus and teachers guides.
b. Identify any four topics for each class
c. For each topic, list the suggested resources that can be obtained from the environment

d. Record your findings in **Table 3.1** below

Table 3.1 Topics and resources identified

Class	Topics	Resources
5		
6		
7		
8		

e. Brainstorm how you can produce teaching and learning resources identified.

f. Swap the table of the topics and the resources identified with another group and make comment on it.

g. Prepare a brief presentation on how each resource can be produced and how they can be used in teaching and learning.

h. Individually, produce teaching, learning and assessment resources that can be used to teach any concept in science and technology.

i. Display the teaching and learning resources and let the rest of the class conduct a gallery walk.

j. In groups plan a micro lesson on one of the topics for which you have produced the teaching and learning resources.

k. Conduct a micro lesson and let peers evaluate using the college evaluation form focusing on the use of resources.

Tips

- The lecturer should have different samples of resources to show to students before they produce their resources
- Production of resources by students should be done outside class time

Activity 3 Improvisation and its importance

Improvisation in science teaching is the art of using alternative resources locally available to facilitate teaching whenever there is lack or shortage of specific teaching aids or equipment. The approach to teaching science in the primary schools, is aimed at constructing an environment in which a learner can explore by feeling, comparing, discovering relationship through own observation. Improvisation of instructional materials are encouraged where original resources are absent or inadequate.

For student teachers

a. Individually visit http://www.learnwithmac.com/2016/03/15/newton-spring-balance-and-hookes-law/ and https://www.reference.com/science/spring-balance-used-

41c08c36c331b48e and read about spring balance.

b. Using quick write, answer the following questions: What is a spring balance? What is a spring balance used for? What is the unit of force?
c. Using authors chair report to the whole class
d. Using think pair share, identify a topic in the primary school curriculum where a spring balance can be used.
e. Visit http://www.exo.net/~donr/activities/Rubber_Band_newton_Scale.pdf and read about, ' ***Rubber Band newton Scale'***
f. Using a 20 centimeters reed or cardboard, a rubber band, a nail and masses of 20g, 30g, 40g, 50g, and 60g follow the steps described in http://www.exo.net/~donr/activities/Rubber_Band_newton_Scale.pdf to produce a ***rubber band newton scale or balance***.
g. Mount the ***rubber band balance*** on a cardboard similar to that used for the spring balance. Calibrate both in grams and newton's
h. In groups identify a topic and plan for a lesson to teach at the primary school using ***the rubber band newton balance*** produced**.**
i. Evaluate the lesson plan developed focusing on how the ***Rubber Band newton balance*** is going to be used in the various developmental steps of the lesson
j. Identify other resources in the primary school curriculum which can be improvised. For example a distillation apparatus can be improvised as shown in **figure 3.3** below.

Fig 3.3: *Traditional distillation apparatus used to separate mixtures*

k. Using quick write, list the importance of improvisation. Present using Authors chair.

Activity 4 Storage and care of teaching and learning resources

It is important to understand the importance of improvisation. This is because it takes effort and time to produce the resources. The resources have to be kept at an appropriate place because it may not be sustainable to be producing the resources all the time. There is need to care for the resources produced by using them appropriately. Ensure that the resources are not kept in dump places.

For Student Teachers

a. Using think-pair-share find out how you can care and store the teaching and learning resources produced in **activity 3** above.
b. Visit https://www.academia.edu/5142591/A_USERS_GUIDE_Teaching_and_learning_using_locally_availabl

e_resources_MIE_Malawi_Education_Support_Activity focus on unit 9 pages 45 to 50 to acquire ideas on how you can store and display the resources

c. Record your findings in **Table 3.2** below.

Table 3.2 Care and Storage of resources

Class	Topic	Resources produced	Care	Storage
4				
5	External parts of a flower	Pressed flowers		
6				
7	Force	Rubber band newton balance		Keep in cupboards
8				

d. In groups, discuss how you can use preservation methods such as drying, salting, smoking and the putting of specimen in formalin solution to preserve teaching and learning resources.

e. Identify any specimen, preserve and display it on the Nature Table.

f. Using quick write, list reasons why it is important to store teaching and learning resources carefully.

g. Swap the list with another group. Identify what needs to be added and discuss your observations.

Activity 5 Importance of science and technology corner and nature table

Science and technology corner and nature table is an interesting learning center in the classroom. It offers opportunities for learners to observe science and technology collections that have been taught, will be taught and some that might be of interest to the learners. It promotes curiosity and allows the learners to extend the classroom science and technology beyond the classroom learning time.

A Nature Table at a Science Corner

For Student Teachers

a. Visit http://www.rainydayprek.com/195/why-create-a-science-corner-in-your-preschool-program/'Why create a science corner in your pre-school program?' and read IPTE student hand book page 73 to 75 about the importance of a science corner.

b. In groups construct a nature table that will be suitable for all classes in the primary school.

c. Demonstrate how to use, care and manage the nature tables.

Tips

- Implementation of most tasks should be outside normal class time
- Height of the Nature table should be based on the height of the shortest learner in the class.

Summary of key concepts

- The use of the local resource base to teach science and technology provides an opportunity for teachers to teach science and technology effectively.
- Since most of the commercial resources for teaching science and technology are not readily available in schools, science and technology teachers should improvise.
- The skill of improvisation in the teacher develops with time.
- Improvisation ensures constant availability of resources in the school.
- Resources should be stored properly in safe places like shelves, cupboards, cartons and other places
- Some of the importance of the science corner and Nature Table include; promoting curiosity in learners and serving as a center of self-learning for learners.
- In the production of teaching and learning resources, safety precautions must be followed.

Reflection and Assessment

1. As a student teacher, describe your experience relating to your involvement in the production of teaching and learning resources.
2. If you were to teach learners about locomotion in fish, what would you improvise to represent a fish pond or fish tank.
3. You have learnt ideas about a science corner in the classroom. Explore ways in which you can develop a school science and technology corner.
4. Give any five specimen that can be displayed on the Nature Table and justify how they could be used to support learning in different aspects of science.
5. Describe how you would improvise materials in teaching concepts of blood circulatory system.
6. You are given two bottle tops, a nail and super glue. Describe how you would use the materials to produce a pulley?
7. Drawing on your knowledge of child development explain why it is important to use resources to illustrate and demonstrate scientific concepts.

Glossary

Apparatus: Equipment used in experiments or practical activities

Environment: The surroundings

Improvisation: **T**he art of using locally available resources; to facilitate teaching whenever there is lack or shortage of specific teaching aids or equipment

Science and technology corner: A place in the classroom where science and technology resources are displayed

Teaching and learning resources: Materials that can help a teacher to teach effectively

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TOPIC 4 Teaching of Plants and their environment

TIME: 7 hours

Introduction

The environment we live in contains a variety of plants. Learners will have interacted with plants in different ways. It is therefore important to teach about plants because the knowledge gained will help them understand their environment and interact with it positively. Using a range of exploratory techniques, a number of teaching and learning activities may be used to help learners develop their ideas about plants that populate different habitats. As such, student teachers should acquire relevant skills for teaching the topic using different approaches and resources.

Success criteria

By the end of this topic, student teachers must be able to:

- explain the concept of teaching plants and their environment.
- use appropriate teaching and learning methodologies to teach about plants and their environment.
- assess learners' knowledge of plants and their environment.

Background Information

Plants are living organisms that produce vegetative and reproductive parts. They can grow on land, stones, water, or on other plants. As living organisms, plants have the following properties or characteristics in common: they can move their parts, respond to stimuli, feed, respire, grow, excrete and reproduce.

Learners may have little understanding of what constitutes a living organism such as plants though they have interacted with them before they come to school. Through first-hand observations and experiences, such as planting seeds and observing plants in the immediate environment, learners should recognize that plants grow and change. They need to know about characteristics of different plants, how they develop, grow, get spread to other distant places and that plants rely on their environment and influence it. Most plants develop from seeds which contain parts that grow into plants. This process is termed seed germination.

Photosynthesis is the process of food making for the growing plants. There are several stages for photosynthesis. Seed dispersal involves the scattering of seed from the parent plant location to other areas. There are several advantages for seed dispersal including avoiding competition for resources.

Misconceptions

- Plants are not living things
- Plants get their food from the soil through the roots
- Seeds are produced in factories

Activity 1 Exploring what is taught on the topic plants and their environment in Malawi primary schools

Most of the sub-topics under the topic plants and their environment are taught from standards 4 to 8. In this activity, students will be involved in finding out what is taught about plants in the Malawi primary school curriculum.

A Plant

For student teachers

In groups,

a. Identify topics using the primary school learners' books, syllabuses and teacher's guides on plants and their environment.
b. Write the topics using **Table 4.1** below.

Table 4.1

Standard	Topics
4	
5	
6	
7	
8	

c. Share the topics you identified with the class by using walk-around-talk-around method.
d. Why do you think each of the topics help the learners in everyday life? Share with the class.
e. Identify some of the scientific concepts/knowledge, skills, attitudes and values that learners should acquire after learning the topics under plants and their environment in the teachers' guides and learners' books. Use the **Table 4.2** to record your findings.

Table 4.2 Scientific knowledge, skills, attitudes and Values

Topic	Concept/ knowledge	Skill(s)	Attitudes and Values
1. 2. 3.			

f. Research on the internet the differences among scientific knowledge, scientific skills, scientific attitudes and values (include source of the information)
g. In pairs, write all the success criteria for the topics from the teacher's guides or learners books.
h. Use **Table 4.3** below.

Table 4.3 Success criteria in Teachers Guides and learners' books

Topic	Success criteria
1 2 3	

i. Let two pairs share their work.
j. As a teacher, why do you think you need to know about the information above?

Tip

- There should be adequate teachers' guides, learners' books and syllabuses for use by student teachers

Activity 2 Teaching learners' classification of plants

When teaching the concept of plants, give learners hands-on experience in classification using plants obtained from the local environment (care should be taken since some plants are poisonous). Learners will be taken outside into the school environment and work individually to observe and collect parts of plants.
Encourage class discussion and questions in order to understand the plants that grow in the local environment.

For student teachers

a. In groups, brainstorm ways you can use to classify plants. Write your findings on a chart and display in class for discussion.
b. During your own free time, prepare the resources which could be used to teach the topic 'Classification of plants' to learners.
c. Prepare the resources in advance and display them on the science corner.
d. Using mind mapping, outline important points you should follow when teaching learners 'classification of plants' to ensure full participation of all learners in your class.
e. Present your points using authors chair.

For learners

a. Ask learners to identify plants in their local environment and collect their flowers, stems, roots and leaves.
b. Inside the classroom divide the learners into groups.
c. Provide each group with different types of leaves which they may not have collected.
d. Ask the learners to classify the leaves using their differences and similarities

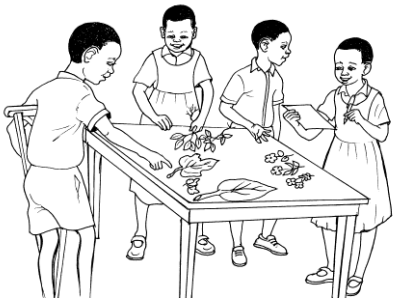


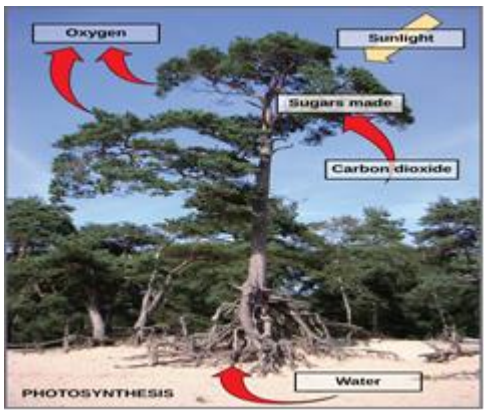
Fig 4.1 *Learners classifying leaves*

Tips

- Some of the activities can be done outside the college timetable.
- Think of other ways of helping the learners understand all plants in the absence of realia.
- Some plants are poisonous and should be handle with care.

Activity 3 Developing an understanding of internal structures of parts of a plant and photosynthesis

Plants uses solar energy, carbon dioxide, and water to produce energy-storing carbohydrates in the process called photosynthesis. Oxygen is generated as a by-product.



Process of Photosynthesis

For student teachers

a. In groups, research using the internet and other library books on internal structure of leaves.

b. Write a booklet of 10 pages as a summary for the findings.

b. In the Booklet include the following information:

i. drawings of the internal structures of a leaf that aid photosynthesis

ii. word formula and balanced chemical formula for photosynthesis,

iii. Explanation on how the internal structures of a leaf are adapted for the function of photosynthesis.

iv. What can be done to investigate conditions for photosynthesis?

c. Submit the booklet to the lecturer for assessment.

For learners

Fig 4.2 *a learner observing internal parts of a stem using a magnifying glass*

a. Ask the learners to collect fresh parts of a plant such as roots, stems and leaves.

b. Let the learners cut the parts in cross and longitudinal sections using a razor blade.

c. Let them observe the internal structures using a magnifying glass. See **figure 4.2**

d. Ask the learners to draw the sections on paper and display for a discussion.

Tips

- The research work should be done outside the college timetable
- Ensure that the computer laboratory is accessible and is working before the time for researching the topic

- Student teachers should be encouraged to draw accurate clear and attractive illustrations for use in the primary schools.
- Safety measures should be observed when cutting parts of a plant to avoid accidents.

Activity 4 Finding out teaching methods on the topic plants and their environment

The term teaching methods refers to the general principals, pedagogy and management strategies used for classroom instruction. In teaching about plants and their environment your choice of teaching methods depends on the diverse needs of the classroom. In this activity you will have an opportunity to learn different teaching methods.

For students teachers

In groups:

a. Visit some of the demonstration teachers to find out about the methods they use to teach the following concepts: Photosynthesis, Seed germination, Seed and fruit dispersal.
b. Apart from the methods you will learn from teachers, what could be other relevant methods for teaching the same concepts? Explain why you think they are relevant.
c. What are some of the challenges you think you will meet when teaching the concept ''seed germination''?
d. Present your finding to the class for discussions.

Tip

- Student teachers may be referred to existing handbooks on methods of teaching such as Ways of teaching Skills and ideas for student teachers and Critical thinking methods. These books are available in the colleges

Activity 5 Planning excursion to observe plants in their environment

Excursions are important to help bridge the gap between hands-on experience and theory. The experience gained during excursions is beneficial to the learners because they learn in a real environment.

For student teachers

a. Read *Teaching Skills and Ideas for Student Teachers IPTE Programme* (*2014*) to find out how to organize an excursion.
b. Using the information you have gathered, plan and conduct an excursion with your group to collect specimen for the following:
   i. Modes of reproduction in plants (Sexual and Asexual reproduction in plants)
   ii. Seeds and fruits dispersed by the following agents; animals, wind and water.

c. Display the specimen in class for discussions.

Tip

The excursion may be conducted outside the college time because some plant specimen may not be easily found within the college environment

Activity 6 Preparing schemes and records of work for teaching about plants and their environment

Schemes and records of work are crucial in the process of teaching and learning. They display teachers' readiness to teach. It is important to prepare effectively to ensure good lesson delivery at all times.

For student teachers

a. Meet a teacher at the nearest primary school to study schemes and records of work for science and technology they prepare.
b. Compare the schemes and records work with the format recommended by the college
c. Report the findings to the class.
d. Work in pairs to identify ways in which the scheme of work could be improved and report to the class for discussion.
e. Individually prepare schemes of work for two weeks on any concept under plants and their environment**.**
f. Give the scheme to a colleague for comments. Share all the observations to the class. Submit the schemes to the lecturer for assessment.

Tips

- Student teachers should use free time to visit qualified teachers.
- The lecturer should supply a sample scheme of work for science and technology

Activity 7 Preparing a lesson plan to teach about the relationship between plants and their environment

By now you must have learnt how to prepare lesson plan in science and technology. This activity will give you more chances to practice preparing lesson plans.

For student teachers

a. Explore science and technology lesson plan samples from the primary school. Compare your findings with a sample lesson plan provided by your lecturer.
b. In groups plan lessons considering learners who are inactive, active and learners with special needs on the following topics:
   i. External parts of a plant
   ii. Flowering and non-flowering plants
   iii. Seed germination.
   iv. Pollination and seed dispersal
c. Write the lesson plan on charts and display in class for critiquing by other groups.

Tips

- Different groups should take different topics
- For further information about preparations of lesson plans to teach about the relationship between plants and their environment visit https://archive.org/stream/TheVsoScienceTeachersHandbook/vsoscience_djvu.txt

Activity 8 Conducting micro teaching

Micro teaching lessons are very important in the process developing teaching skills. This is because they predict what the student teacher is likely to expect when teaching the same topics or what behaviors learners are expected to show as they will be taught. In the course of doing this the student teacher may adapt the teaching methods and skills to other contexts.

For student teachers

Micro teach the lesson prepared in activity 7 and evaluate it using the check list below

Checklist

Assessment Item	Yes	No
Introduction		
Is it linked to the previous lesson (If it is a continuation)?		
Is it relevant to the current topic?		
Is it motivating?		
Development		
Are the teaching and learning methods participatory?		
Are the methods varied?		
Are teaching and learning resources available?		
Are the teaching and learning resources relevant to the topic?		
Are the teaching and learning resources used effectively?		
Does the teacher show mastery of the subject matter?		
Did the teacher use appropriate questions to assess the learners' understanding?		
Did the teacher give clear instructions?		
Conclusion		
Are the main points summarised?		
Are the success criteria achieved?		
Any other comments		

Discuss your observations as a class.

Tips

- The checklist development depends on the nature of the topic
- Student teachers should use the same checklist developed when conducting microteaching.
- You can use the college lesson evaluation form when evaluating lessons

Activity 9 Analysing varied ways of assessing learners' knowledge of plants and their environment

It is important to assess learning by focusing on assessment ways that cover all the domains of knowledge. The ways should be of different forms and formats. This will ensure that learners with diverse needs are taken care of.

For student teachers

In groups

1 Analyse ways of assessing learners' knowledge and understanding of plants and their environment.
2 Develop a rubric that can be used to assess learners on the topic you taught in Activity 8.

Tips

- Items should focus on the knowledge and skills gained by learners

Activity 10 Developing and evaluating assessment items on plants and their environment

When developing and evaluating assessment items, the table of specification for science and technology should be used. In developing the test items ensure that the test is clear, consistent and it systematically measures the behaviour or what is learnt. Before the test is administered it should be trial tested to ensure that it meets six specific criteria which are clarity, consistency, validity, practicality, efficiency, and fairness.

a. In groups study the table of a checklist of questions that should be asked after the test (or any assessment activity) has been prepared and before it is administered:

Criteria	Indicators
A clearly defined Purpose	Who is being assessed? What material is the test (or activity) measuring? What kind of knowledge or skills is the test (or activity) measuring? Do the tasks or test items relate to the objectives?
Standardization of Content	Are content, administration, and scoring

	consistent in all groups of learners?
Validity	Is this test (or activity) a representative sample of the material presented in this section? Does this test (or activity) faithfully reflect the level of difficulty of material covered in the class?
Practicality and efficiency	Will the learners have enough time to finish the test (or activity)? Are there sufficient materials available to present the test or complete the activity effectively? What problems might arise due to structural or material difficulties or shortages?
Fairness	Did the teacher adequately prepare learners for this activity/test? Were they given advance notice?

b. Write a test of 5 questions on plants and their environment which can assess all the levels of bloom taxonomy and check if this test meets all above discussed criteria.
c. Explain how you can answer some of the questions in the table above before administering the test.

Summary of key concepts

- Plants are classified as Flowering plants (e.g. mangoes, maize, rose) and non-flowering plants (e.g. mosses, ferns, conifers)
- Some of the external and internal parts of the seed include testa, plumule, radicle, micropyle, scar
- Conditions for seed germination are warmth, moisture and oxygen gas
- Plant growth and development involves increase in size, height, mass and number of structures (e.g leaves, branches, roots)
- Photosynthesis is the process of manufacturing sugar by green plants using water and carbon dioxide, in the presence of chlorophyll and sunlight
- Transport in plants involves Internal structure of roots, stems and leaves
    - Modes of reproduction in plants are sexual and asexual
- Seed and fruit dispersal is the process in which seeds are scattered from the parent plant to other locations.

- Agents of seed dispersal include animals, wind, water and explosive mechanism.
- Learners should be assessed using various tools to check their understanding.

Reflection and Assessment

1 Explain the meaning of the term 'classification'.

2 Explain how you would classify plants using the arrangement of leaves.

3 A learner carried out an investigation to determine the growth pattern of 10 tomato plants. The learner measured the height of each of the plants daily from the time the shoots appeared until the plants matured. The learner then plotted a graph of average height of the plants against days. An S-shaped growth curve was obtained. Explain what the S-shaped growth curve means.

4 Design an experiment which you would carry out to show that water is necessary for seed germination.

5 Describe how you would test a leaf for starch.

6 With the aid of a diagram describe an experiment to show that sunlight is necessary for photosynthesis.

7 Study Figure 1 below.

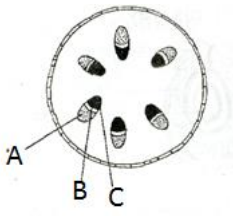


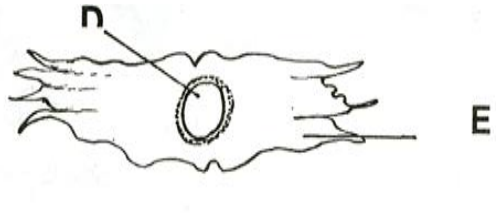
Figure 1

i. Name the parts labelled A, B and C.

ii. What are the functions of the parts labelled **A** and **C** in Figure 1?

8 Compare and contrast characteristics of wind and insect pollinated flowers.

9 Figure 2 below shows a seed of *Tecoma.*



i. Name the parts labelled D and E.

ii. Explain how the seed is dispersed.

Glossary

Photosynthesis : the process in which plants combine carbon dioxide and water in the presence of sunlight and chlorophyll to produce carbohydrates. Oxygen is released as a by- product.

Classification : the sorting out of things according to their differences and similarities

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TOPIC 5 Teaching of animals and their environment

TIME: 3 Hours

Introduction

It is necessary for learners in primary school to learn about animals and their environment so that they may be able to understand animal behaviors and how to relate to them. The knowledge and skills learnt in this topic will help student teachers understand how to handle the topic "Animals and their environment" in primary schools.

Success criteria

By the end of the topic student teachers must be able to:

- explain the concepts of teaching animals and their environment.
- analyse challenges in teaching animals and their environment.
- use appropriate teaching and learning methodologies to teach learners about animals and their environment.
- assess learners' ability to understand the relationship between animals and their environment.

Background information

There are different kinds of animals that live in different environments. These animals can be classified in different ways according to their similarities and differences.

As animals interact in their environment, they are exposed to danger. They survive by protection, reproduction, hibernation and feeding habits.

Misconceptions

- Some animals like frogs fall from the sky during the rainy season
- When you meet certain animals like snakes it is a bad omen
- When animals like owls are seen on roof tops of houses it is a bad omen
- Some eyes of animals produce fire
- Certain parts of animals are not edible by children
- Certain animals are sacred

Activity 1 Identifying challenges in learning about animals and their environment

In this activity, student teachers will identify challenges that learner face when learning about animals and their environment in addition to the misconceptions listed above.

For student teachers

a. Reflect on your own early primary school days. How were issues of animals and their environment viewed?
b. Come up with a list of misconceptions that you had about animals.
c. Share these with the whole class using walk-around-talk-around method.
d. Use paired brainstorming to generate a number of strategies you might use to address the

challenges that learners face in learning about animals and their environment. Share the strategies to the class for discussion using give one take one.

Tips

- Provide student teachers with some ideas about using learners' misconceptions refer to In Went (2009:36)
- The following methodologies may also be used: know-want to know-learn (K-W-L), Jigsaw, and Free write to cater for learners with diverse learning needs

Activity 2 Analyzing texts on animals and their environment.

This activity involves analyzing textbooks in the primary school on the topic animals and their environment.

For student teachers

In groups:

a. Examine the standard 5 and 7 Science and Technology syllabus, teacher's guide and learner's book to find out what is taught on animals and their environment, Write your findings and report using author's chair.
b. In groups, write a summary of the units which contain topics about animals and their environment.
c. Present your findings to the whole class using a gallery walk or power point presentation.
d. Using mix/freeze/pair reflect on why it is important to teach learners about animals and their environment.

Tips

- The following critical thinking strategies can be used; structured overview paired reading/paired summarizing, one stay, three astray and quick write
- Students should do this activity outside class time

Activity 3 Exploring challenges learners face to understand the concepts metamorphosis and survival mechanisms of animals in their environment

Learners have their own ideas about metamorphosis and survival mechanism and an effective teacher takes account of these ideas when teaching. This activity involves exploring challenges learners face to understand these concepts.

For student teachers

a. In pairs carry out a book research or conduct a short visit to demonstration school on challenges learners have in understanding metamorphosis and survival mechanisms of animals in their environment.
b. Report your findings using ball bearing method.
c. In groups, list the strategies that can be used to overcome these challenges.

d. Using power point presentations or using flash light report your findings to the whole class for discussion.

Tips

- When making a short visit to the demonstration school, make proper arrangement in advance with the subject teacher
- Student teachers may also use the following critical thinking methods: Know-Want to know-Learn, walk around/ talk around and fish bowl/enhanced lecture.

Activity 4 Analyzing teaching and learning methods used in the teaching of animals and their environment

In groups:

a. Conduct a book research and analyze teaching and learning methods.
b. Select methods that can be used when teaching the topic animals and their environment in primary schools.
c. Report your findings using a devil's advocate or debate.
d. Brainstorm and discuss various activities and local resources that can be used to engage all learners in the topic 'animals and their environments.'
e. In your groups, prepare a micro lesson on any concept on the topic animals and their environment'.
f. Use the evaluation tool developed in topic 4 to analyze teaching and learning methods used in the teaching of animals and their environment.
g. Video record the micro teaching lesson.
h. Evaluate these lessons using a 'pen in the middle' method.

Tips

- Each group should choose a different component of the topic 'Animal and their environment' when developing a lesson plan
- Student teachers may also use the following critical thinking methods: paired brainstorming, role play, mix/freeze/pair and M-chart

Activity 5 Assessing learners ability to understand the relationship between animals and their environment

In groups:

a. Identify and analyse varied ways of assessing learners taking account of the challenges of large classes
b. Develop assessment items on the teaching of animals and their environment
c. Report your findings using author's chair.

Summary of key concepts

- Animals can be classified based on a number of characteristics.

- Various animals have developed mechanisms to protect themselves from enemies
- Some invertebrates undergo complete metamorphosis while others undergo incomplete metamorphosis
- Some of the suggested teaching and learning methodologies are; field trips, excursions, group work, research and individual work

Reflection and assessment

1 Having studied the topic explain how can you ensure that learners conserve the habitats for the animals in the environment

2 Why is it important to teach learners about life cycles of mosquitoes?

3 Describe an investigation you would conduct with your learners in standard 7 to study life cycle of house flies.

4 Explain why it is important to use field trips and excursions when teaching and learning the topic 'animals and their environment.'

5 A teacher is planning to teach the topic "Classification of Vertebrates" in standard 6.

a. State any two appropriate learner centered methods the teacher could use in teaching the topic.

b. Explain any three challenges a teacher would face when teaching the topic.

c. Formulate any two success criteria on "classification of vertebrates'

1. Design a checklist with five items that would be used to evaluate learners' understanding of the topic "animals and their environment.''

Glossary

Complete metamorphosis: A change in a life cycle when the stages are completely different from each other during the development of an organism.

Incomplete metamorphosis: A situation where the egg hatches into an organism that resembles an adult and the young organisms resemble each other during development.

Environment: external surrounding in which plants and animals live.

Habitat: a natural home of an animal or a plant.

Invertebrates: animals without backbones.

Metamorphosis: process of changes that take place in

the development of an organism.

Vertebrates: animals with backbones.

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TOPIC 6 Teaching of interdependence between plants and animals

TIME: 2 Hours

Introduction

The environment consists of living things such as plants and animals, and non-living things such as water, soil, air and light. These components of the environment are related to one another in many ways.

Although plants and animals belong to different kingdoms, they depend on each other in various ways such as feeding and protection. Primary school learners need to understand the relationships that exist between plants and animals. This understanding will help them appreciate the importance of the environment and the need to take care of it so that it can continue being sustainable and productive.

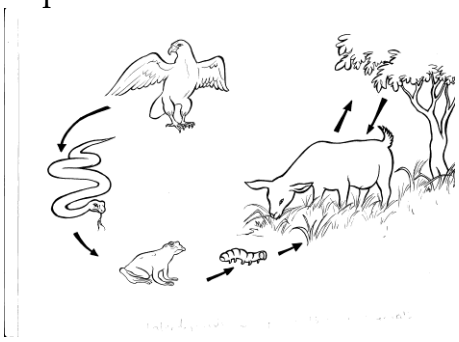
Success criteria

By the end of this topic, student teachers must be able to:

- describe the relationship between plants and animals
- use different strategies on the teaching of interdependence among plants and animals
- assess learners' ability to develop models to demonstrate their understanding of food chains and food webs

Background information

Organisms depend on each other for their living. Some feed on other living organisms while others make their own food. Others find shelter on other organisms. Animals depend on plants for food directly or indirectly. Food chains show how each living organism gets food. Most organisms belong to more than one food chain in order to meet their food and energy requirements.



Pyramids of Numbers, Pyramids of Biomass and Pyramids of energy are derived from food chains.

Misconceptions

- Organisms in the higher trophic levels eat everything that is lower in food chain or food web.
- Plants are not living organisms but animals.

Activity 1 Researching on the topic interdependence among living things

For student teachers

a. Using paired reading analyze the science and technology syllabus, teacher's guide and learner's books for standard 5 in order to find out what learners should learn about the interdependence among living things.
b. Summaries your findings

c. In pairs, report your findings to the whole class using a power point presentation.
d. In groups, conduct a book research or read information on relevant internet sites using your mobile phones/computers on concepts of food chain, food web and food pyramid. Write a report on your findings to show the relationships between plants and animal.
e. Share your findings with the class using a gallery walk.
f. Prepare a field trip/ excursions to study the relationships among living things.
g. Using your cameras or mobile phones, take photos of some relationships among living things in your local environment.
h. Share the photos to your classmates

Tip

Provide science and technology syllabuses, teacher's guides and learners' books for standard five before the lesson begins

Activity 2 Examining strategies in teaching relationships between plants and animals

Teaching relationships among living things requires a lot of concrete examples to ensure that learners are able to see the relationships. In order to achieve this, the use of a variety of methods is required.

For student teachers

a. Brainstorm in pairs various learning difficulties among learners of diverse educational needs when conducting field trips and excursions.
b. Share your discussions with the whole class using recorded information in your mobile phones.
c. In your groups, analyze teaching and learning strategies you might use to accommodate learners with different needs on the topic relationship between plants and animals.
d. Present you findings to the whole class using plenary.

Activity 3: Developing assessment tools to assess learners' understanding of food chain and food webs

a. In group, brainstorm some of the assessment tools that are relevant when assessing models of food chains and food webs which are made by learners.
b. Formulate the tools in groups.
c. Display the tools in class for discussion using bus stop.

Summary of key concepts

- Plants are primary producers.
- Animals feed directly or indirectly on plants.
- Food chains and food webs help to maintain the balances of plants and animals.
- Ecological pyramids show the flow of energy, number of

organisms and biomass of organisms from one trophic level to the other.

Reflections and Assessment

1 Imagine that learners are disputing that human beings can depend on plants or that plants can depend on animals. What can be done to convince the learners?
2 With relevant examples from learners' everyday life, differentiate a food chain from a food web.
3 Design a checklist with five items you would use to evaluate learners understanding of interdependence between plants and animals.
4 Explain in your own words why it is important to teach learners in primary school about the interdependence between plants and animals.
5 Describe any three practical activities that a teacher would engage learners in when teaching and learning 'interdependence between plants and animals''.
6 identify a symbiotic relationship that exists between the following organisms;
   i. A bird eating a snake.
   ii. Protozoa in the human body.
   iii. Ticks on the back of a cow feeding.

Glossary

Ecological pyramid: graphical representations of food chain and food web.

Food chain: the series of organisms showing feeding relationships.

Food web: a series of branching /interrelated food chains.

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TOPIC 7 Teaching of human skeleton

TIME: 2 Hours

Introduction

The human skeleton is vital to the functioning of the human body. Understanding the parts and functions of human skeleton will assist learners in taking appropriate measures to take care of their own skeleton.

The skills and knowledge gained will assist student teachers to teach this topic in primary school effectively and efficiently in order to generate an understanding on how the human skeleton works.

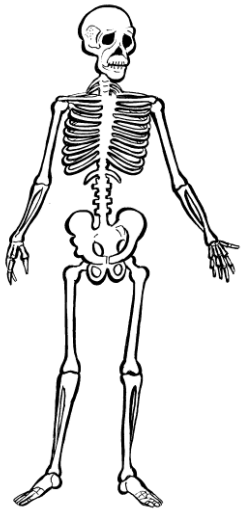
Success criteria

By the end of this topic, student teachers must be able to:

- develop a model of a human skeleton
- explain challenges learners would face in understanding human skeleton
- explain different strategies for teaching the human skeleton.
- assess learners' performance on the topic human skeleton

Background information on teaching and learning about human skeleton

The human skeleton is made up of bones and cartilage. It provides a framework to support the parts of the body, protects internal delicate parts, helps in formation of blood, assists in movement and stores some minerals.



To allow movement, the skeleton has muscles and joints. There are two types of joints; movable which include hinge joint, ball and socket and gliding joints; immovable joints found in the skull and hip bone.

The muscles contract and relax to cause movement. There are three types of muscle namely, skeletal muscles, cardiac muscles and smooth muscles.

There are several problems associated with the human skeleton. These problems include fractures, sprains, dislocations, arthritis and osteoporosis.

Misconceptions

- An fat person has more and big bones.
- Exercises are not part of taking care of the human skeleton
- Bones are not living

Activity 1 Identifying challenges in learning about human skeleton

The teaching of the skeleton is an abstract concept. As such it brings a number of challenges to both teachers and learners. This activity aims at identifying some of these challenges.

For student teachers

The misconceptions as listed above are some of the challenges that learners may face when learning human skeleton.

a. Using think-ink-pair share, reflect on your old school days then write down a list of things that you found challenging including the misconceptions you had before learning about the human skeleton.
b. Share the list to the whole class using a semantic map.
c. Conduct a research on the internet using your mobile phones to come up with a list of challenges and misconceptions when learning human skeleton.
d. Share your findings with the whole class using a gallery walk.
e. In your groups, conduct a research at the demonstration school to explore various strategies on how you would overcome the challenges in a class of learners with diverse needs.
f. Using pen in the middle, report your findings.

Tips

- **The visit to the demonstration school should be done outside class time**

Activity 2 Conducting a book research on the topic human skeleton

The topic human skeleton has been included in primary school curriculum in order for learners to have an awareness of their skeletal system. The activity involves finding out what learners learn on the topic human skeleton.

For student teachers

a. Using paired reading, analyse the science and technology syllabus, teacher's guides and learner's books for standard 6 in order to explore what learners should learn about the human skeleton
b. Share your findings with the class using the authors' chair
c. In your groups, conduct a book research or read information on the internet site using your mobile phones/computers on the rationale for learning the human skeleton and how it can be linked to prior knowledge of learners
d. Write the findings on chart paper.
e. Use bus stop to present the findings

Tip

- ICT tools should be used appropriately

Activity 3 Developing a model of the human skeleton

In order to teach the topic of the human skeleton effectively, a model should be used because it is unethical to use real human skeleton. In this activity, a model of the human skeleton will be developed.

For Student teachers

a. In pairs, study the illustrations of the human skeleton on page 10 of Science and Technology teachers guide for standard 6 and page 6 of learner's book or from any other relevant Biology book.
b. Also study the model of a human skeleton found in the science and technology laboratory.
c. In groups, analyse functions of parts of the human skeleton.
d. Share your points using walk around talk around.
e. In groups, analyse materials and procedures for making a model of a human skeleton.
f. In the same groups, develop a model of the human skeleton.
g. Present the model to the class for comments.
h. Take pictures of your model using camera for reflection and future reference.

Tip

- Use appropriate model of the human skeleton from the science and technology

Activity 4 explaining different strategies when teaching the human skeleton

This activity will help to explore different strategies that can be used when teaching the human skeleton.

For student teachers

a. Brainstorm different resources and strategies for teaching the topic human skeleton
b. Compare your findings with the ones found on page 12 of Science and Technology teacher's guide for standard 6
c. Make a table of the Strategies and the Resources listed.
d. In groups, choose a component of the topic and prepare lesson plan.
e. Present your lessons plan to the class for observations, pointing out strengths and areas of improvement in the lesson plans.

Tips

- Ensure that groups should not prepare a lesson from the same concept of the topic
- Advise student teachers to include resources and methodologies in their lesson plans that are inclusive and cater for learners with different needs

Activity 5: Analyzing ways of assessment on the teaching of the human skeleton

For student teachers

a. Suggest some of the ways you can use to assess learners on the topic human skeleton. Discuss the advantages and disadvantages of the ways suggested.
b. In groups, develop assessment items on some concepts about the human skeleton.
c. Compare the items with those of another group for comments.

Summary of key concepts

- The skeleton is the framework of the human body
- The human skeleton is made up of bones and cartilage
- It is composed of 208 bones
- The human skeleton performs a number of functions some of which are Movement, protecting delicate parts and maintain the shape of the body
- The human skeleton is made up of two main parts; the axial skeleton (skull and vertebral column) and the appendicular skeleton (girdles and limbs)

Reflections and Assessment

1 Explain why it is necessary to teach primary school learners about human skeleton.
2 After learning about how to teach the human skeleton, suggest how it can be cared for.
3 Drawing on your knowledge of the functions of the human skeleton, how can you demonstrate that the human skeleton protects internal organs?
4 Describe various ways you would teach learners to take care of the human skeleton.
5 Outline steps you would use to make a model of human skeleton using local resources.
6 Write down any three success criteria that would enable you achieve the practical aspects of the topic 'Human skeleton'.
7 Write down any three hands on activities that the learners would be involved in during the teaching and learning of the topic human skeleton
8 A standard 6 teacher planned to teach a lesson on "human skeleton".
   i. Mention any two teaching and learning resources the teacher would need for the lesson.
   ii. Give any two methods that would encourage full participation of the learners
9 Design a checklist with five items you would use to evaluate learners' understanding of human skeleton.

Glossary

Appendicular skeleton: region of human skeleton made up of shoulder blades (pectoral girdles), hips

(pelvic girdles), arms and legs

Axial skeleton: region of human skeleton made up of the skull, rib cage and vertebral column

Bone: a living hard connective tissue

Cartilage: a flexible connective tissue with a smooth glossy appearance

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TOPIC 8 The teaching of coordination

TIME: 4 hours

Introduction

The human body is a complex system that contains different parts which requires coordination. It is important for learners to learn about coordination in order to understand how a human body functions. The main focus of this topic is on the senses and their respective organs.

Student teachers should learn the relationship of sense organs and nervous system, sense organs and their functions, analyse the nervous system and its functions in order to understand how their bodies function and how parts of the body complement each other functionally. The thorough knowledge of these will help you understand how the body works in order that you are able to teach the topic effectively.

The main focus of this therefore, on the senses and their respective organs.

Success criteria

By the end of the topic, student teachers must be able to:

- explain the concepts for teaching coordination in human beings.
- use appropriate teaching and learning methodologies to teach coordination.
- assess learners' understanding

of the relationship between the five senses and the nervous system.

Background information

Coordination is the process of organising different elements of a complex body or activity to work together effectively.

Coordination system of the human body comprises sense organs and human nervous system. The sense organs include the eye, ear, skin, tongue and nose. On the other hand, the nervous system in made up of the brain and the spinal cord.

Misconceptions

- The sense organs work independently
- The nervous system is a difficult topic to understand

Activity 1 Identifying challenges in learning about coordination

The misconceptions cited above are just part of the challenges that learners may face when learning coordination. The purpose of this activity is to identify challenges learners may have in understanding the topic coordination.

For student teachers

a. Reflect on your own learning of coordination and come up with a list of the challenges that you encountered and the misconceptions that you had about the topic coordination.

b. Share the list of misconceptions with a friend
c. Use ideas from Inwert, (2009) on pages 35 and 36 in order to develop your understanding of how you can use learners' misconceptions as the starting point for your lessons.
d. Present to the class for discussions.
e. In groups, brainstorm strategies that you might use to address the challenges that children face in learning about coordination.
f. Present the strategies using ball bearing.

Tips

- use models to show the parts
- Ensure Inwert(2009) or the specified pages are available before the activity

Activity 2 Analyzing text on the topic coordination

Coordination is one of the topics taught in primary schools. There is need to be familiar with the concepts that are taught.

For student teacher

a. In group identify the concepts about coordination which are taught in the primary school using syllabuses, teachers' guides and learners' books.
b. Present your findings on a flip chart and display in class for discussion.
c. In pairs, explain the rationale for teaching and learning the topic coordination in the primary school.
d. Present your discussions to the class using author's chair.

Activity 3 Developing different strategies on how to teach coordination

To teach the topic effectively, the teacher should use the right methods and resources

For student teacher

a. Using paired brainstorming, list some of the teaching methods you may use to teach coordination.
b. Present your discussions using walk around talk around.
c. Suggest some of the teaching and learning resources for teaching the topic coordination.
d. Make models of some of the organs of the topic coordination.
e. Display the models in the classroom for observations and comments.

Activity 4 Microteaching on some concepts on the topic coordination

To perfect the teaching skills there should be enough practice. This activity, micro teaching on the topic coordination will be done.

For student teacher

a. In groups, read about science activities for learners in the book 'Science Teachers handbook' by Byres (1994) on the topic coordination or any other relevant books.
b. Prepare lesson based on the activities
c. Microteach the lessons.
d. Evaluate the lesson presentations.

Activity 5 Analyzing varied ways of assessing learners on the topic coordination.

Assessment is an important component in the teaching and learning because it monitors the level of achievement. This activity involves the development of tolls that can be used when assessing learner's performance on the topic coordination.

For student teachers

a. In groups explain how issues of assessment can incorporated when teaching the topic coordination.
b. In pairs, develop assessment tools to assess the teaching of coordination.
c. Present to the class for discussion using gallery walk.

Tip

- **Use Microsoft package to develop the assessment tools**

Summary of key concepts

- Coordination the linking together on body systems and processes. It is made of sense organs and nervous system.
- The sense organs are the eye, the nose, the mouth, the skin and the tongue.
- The nervous system is divided into two: central nervous system and peripheral system.
- Reflex action is an automatic and rapid response to stimulus.
- Reflex arc is a path followed by a nerve impulse from the receptor to the central nerve system to the effector.
- Sensory, motor and association neurons link the sensory organs and the central nervous system.
- Modelling is good for mastery of content and ideas.
- Games also help to teach the content effectively to cater all learners. For instant when linking senses.

Reflection and Assessment

- In your own words define coordination.
- Why are semi-circular canals set at right angles to each other?
- Which is reading in a moving vehicle not recommended?

- Prepare suitable teaching, learning and assessment resources that you can use in the lesson.
- Conduct a micro-teaching using the resource prepared. Assess the suitability of the resource in groups.
- Mention any one inclusive assessment method that can be used when teaching coordination?

Glossary

Reflex action: an automatic rapid response to stimulus

Reflex arc: a path through which a nerve impulse passes from the receptor to the central nervous system to effector.

Stimulus: any change in the environment that affects an organism

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TOPIC 9 The teaching of properties of matter

Time: 5 Hours

Introduction

All objects whether living or non-living are made up of matter. Matter is anything that has mass and takes up space. It is classified based on physical properties. There are three states of matter: solid, liquid and gas. It is also classified based on chemical composition and such a classification of matter includes elements and compounds.

The types of matter differ in many ways; some are visible while others are invisible. They are used in many ways in day to day life. Therefore, it is important that learners in primary schools learn about examples of matter found in the environment.

By understanding the properties of matter, learners will appreciate the building blocks of nature. Learning about states and properties of matter will allow learners understand the changing world they live in and appreciate how things are made in the universe.

This topic focuses on building knowledge and skills on how to teach the properties of matter.

Success criteria

By the end of the unit you must be able to:

- Link the teaching of properties of matter to prior knowledge of learners.
- Analyse challenges learners would face in understanding properties of matter.
- Use different strategies on the teaching of the properties matter.
- Develop assessment items on properties of matter.

Background information

Matter is anything that occupies space and has mass. There are four states these are solid, liquid, gas and plasma. Matter is classified based on physical and chemical properties. Examples of physical properties of matters are; compressibility, volume, shape and density while examples chemical properties are ability to change from one substance to another.

Matter changes from one state to another through heating or cooling. The processes through which matter changes from one form to another include: melting, condensation, freezing, evaporation and sublimation.

Applications of change of state of matter include; drying of clothes, making ice blocks and distillation of

alcohol.

Misconceptions about properties of matter

Sometimes learners have misconceptions about the three states of matter, their properties and how they change from one state to the other such as;

- particles of solids have no motion.
- gases have no masses.
- Smoke is a gas.
- gases are poisonous.
- all solids are heavy and hard.
- ice is a liquid.
- steam is hot air.
- expansion of matter is due to the expansion of the particles.

Activity 1: Exploring concepts on the topic 'properties of matter'

In this activity student teachers will explore concepts which are learnt in the topic "properties of matter'. The knowledge will help them understand the content that will be taught to learners in the schools so that they teach it competently.

For student teachers

a In pairs, investigate what learners should learn about properties of matter using the Science and Technology syllabus, teacher's guides and learner's books for standard 6.

b Report a summary of your findings to the whole class using power point presentations.

c In groups, discuss reasons for teaching learners about properties of matter using quick write strategy.

d Share your findings with the class using recorded information on your mobile phones or iPad.

Tips

- Read rationale for teaching science and technology in the preliminary pages of science and technology teacher's guide for standard 8.

Activity 2: Analyzing ways of introducing the topic 'properties of matter' to learners.

This activity will help students to acquire skills of understanding background information of learners which helps to identify gaps in knowledge and skills

For student teachers

a Using a discussion web, identify the prerequisite knowledge learners should have before teaching about properties of matter.

b In groups, explain how you can link the topic 'properties of matter' to prior knowledge of learners when teaching.
c Report your findings using a gallery walk.

Activity 3: Identifying challenges in learning about properties of matter

In this activity students will reflect on the challenges they had about properties of matter and challenges learner have on the topic. An understanding of these challenges will help them teach the topic effectively.

For student teachers

a Reflect on your early primary school days and identify the challenges you had on understanding properties of matter.
b Share with the whole class the challenges you had related to properties of matter using a 'semantic map' method for discussion.
c Take pictures of the semantic map using your ipads or mobile phones for reflection.
d In your groups, read information on the relevant internet sites about 'children's misconceptions on states of matter'
e Share the findings with the class using fish bowl method.
f Using paired brainstorming; describe some strategies you might use in order to overcome misconceptions and challenges learners may have before and during learning about properties of matter.

Tips

- In addition to semantic map, the following critical thinking startegies may also be used know-want to kow--learn (K-W-L_, jigsaw, mix/freeze/pair and free write.
- Assist student teachers to list the misconceptions.

Activity 4: Analyzing strategies for teaching properties of matter

Good choice of methods helps the teacher to teach knowledge, skills and attitudes effectively. In this activity students will explore strategies that students can use to teach the topic "properties of matter" effectively.

For student teachers

a In groups, conduct a book research to analyze teaching and learning methods and a range of resources that may be

used in teaching the topic 'properties of matter' in primary school.

b Report your findings using author's chair.

c Brainstorm various practical activities you can engage learners in when teaching the topic 'properties of matter'.

d In groups, discuss how the topic can be linked to learners' daily lives.

e Present your findings to the whole class for discussion.

Tip

- Ensure that each group has chosen a different concept of the topic 'Properties of matter' for a lesson plan

Activity 5: Designing and developing models for teaching properties of matter (project).

Teaching and learning resources help the teacher to make concepts clear and save time during lesson delivery. This activity aims at developing models which student teachers use to help them teach the topic "properties of matter" successfully.

For student teachers

a Download from the relevant internet sites pictures and drawings of models of the three states of matter that can be used in teaching of properties of matter.

b Alternatively observe models of the three states of matter; solids, liquids and gases in your science laboratory or at the demonstration school.

c Share your findings with the class using power point presentation.

d In groups discuss various local resources and procedure you can use to make models for teaching properties of matter.

e Present your findings in plenary

f In pairs, design at least one model of each state of matter, you would use in teaching properties of matter to your learners.

g Using your mobile phones, take pictures of your model

h Present your model to the whole class and explain how it works.

Tips

- Student teachers should develop models outside the class time.
- Assist student teachers to find relevant internet sites to read information of states of matter

Activity 6: Discussing how Assessment on the topic 'properties of matter can be done

Assessment helps to monitor learning and retention during the teaching and learning process. In this activity, students will develop assessment items on the topic 'Properties of matter'. The skills learnt will help them in assessing learners.

For student teachers

In groups,

a Discuss different ways of assessing learners on the topic properties of matter.
b Analyse assessment items from demonstration school on properties of matter and find out how the items cover all levels of bloom taxonomy
c Present your findings using author's chair.
d In groups write five assessment items on the topic 'properties of matter (ensure that they are of different levels and cater for learners of diverse ability and special needs children.
e Exchange your list of assessment items with another group for critiquing
f Display them on the walls for the class to discuss during gallery walk

Tips

- Ensure that students; assessment items cover various levels of the blooms taxonomy.
- The items should be inclusive for special needs learners.

Summary of key concepts

- Matter can be classified into solids, liquids, gases and plasma.
- All matter has two main types of properties: physical and chemical.
- The physical properties of matter are things that we recognise by sight, smell, touch, hearing or taste.
- Matter changes state when heated or when cooled.
- The changes of state of matter are applied in everyday life for various purposes such as in drying of clothes, making of ice blocks and in distillation of alcohol.

Reflection and assessment

1 Design a checklist of at least five items that you can use to assess learners understanding properties of matter.
2 Explain how the knowledge and skills gained in learning

about properties of matter will assist learners in their everyday life.

3 Describe at least four practical activities you can engage learners in when teaching the topic properties of matter.

Glossary

Compressible: making something smaller by applying pressure or a similar process or becoming smaller in this way.

Matter: anything that occupies space and has mass.

Properties: distinguishing characteristics of a substance used in its identification and description

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TOPIC 10 The teaching of mixtures

Time: 3 hours

Introduction

Mixtures are used by learners in their everyday life. For instance, the air they breathe in is a mixture of gases. Different mixtures are also used to prepare foodstuffs, drinks and drugs. Mixtures can be separated. There are different methods of separating mixtures.

It is necessary to equip learners with knowledge and skills about mixtures and ways of separating them to enable them use it in various situations in their everyday life.

The knowledge and skills gained in this topic will enable student teachers to teach the topic in primary school competently and confidently.

Success criteria

By the end of this topic student teachers must be able to:

- Design experiments which would enable learners to investigate ways of combining substances and separating components in a mixture.
- Analyse challenges that learners face in understanding how to separate a solute from a solvent in a solution.
- Apply appropriate methodologies when teaching methods of combining and separating components parts of a mixture.
- Use appropriate assessment strategies to evaluate learners' skills and knowledge associated with the mixture.

Background information

A mixture is formed when two or more different substances are put together. The substances can be of different state, colour, size or shape. The substances that are put together are not chemically combined. This means that different atoms from the substances that are mixed do not rearrange themselves to form a new substance. Examples of mixture are sand and maize flour or sugar and water.

Mixtures can be formed in a number of ways. These include mixing:

1 a solid and another solid, e.g., bean seeds and sand
2 A solid and a gas, e.g. dust particles in air or fine sand particles suspended in air
1 A solid and a liquid, e.g. sugar and water

2 A liquid and another liquid e.g. petro and paraffin
3 A liquid and a gas e.g. fizzy drinks
4 A gas and another gas, e.g. air

There are two basic types of mixtures. *Heterogeneous* mixture or suspension. This is a mixture where the components that make up the mixture are not uniform. For example, the mixture of maize flour and water. *Homogenous* mixture or solution. This is a mixture where the components that make up the mixture are uniform throughout the mixture for example mixture of water and salt. In this type of mixture, the substance which allows another substance to dissolve is called a solvent while the substance which dissolves in another substance is called a solute. The solubility depends on the temperature and volume of the liquid and on the size of the particles.

Mixtures can be separated. There are different methods used to separate mixtures. These include; hand picking, winnowing, decanting, evaporation, filtration, flotation, magnetism, sieving and paper chromatography. These methods of separating mixtures depend on a number of factors such as particle sizes and nature of the substances.

Misconceptions about mixtures

- In clear mixtures the solute cannot be recovered.
- Mixtures are those with visible components.
- Air is not a mixture.
- Some heterogeneous mixtures are solutions.

Activity 1 Researching on the topic mixture.

In this activity, student teachers will find out more about the topic 'mixtures' through research and they will also find out the reasons of teaching the topic 'mixtures' in primary schools

For student teachers

a. In groups, research on the topic 'mixtures' by analysing national primary curriculum syllabus, learners' book, teacher's guides and on the internet to establish what learners are supposed to cover on mixtures
b. Explain why it is important to learners to learn about mixtures.
c. Present your findings using gallery walk.

Activity 2: designing investigations for separating mixtures

In this activity student teachers will design experiments that will be used to teach learners in primary to

enhance their understanding on the topic 'mixtures'.

For student teachers

a In groups, design investigations that can used to teach learners about mixtures
b Present your findings using gallery walk.

Activity 3: Identifying challenges in learning about mixtures

In this activity, challenges will be generated and used as a basis for further learning.

It is necessary for you as a teacher to reflect on your early primary school days and consider how you understood ideas related to mixtures in your study.

For student teacher

a Individually come up with a list of misconceptions you experienced as challenges in understanding mixtures.
a Share these with the whole class using 'pen in the middle' method.
b Use think-ink-pair share to generate a number of strategies you might use to address the misconceptions that children face in learning about mixtures. Share the strategies with the whole class for discussion using 'card collection and card clustering' method.
c Conduct a book research or read information on the relevant internet sites to find out how you can link the concepts of mixtures to learners' prior knowledge.

Tips

- The following methodologies may also be used: structured overview, Jigsaw, fish bowl/enhanced lecturer and Free write to cater for learners with diverse needs.

Activity 4: Exploring ways of separating components of the mixtures

Separation of mixtures is part of the day to day activities at home. Learners have separated mixture like tea straining, removing stones from beans and many others. In this activity, student teachers will explain different forms of mixtures. They will also separate them so that they understand the concept and how to effectively teach the topic to the learners in the primary schools.

For student teachers

a. Conduct a book research or read information on relevant internet sites about different examples of mixtures and methods of separating components of the mixtures.

b. Present your findings using authors chair

For learners

a In groups, ask learners to brainstorm how they can separate the components of the mixtures. Let learners choose at least two mixtures from the list to separate.

b Ask learners to separate the components of the mixtures based on the characteristics of the components in the mixture.

c Let them establish the importance of separating components of mixtures in everyday life.

d Let them report their points at plenary to the class for discussion

Tips

- Provide student teachers with necessary resources that can be used to separate components of various forms of mixture ,
- Ensure that all the materials are inclusive and respond to learners of diverse needs

Activity 5: Exploring various appropriate strategies for teaching mixtures.

Choice of methods and resources is important in the process of teaching. In this activity, student teachers will explore suitable methods and resources for teaching the topic "Mixtures". This will help to prepare them for teaching the subject effectively.

For student teachers.

a In groups, explore teaching and learning strategies that can be used when teaching concepts of mixtures to learners with diverse needs in a large class.

b Share your findings with the whole class using a gallery walk.

c Conduct a debate on why some teaching and learning strategies may be more suitable than others when teaching mixtures to learners of diverse needs.

d Read information on relevant internet sites or science and technology text books about key scientific language which must be used when teaching the topic Mixtures.

e Share your findings with the class for discussion

Tips

- Advise student teachers to choose methodologies that can cater for learners with different needs
- Alternatively the following strategies can be used in activity 5; brainstorming, walk around/talk around, value line, fish bowl and enhanced lecture.

Activity 6: Conducting a micro teaching session on mixtures

In this activity the student teachers will plan a micro lesson on a concept of their choice from the topic "mixtures" and teach it. The practice will give them confidence as they develop to become teachers

For student teachers.

a. In groups, choose a concept on the topic "Mixtures" and prepare a micro lesson.
b. Present your lesson while the rest of the groups record their observations using video camera or mobile phones or computers with camera.
c. Discuss observations pointing out strengths and areas of improvement in the lesson.
d. State suggestions on how the lesson could be improved.

Tips

- Some of the appropriate concepts to focus on when writing a lesson plan would be; types of mixtures, forms of mixture, methods of separating ingredients of the mixture or uses of mixtures.
- include resources and methodologies in their lesson plans that are inclusive and cater for learners with different needs

Activity 7: Assessing a practical lesson on methods of separating mixtures

Assessment helps to monitor progression of acquisition of knowledge and skills.

In this activity, student teacher will design a tool for assessing learners in a practical lesson on 'separating mixtures'.

For student teachers

In groups:

a Design a check list to be used to assess learners in a lesson on separating of mixtures.
b Paste the chart on the wall for the whole class to see during gallery walk.
c Use author's chair to explain to the whole class how the check list can be used.
d In groups, develop items to assess learners understanding on the topic mixtures
e Present your items using gallery walk.

Tips

- Guide student teachers on the proper design of the table of the check list.
- Assist the student teachers to write correct items for the activities in the practical such as ability to assemble the apparatus and ability to make accurate observations.

Summary of key concepts

- A mixture is a combination of two or more substances that are not chemically combined
- Some mixtures occur in nature such as soil, air, humus, breast milk, crude oil and sea water.
- There are two main types of mixtures namely homogenous and heterogeneous.
- Examples of homogenous mixtures are; air, blood, mixture of sugar and water, mixture of salt and water, mixture of ethanol and water, mixture of paraffin and paint.
- Examples of heterogeneous mixtures are; mixture of bean seeds and maize seeds or sand and gravel.
- Different mixtures can be separated using different methods depending on the nature of components/ingredients.
- Mixtures such as , drugs , food, , fuels, fertilizers, detergents, disinfectants, insecticides and others have different uses in everyday life
- In order to achieve the above content key areas, the following methodologies are suggested; research, group work, discussion web, paired reading/paired summarizing and experiments.

Reflection and assessment

1 State any three forms of mixtures,
2 Describe a step by step procedure that can be used to separate a mixture of maize flour, kitchen salt and beans.
3 Explain in logical order how you can teach learners to recover all components in a mixture of madeya, iron filing.
4 Using a simple well labeled distillation apparatus, outline how kachasu is produced.

5 Formulate any three success criteria that will enable a teacher to achieve the desired outcomes of the topic 'mixtures'
6 Explain how the knowledge and skills gained in mixtures can be applied in everyday life by learners.
7 Describe at least four practical activities you can engage learners in when teaching concepts of mixtures
8 Design a checklist of five items which can effectively be used to assess learners in understanding mixtures

Glossary

Decant: pouring off slowly.

Dissolve: a salute to disappear in a solvent

Distillation: process of evaporating a liquid and condensing the vapour (gas) back into a liquid.

Evaporation: a method of separating a soluble substance (solute) from its solvent by losing the solvent as vapour during heating

Filtration: a method used to separate an insoluble solid from a liquid by passing the mixture through a filter paper or piece of cloth.

Magnetism: a method used to separate ferrous (containing iron) material from nonferrous materials in a mixture.

Paper chromatography: a method used to separate a mixture of coloured liquid such as ink.

Soluble: able to dissolve.

Solute: a substance that dissolves in another substance [liquid].

Solution: the mixture of solute and solvent.

Solvent: a substance [liquid] in which a solute dissolves.

Suspension: it is the mixture of a liquid and solid in which some solid particle settle at the bottom of the container while others remain floating in the liquid.

Heterogenous mixture: is a mixture where components are not uniform

Homogenous mixture: is a mixture where compenents are uniform

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TOPIC 11 The teaching of forces and pressure

Time: 2 hours

Introduction

Forces and pressure are experienced and observed on daily basis in many aspects of our lives.

However, the concepts force and pressure are abstract, thus there is need to involve learners in designing and carrying out experiments so that they have practical experience and concrete examples of forces and pressure.

The concepts of force and pressure should be handled carefully by teachers so that learners understand it with ease. This topic will help teachers to prepare to teacher the concepts of force and pressure effectively

Success criteria

By the end of the topic student teachers must be able to:

1 explain a model of teaching to support learners to understand the relationship between forces and pressure.
2 demonstrate different strategies for teaching of forces and pressure
3 assess learners' understanding of key concepts related to forces and pressure.

Background information

There are many forces acting on objects. These forces enable us to accomplish tasks such as: picking up an exercise book, opening and closing a door and sitting on a chair. Force pushes and pulls us so we cannot fall, for example, pulling each other in a tug of war game, , riding a bicycle fast or making it stop. Forces are responsible for making objects move, stop, and speed up, slow down, stay stationary and change direction as observed when a ball hits the wall.

Pressure is exerted by things like solids, liquids and gases. The knowledge of pressure helps us in many ways like in strengthening dams and construction of lift pumps. Force and pressure are so important that we cannot do a lot of things without them because most of the activities in everyday life involve their application.

It is important to develop an understanding of forces and pressure and their impact on our daily lives so that we can accomplish tasks. For example,

an inclined plane can be made efficient by making its surface smooth or using rollers so that heavy loads are carried more easily because friction is reduced.

Knowledge of the relationship between force and pressure can be used when designing structures, for example, to calculate pressure when constructing the weight bearing parts of bridges.

Misconceptions

- Only animate or moving objects can exert a force.
- If an object is at rest eg a table, there are no forces acting on it.
- A rigid solid cannot be compressed or stretched.
- Friction only occurs between solid objects.
- Things fall naturally – no forces are involved
- Gravity stops acting when the object hits the ground.
- Mass and weight mean the same thing and they are equal at all times.
- Gravity only affects heavy things.
- Power, work, energy and force all mean the same.

Activity 1 Researching about forces and pressure

People experience forces and pressure all the time. Unfortunately many are not aware of these experiences and the related concepts. This activity will explore the concepts of forces and pressure through research.

For student teachers

a. In pairs, brainstorm some of the everyday activities that involve forces and pressure.
b. Join with another pair to share your discussions.
c. Using fish bowl, present to the whole class.
d. Individually carryout a research on some concepts of force and pressure, including meaning, types, measurement, effects, relationships and applications.
e. Write a summary of the concepts and do peer assessment. Present your observations to the class using ball bearing.

- The research work should be done outside class time
- Use improvised resources where ever possible

Activity 2 Exploring what learners learn about forces and pressure in primary schools

The topic force and pressure is taught in the primary schools. This topic is important for the learners' mental and practical development. This activity will find out the concepts of force and pressure taught in the primary schools.

For student teachers

In groups

a. Using primary school teachers guides, learners book and syllabuses, outline all the knowledge, skills and values that learners should gain on the topic forces and pressure.
b. Present to the class for discussion.
c. Using jig saw, discuss the reasons why it important for learners to understand the principles about forces and pressure.

Tip

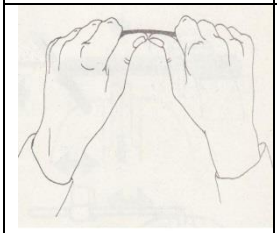
- Ensure that the primary school books are available before the activity

Activity 3 Designing and conducting scientific investigation for teaching forces and pressure

a Prepare the following resources, a nylon rope, arrange with a car owner to bring a car to school, bags of maize , a wheel burrow and two groups of learners to compete in a tug of war

b Use bus stop (work station) to let learners identify forces by creating nine stations and that at each station learners have to do some work in 1 pushing a car, 2 tug of war, 3 lifting a bag of maize, 4 bending a piece of wire, 5 squeezing a piece of cloth to dry, 6 pulling a catapult, 7 Standing on a plank of wood, 8 opening a bottle, 9 Squeezing an orange as shown in the diagrams on **table 9.1**.

Table 9.1 Demonstration of Forces.

	**Work Station 1**
	**Work Station 2**
	**Work Station 3**
	**Work Station 4**
	**Work station 5**
	**Work station 6**

	**Work station 7**
	**Work station 8**
	**Work station 9**

e Describe what you are doing in each of the nine work stations .

f In your work stations identify what is responsible for the actions taking place? i.e. for the car to move (write in one word), for one group to win during tug of war, for the bag of maize to be lifted, for the piece of wire to be bent, for the lemon to be squeezed and for the bottle to be opened?

g. describe what force is by summarizing what is depicted in the diagrams Record what force is using the following table.

Force is	**A**	**1**	**push**
		2	
		3	**Lift**
		4	
		5	
		6	**pull**
		7	
		8	**Turn**
		9	
Therefore force is a push or pull that occurs due to interaction between two bodies			

h. Use ICT to compliment your understanding about what force is. Follow the link below http://www.edinformatics.com/math_science/force.htm

i. Explain to the students that the actions they performed: pushing the car, pulling in tug http://www.edinformatics.com/math_science/force.htm . Of war, moving the bag of maize turning a bottle opener, bending a bamboo, all are what force is.

Tip

- There is need for thorough consolidation of the activities on demonstration of force to ensure that learners understand the concepts

Activity 4 Discussing different strategies of teaching forces and pressure in an inclusive classroom

A variety of teaching methods should be used to cater for individual needs of all learners. This activity will analyse teaching methods that are inclusive.

For student teachers

a. As a class, brainstorm the teaching methods you know. Write the methods on cards and paste them on the chalkboard.
b. Using card clustering, categorize the methods into inclusive and non-inclusive methods.
c. Explain in groups the characteristics of the inclusive methods.
d. Present to the class for discussions.

Summary of key concepts

- A Force is a push or a pull
- Vectors show the magnitude and direction of forces.
- The magnitude or strength of a force is measured in a unit called a Newton (N).
- The total force on an object after all forces are added is called the net force.
- Unbalanced forces cause objects to start moving, stop moving or change directions.
- Balanced forces acting on an object do not change an object's motion.
- Friction is a force that occurs when two objects slide over one another.
- Friction may slow down motion or it may produce movement
- The knowledge of forces is commonly applied in daily life.
- **Pressure** is a measure of the amount of **force** acting on a given amount of surface **area**. A quantitative, or mathematical, **relationship** exists **between force, area**, and **pressure: pressure = force / area.**

- This **relationship** has many practical applications.

Reflection and Assessment

1. Survey the college premises including your hostels .Identify any four instances in which the knowledge of liquid pressure is applied.
2. Design one activity that a teacher can conduct to establish the relationship between force end pressure.
3. A brick has a force of 200 newton's. The sizes of its three surfaces are 15cm by 4cm, 15 cm by 3cm and 4cm by 3 cm respectively. Calculate the pressure the brick exerts on the ground when placed on each side. Which side exerts the highest pressure on the ground and why?
4. State whether the boxes below will move or not. Give a reason for your observations in each case.

a. 

t wo forces [pushes]acting on the box opposite each other, 7N and 10N

b. 

Two forces on one side of the box, 13n push and 5N pull and a push of 8N on the other side of the box..

c. 

A pull of 10N and a push of 17 N on one side and a push of 18 n on the side of the box .

5. Fire was produced by rubbing in the past. Explain how the knowledge of friction was used in this case.
6. Drawing on your knowledge of child development explain why it is important to use practical experiments when teaching about forces and pressure
7. Reflect on how a tanker driver is able to stop the vehicle in an emergency when he applies the breaks.

Glossary

- **Force** - a push or pull on an object.
- **Pressure** - is a measure of the amount of force acting on a given amount of surface area
- **Exert** - Act on
- **Friction** - is the resistance to motion of one object moving relative to another

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Time: 7 hours

Introduction

Energy plays a key role in determining the quality of lives. It provides comfort and increases productivity. We encounter different forms of energy in various aspects of our lives. Energy is key to the success of modern economies

Energy is an important concept in all branches of science and technology.

It is important to enable learners to develop an understanding of the properties of energy

Energy demands are closely linked to the economic growth of a country.

Lectures, student teacher and learners need to be aware that there may be overlap between types of energy and an object may possess more than one type at a time. For example, a swinging pendulum has both kinetic and potential energy. In order to communicate the scientific idea of energy to learners, teachers have to simplify it – but still ensure that what is taught is clear and provides a sound basis for developing an understanding.

Success criteria

By the end of this topic student teachers must be able to:

- Explain the concepts on teaching of forms and sources of energy.
- use appropriate teaching and learning methodologies to teach energy
- analyse challenges learners would face in understanding energy and how the challenges could be overcome
- assess learners' understanding of energy and their ability to demonstrate the different ways in which it is produced

Background information

Energy is defined as the capacity or ability of a physical system to do work or cause change. There are different energy sources such as fossil fuels, hydropower, solar power, bioenergy, geothermal energy, nuclear energy, wind power and sound. Energy exists in many forms such as heat, kinetic or mechanical, light, potential,

electrical, magnetic, chemical, nuclear geothermal and sound energy.

Energy has the following properties:

- energy can be transferred from one object to another,
- energy comes in different forms, which can generally be divided into Potential or Kinetic energy,
- energy can be converted from any one of these forms into any other, and vice versa,
- Energy can never be created nor destroyed - this is called the First Law of Thermodynamics.

Energy has different forms which have own unique properties. These properties are a measure of the ability of an object or system to do work on another object or system. In other words, the forms are *different ways in which* an object or a system can possess energy. The table below indicates the specific properties of the forms of energy and their effects.

Table of properties and effects

Form of energy	**Properties**	**Effects**
Light	• Light travels in a straight line • Light can be reflected • Light can be refracted bent • Light can be dispersed • Light can be diffracted.	• Shadow**s** occur when an object blocks light from a light source. • An object that does not let light through is called ***opaque (effect,***

		objects cannot be seen) • Object that allows light to pass through is called ***transparent (objects can be seen through).*** • An object that allows some light to pass through is called ***translucent* (*Effect, objects cannot be seen through).*****
Heat	Heat travel by • Convection either in air or liquid • Radiation • Conduction	• When a material body, solid, liquid or gas, is given **heat energy**, its temperature increases. • When hot body gives out **heat energy** its temperature decreases.
Sound	Sound travels through • Solids • Liquids • Gases • Can be reflected {Echo}. Sound has • Amplitude: ***amplitude*** refers to the length and width of waves, such as sound waves, as they move or vibrate. • Period: Period refers to the time for something to happen and is measured in seconds/cycle. In this case, there are 11 seconds per 33 vibrational cycles. Thus the period is (11 s) / (33 cycles) = *0.33 seconds*. The period is *3.2 seconds*	• Can cause movement of objects. • Can break objects, or shutter them.

	and that the frequency is 0.31 Hz. • Frequency. The number of cycles of vibration in a given unit of time. The number of cycles in a second is one Hertz (Hz). • Wavelength: **Wavelength** is the distance between two identical adjacent points in a wave. It is typically measured between two easily identifiable points, such as two adjacent crests or troughs in a waveform. ... **Wavelength** is inversely proportional to frequency. • Pitch - highness or lowness of sound	
Electricity	• The amount of current (amps) is related to the voltage (volts) pushing the electrons and the degree of resistance to flow (ohms). • During their flow around a circuit, electrons can be used to create a number of useful byproducts such as heat and light. • As electrons flow, they alter the charge of the matter they flow through, which may also generate electromagnetic effects.	• Electric current has the ***chemical*** effect • Electric current has the ***heating*** and ***lighting*** effect • Electric current has the ***magnetic*** effect

Misconceptions about Energy

- Energy is truly lost in many energy transformations.
- There is no relationship between matter and energy.
- Energy is not conserved because we run short of it.
- Energy can be changed completely from one form to another (no energy losses).
- Things "use up" energy.
- Energy is confined to some particular origin, such as what we get from food or what the electric company sells.
- An object at rest has no energy.
- The only type of potential energy is gravitational.
- Energy is a "thing."

- The terms “energy” and “force” are interchangeable.
- Only metals and water reflect light.
- Everything reflects light but only if it is in the Sun.
- Black does not reflect any light and/or white does not absorb any light.
- Only shiny materials reflect light.
- Water does not reflect or absorb light but light can go through it.
- The distance that light travels depend on the amount of energy that light has.
- The stronger the source of light the bigger the shadow and the bigger the source of light the smaller the shadow.
- Shiny objects reflect more light than dull objects.
- Light always passes straight through transparent objects (without changing direction).
- Light needs air to travel.
- The distance light travels depends on day or night.
- Objects that reflect are sources of light (e.g., the Moon).
- Our eyes produce light so we can see things.
- Shadows are always black
- A shadow is a reflection from the Sun.

Activity 1: Identifying challenges in learning about energy

For student teachers

The topic energy is an abstract concept and difficult to understand. This activity will involve stating misconceptions and challenges learners face on the topic energy.

a In pairs, reflect on your own experience about Energy during your primary school days. What misconceptions did you have about energy?

b Exchange your list with another pair to provide suggested solutions.

c Reflect on what type of methods can be used to deal

Activity 2: Developing a concept on teaching of forms and sources of energy.

It is important that the teacher have the right information about energy. This activity involve listing some concepts of some forms of energy.

For student teachers

a In groups research from relevant books and internet and write information about energy – source, forms, effects and properties of energy.

b Use the table below record your findings.

The forms of energy		
Sources of forms of energy		
No	**Form of energy**	**Source**
1		
2		
3		
4		
Properties of energy		
1. 2. 3. 4		
Forms of energy, properties and effects.		
No	**Form of Energy**	**Properties**
1		
2		
3		
4		

No.	Form of energy	Effects
1		
2		
3		
4		
What I found difficult in learning about energy		
No	Form of energy	Specific challenge
1	Light	
2	Sound	
3	Electricity	
5	Heat	

Use authors chair present your findings.

Activity 3: Finding out what learners should learn in primary schools

In this activity primary school books will be used to find out what learners learn on the topic energy.

For student teachers

a In groups, use standards 5, 6, 7, and 8 learners books and teachers guides to write what is learnt in primary schools on the topic energy.

b Use a table to record the information.

a. State reasons why learners need to learn about energy.

b. Present your finding in plenary.

Activity 4 Investigating the properties and effects of the forms of energy

Investigations help learners to acquire basic scientific skills, attitudes and values. As such teacher should how to engage learners in investigations. This activity involves investigating properties of light.

For the learner

1. **Light:**

a let learners design investigations on the properties of light.
b provide learners with chart paper on which to write their designs.
c let learners present their designs during gallery walk.
d ask learners to conduct the experiments following their designs.
e let learners summarize their findings.
f discuss applications of the properties of light you have investigated.
g fill your points in the table below.

Property of light involved	Area of application	How it is used

Activity 5 Researching Heat transfer in Solids, liquids and gases

In this activity, heat transfer in solids, liquids and gasses will be researched.

For student teachers

a. Carry out independent research into the methods of heat transfer in solids, liquids and gases and record your findings in a Table 9.7 below

Table 9.7 Methods of heat transfer

Medium of heat transfer	**Methods of heat transfer**
Solids	
Liquids	
Gas	
Vacuum	

b. Use ICT to acquire ideas on how to design experiments to demonstrate heat transfer in solids, liquids, gases and vacuum.
c. In groups prepare a range of locally available resources that you can use in order to conduct experiments with learners on heat transfer in solids, liquids, gases and vacuum.
d. Prepare a lesson plan on heat transfer using the resources prepared above.
e. Exchange the lesson plan with another group and assess the

key concepts of the lesson. Report the assessment of the key concepts to the class for discussion.

Activity 6 Application of the knowledge of how heat is transferred in solids, liquids and gases

The methods of heat transfer are applied in many situations in daily life. In this activity, the areas of application of heat transfer and how they are applied shall be explored.

For student teachers

a. Carry out independent research on how the methods of heat transfer are applied or used in everyday life, for example, a thermos flask, a ceiling of a house and air vents.
b. Identify areas where the knowledge of heat transfer is applied and explain how it is applied.

Summarize your findings in a Table 9.8.

Matter	Area of application	How it applied
Solids		
Liquids		
Gases		

Activity 7 Developing an understanding that sound is a form of energy

Sound is usually not considered as a form of energy. This activity involves experimentations on sound transfer methods.

For learners

a. Using think pair share let learners identify sources of sound.

b. Provide learners with different objects that produce sound. Let them produce sounds.

c. Ask learners to state how sound is produced.
d. Carry out a research to found out if sound travels in solids, liquid and gases

e. Use mobile phone to conduct a research on the applications of how sound travels in solids, liquids and gases is used in everyday life.

Summarize the findings in Table 9.9 below

Aspect of sound	**How the knowledge is applied**
Transmission of sound in solids	
Transmission of sound in liquids	
Transmission of sound in gases	
Sound produces as echo	

Activity 8 Understanding the concept of electricity as a form of energy

Electricity is one of the most important forms of energy. This activity involves finding out concepts about electricity

For student teacher

a. Using one stay and three astray, share with fellow students what you know about electricity.
b. Using bus stops (work stations) explain how each of the apparatus provided in the appendix produces electricity.
c. Walk from station to station and work on the tasks as presented on the pictures at each work station, ask them to undertake research to find out what is happening at each station.
d. Present or demonstrate what you have learned.
e. List ideas on how you can teach a lesson in standard 8 on how electricity is produced.
f. Present the ideas in a plenary.

Tips

Use a variety of teaching and learning methods such as projects, research and survey in order to provide opportunities for first hand experiences

Activity 9 Investigating the effects of electric current

Electricity is one of the most important forms of energy man has discovered. This activity requires

learners to generate a list of the effects of electric current

For learners

a Using quick write let learners answer the questions, 'What are the effects of electric current?'
b Using authors chair invite some learners to present their responses

For students

a. In groups of four, search on the internet and to find out experiments about the effects of electric current and what can be done with learners to demonstrate the effects. Follow the link below http://www.learnhive.net/learn/cbse-grade-7/science/electric-current-and-its-effects .
b. In the groups of four design a lesson in which learners are asked to conduct an experiment that would enable them determine that electric current has lighting, heating, magnetic and chemical effects.
c. Let them write their designs as follows:

Effect to investigate	**What to do in order to find out?**
Electric current has lighting effect	
Electric current has heating effect	
Electric current has chemical effect	
Electric current has Magnetic effect	

d. Undertake micro teaching to teach the lesson you have prepared.
e. Evaluate on the design and teaching of the lesson.

Tips

- Prepare an electrolyte solution in advance
- Observes safety at all times
- Provide adequate resources for the activity

Activity 10 identifying the use of the knowledge of the effects of electric current.

The effects of an electric current are important in daily life. This activity

involves the uses of effects of electricity.

For student teachers

a. Using ICT work in pairs to produce a presentation on how the effects of electric current are used in everyday life.

(*Diagram of cooker or bulb*)

b. Design experiments to demonstrate to learners in primary school how some of the effects of electric current are used in everyday life.
c. Conduct a micro lesson on the experiment you have designed

Activity 11 Assessing learners on the understanding of topic energy

This activity aims at imparting skills of assessment to the student teachers on the topic energy.

In groups

a Write five assessment items that can be used to assist learners on the topic energy.
b State four problems that learners can investigate on the topic energy. Write two as questions and the other two as statements.
c Write the responses on a chart paper and prevent them using authors chair.

Tip
Guide student teachers on how to present an investigation problem as a statement and as a question

Activity 12 Developing teaching and learning resources for the topic energy

Energy is a long topic with many abstract concepts. This activity involves production of resources that can be used to teach different concepts of the topic

(Diagrams of a circuit board, string telephone, pin-hole camera**)**

For student teachers

In groups, produce one resource for teaching each of the following concepts of energy: light, sound, heat and electricity.

Display your resources for other groups to see and comment using gallery walk.

Store your resources safely for use in future lessons.

Tips

The lecturer should access the resources as a project on resource production

Summary of key concepts

Energy is defined as the capacity or ability of a physical system to do work or cause change. Electricity, light, heat, and sound are the forms of energy. Each form has properties. Energy is used in the home, school, industry, communication and transportation. Each from of energy has properties and effects and it is the knowledge of the effects and properties that we apply. For example the knowledge of the properties of electricity such as lighting effect is used for lighting up our homes.

Reflection and Assessment

- In preparing to teach, design a record sheet where your learners will record their findings focusing on what the effects of electricity are.
- Consider undertaking a science fair project and visit the following web site http://www.all-science-fair-projects.com/print_project_1434_50
- What will you consider as the best way of teaching effects and properties of the forms of energy?
- Reflect on what type of methods you can use to deal with the misconceptions that learners may have on energy.

Glossary

Conduction : Method of heat transfer in solids

Convection : method of heat transfer in liquids and gas

Echo : reflected sound

Electromagnet : Any devise which produces magnetic force by action of an electric current.

Electroplating: **Coating** of a metal by another metal to prevent corrosion and improve appearance

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