

BET 4208 SUBJECT METHODS

PHYSICS

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Lesson 1

The Nature of Physics

1.0 Introduction

In this lesson, I am going to discuss the nature of physics and how it relates to science in general. Science has several branches and physics is one of these branches. Science is seen as a particular way of knowing about the natural

world. In science, the explanations given are limited to those based on observations and experiments. These explanations can be substantiated by other sciences.

1.2 Objectives

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

- Explain the nature of science
- Outline different sources of knowledge
- Examine the four themes of the sciences
- Explain how different themes relates to the teaching and learning of physics

Please note

Explanations that cannot be based on evidence are not part of science. According to a layman, the study of science involves: -

- Discovering nature
- Organizing facts into theories
- A method of discovery
- A body of organized knowledge
- Problem solving

• A process of finding out
• Logical reasoning
• A study of nature
• The search for truth
• Observing and describing reality

1.3 The Scientific Enterprise

Having looked at the layman's view of what science entails, we now look at what is referred to as the **scientific enterprise**.

The Scientific Enterprise explains how scientists go about their work and for what purpose. A scientist will have three main responsibilities. These are

- To understand
- To explain
- To apply the results of that understanding

Physics teachers should aim at achieving these three levels in the course of their teaching. Where the third level is not achieved directly, effort should be made to explain the daily application of the knowledge learnt.

There are different types of scientists. Some are theoretical; others are experimental while others are technologically minded.

Activity 1.1

Explain how physics can be taught so that learners are in a position to apply the knowledge of physics in daily life

1.4 The Nature of science

I want to explain what science entails and how it differs from other subjects.

Science generally deals with the study of living and non-living things. The method of its study is different from the study of humanities and other classical studies. It is different and should be treated as such.

Quote

“Science distinguishes itself from other ways of knowing and from other bodies of knowledge through the use of empirical standards, logical arguments, and skepticism, as scientists strive for best possible explanations about the natural world”

There are other sources of knowledge. This kind of knowledge is different from the scientific knowledge since it cannot be verified or falsified.

- Myth
- Superstition/ Mystical belief
- Personal belief
- Religious values (faith)
- Authority
- Observation
- Speculation
- Imagery and
- Intuition

The explanations for each discovery made need to be documented and communicated well to the intended audience. Scientific explanations must be clear and be able to meet certain criteria, which distinguishes science from other sources of knowledge.

These Scientific explanations must accurately reflect empirical observation and experimental results. It therefore implies that any scientific statement made should be able to withstand verification in different occasions and be able to give similar results.

Logical arguments are also necessary to explain ideas while reserving the right to reject any of its theories and principles. This means that even theories are tentative and remain varied until proved otherwise.

For example, the original model of the atom had the nucleus at the centre of the nucleus as the electrons revolved round them. Later on, this model was revised where the electrons exists at different energy levels.

The earth was initially taken to be the centre of the universe. The scientists held this belief for a long period before this kind of thinking was revised and now the sun became the centre of the universe

1.5The Definition and Conception of Science

We now look at the two main definitions of science.

Competing philosophical orientation has made it difficult to have one universal definition of science. Hence science has many definitions. Basically we have two broad definitions. These are static view and dynamic view. Let us now discuss one at a time and hoe these views impacts on the teaching/ learning process.

(i) **Static view**

According to static view of science, science is a cumulative body of knowledge about nature, which accrues from the application of scientific method.

Such knowledge is a monopoly of experts, which could only be transmitted to novices under the assumption that the people's minds are blank slates "*tabula Rasa*". Such knowledge is assumed to be objective and absolute.

The guiding principle of this view is that scientific knowledge can either be verified or falsified through experiments.

(ii) **Dynamic view of science**

The dynamic view of science emphasizes the **process** of science rather than the **product**; and acknowledges the **tentative** nature of scientific knowledge.

It despises the scientific method as the only source of scientific knowledge.

Scientific knowledge is thus neither cumulative nor objective but conceptual and subjective.

For example, the mass of an object was regarded as static until relativistic theory was discovered and it was shown mathematically that the mass of an object varies with the

speed when the speed of the object is close to the speed of light i.e.

$$M = m_0 / (c^2 - v^2)^{-2}$$

Where M is the mass of the object, m_0 is the original mass, c the speed of light and v the speed of the object.

Activity 2

1. Differentiate between the static view and the dynamic view of sciences.
2. Explain how these views affect the teaching of physics

1.6 The Themes of the Sciences

Science is basically grouped into four themes. These are; -

- Science as a way of thinking
- Science as a way of Investigating
- Science as a body of Knowledge
- Science and its interaction with technology and society

These four themes should be evident in science instruction in various degrees. Table 1 gives a summary of the four themes of sciences.

Table 1: Themes of sciences

Science as a way of thinking
Science as a way of investigation
Science as a body of knowledge
Science and its interaction with technology and society

The illustrations indicates that science content is often given more consideration than other dimensions

1.6.1 Science as a Way of Thinking

Science has several components. Different people perceive it differently. One way is when it is seen as a way of thinking. The early scientists held this view for a very long period. According to Einstein, 1954

“The whole of science is nothing more than a refinement of everyday thinking.” Einstein, 1954

In this view, the study of the sciences involves the clarification of beliefs, curiosity, imagination, reasoning and clarification of cause and effect relationships.

Let us now see the meaning of each of these.

- **Beliefs**

Science tries to explain some of the beliefs held by the scientists about the natural world. For example, the belief that the earth was the centre of the universe was dominant for thousand of years. Even **Copenicus** believed that the earth's orbit around the sun was circular rather than elliptical. This view of the earth being seen as the center of the universe was held to be true until it was proved that this was not the case.

- **Curiosity**

Scientists are naturally uncontrollably curious. They have many interests and always try to answer the question, why? This has been the case since antiquity. They have always tried to pursue many of these interests with an intention of understanding the world and also trying to get self-fulfillment. For example

1. **Nicholas Copenicus** (1472-1543) caused a revolution when he placed the sun at the centre of the solar

system instead of the earlier held belief that the earth was at the centre. He also pursued many vocations.

“Copernicus was a churchman, a painter, an economist, a poet, a soldier, and a scientist.”

2. **Jean Henrie Fabre** (1823-1915) began his fascination with insects at an early age. He finally produced volumes describing anatomy and behaviors of insects including bees, gnats, dung beetles, spiders and scorpions.

3. **Leonardo da Vinci** (1452-1519) was a great artist and scientist. He came up with sketches of gears, hydraulic jack, flying machines, parachutes, cranes, drilling machines, underwater breathing apparatus and many others.

- **Imagination**

In addition to being curious, scientists rely heavily in imagination. For example,

1. **Albert Einstein** came up with the theory of relativity. He imagined himself riding on a beam of light holding a mirror in front of him, reasoning how long it would take a light beam to register his image back to him to a stationary observer.

2. **James Clerk Maxwell** formed abstract pictures that he attempted to solve concerning electromagnetic fields.

3. **August Kekule** visualized the benzene ring in a dream when he dreamt of a snake biting its tail.

- **Reasoning**

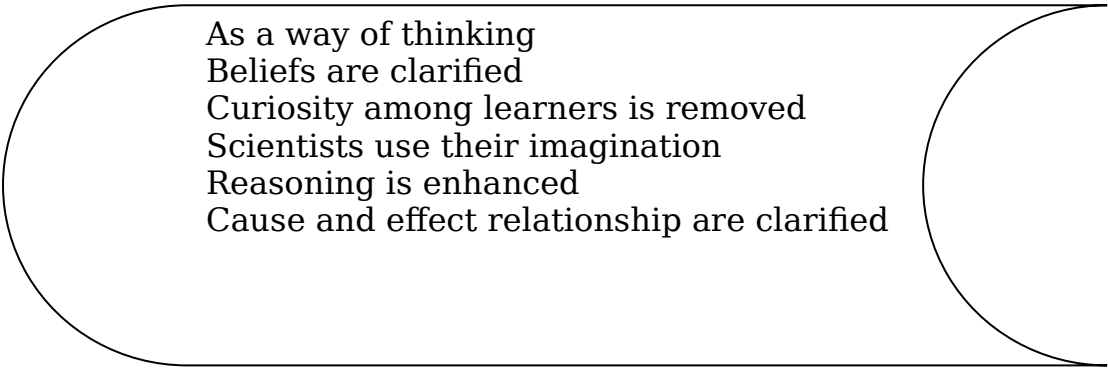
Scientists engage in a variety of reasoning behaviors to elucidate patterns in nature. They either use **inductive** thinking or **deductive** thinking.

Through inductive reasoning, one arrives at explanations and theories by piecing together facts and principles.

Deductive reasoning involves the application of general principles to other instances. The deductive process makes inferences about specific situations from known or tentative generalizations.

This form of reasoning is often used to test hypothesis, either confirming or disproving them.

The following figure gives a summary of what we have discussed.



As a way of thinking
Beliefs are clarified
Curiosity among learners is removed
Scientists use their imagination
Reasoning is enhanced
Cause and effect relationship are clarified

Cause and Effect Relationship

Scientists often seek to establish cause-and-effect relationship to advance their understanding of the world. An example in point is Newton's third law of motion, which states that for every action, there is equal, and opposite reaction. Many of these relationships can be represented by a graph showing the y-and x-axis.

1.6.2 Science as a Way of Investigation

The processes involved in investigations and enquiry includes observing, manipulating variables, experimenting and calculating and hypothesizing among others. These scientific skills acquired through this process are refereed to as *process skills*. The scientific method is also followed when experimenting.

- **Hypothesis**

A hypothesis is an investigative tool that helps the inquirer to clarify ideas and state relationship so that they can be tested. It is an untested condition that needs to be examined.

It can also be referred to as a concise statement that attempts to explain a pattern or predict an outcome. It can

also be referred as an “***educated guess***”. Hypotheses remain tentative until proved or disapproved.

- **Observing**

Through observation, data and information are gathered and organized to make sense out of reality. For example, when data is collected after performing an experiment, it may not make any meaning on the face value until it is organized into patterns that make sense. For example, when the data is used to plot a graph, then it becomes easier to see the relationship between the variables under study.

- **Experimenting**

Through experimenting, ideas can be confirmed or supported and erroneous beliefs that have been passed down by authority can be discarded.

Cause and effect relationship can be tested and determined. For example, an experiment can be done to show the relationship between force and extension on a wide range of values. A graph can then be drawn to show this kind of relationship.

- **Mathematics**

The formulae and symbols assist in identifying relationships that represents laws and patterns. It also helps in

representing models of situations that we cannot possibly observe. Some known formulae in physics are:

1. $F=ma$
2. $S=ut + \frac{1}{2}at^2$
3. $v=u + at$
4. $V^2=u^2+2as$

Each of these formulas has some implications, which need to be understood by the students. Each letter represents a physical quantity. Letter s represents displacement, which stands for distance covered in a straight line, t stands for time in seconds, u stands for the initial velocity while v stands for the final velocity of motion.

What we have discovered so far can be summarized as shown in table

Below.

Science as a way of thinking involves:

- Testing of hypotheses
- Making of observations
- Experimenting
- Solving mathematical problems

1.5.3 Science as a body of knowledge

The facts, concepts, principles, laws, hypothesis, theories and models form the content of the sciences. When teachers see physics as a body of knowledge, they put emphasis on the coverage of the syllabus.

- **Facts**

A fact is often a thought of a truth and the state of things. Facts represent what we can perceive through the senses. It should be noted that the representation of facts alone in science is not enough, because the receiver of the information should know how the facts were established. The lowest level of teaching involves giving factual information about something as it is. At the level of knowledge, students may be asked to define some basic known facts.

- **Concepts**

The relationship between facts is called a concept. Therefore a concept is an abstraction of events, or phenomenon that seems to have certain properties or attributes in common. The concept of density shows the relationship between mass and volume of a substance.

A concept has five attributes/elements. These are:

1. name
2. definition
3. attributes
4. Values
5. Example

Examples of concepts are an electron, proton, neutron, a wave, solid and, x-rays.

- **Laws and Principles**

Laws and principles are composed of concepts and facts. They describe phenomena and patterns of nature. For example, gas laws show the behavior of gas under different conditions. Boyle's states the relation between pressure and volume when the temperature of a gas is kept constant.

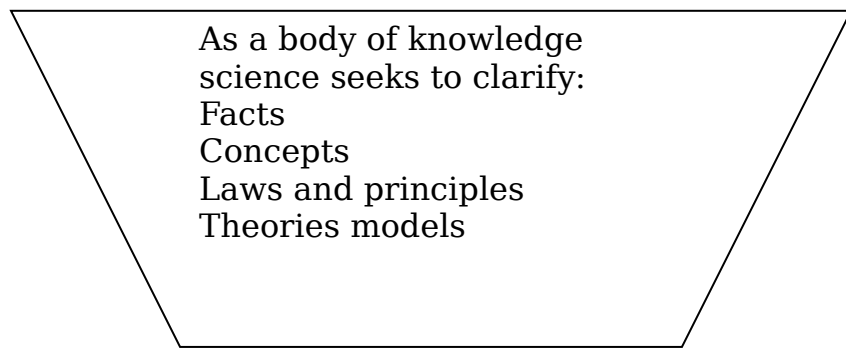
- **Theories**

Theories are used to explain underlying patterns and forces. They remain tentative until disproved or revised. The theory of relativity estimates the behaviors of an object if it is moving at speed close to that of light.

- **Models**

A scientific model is a representation of phenomenon that we cannot see or observe directly. It can either be in the form of a concrete structure or a mathematical model e.g.

1. The Bohr Model of the atom
2. The planetary model of the solar system
3. The double helix of the DNA

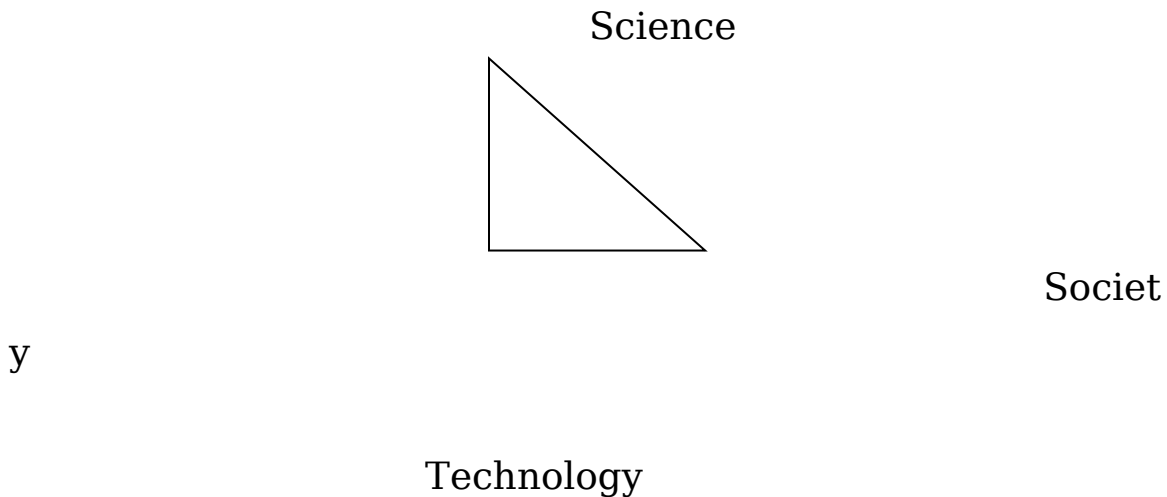


A model of an engine is a miniature representation of a real engine. It is an example of a concrete model that can be used to teach some principles of physics. Other models are very effective in the teaching-learning process.

1.5.4 Science and Its Interaction with Technology and Society

Scientific progress is influenced by the society and the availability of technology to support data collection and analysis. Some highly sophisticated equipment is used to advance scientific knowledge. These include particle accelerators, chromatographs, spectrometers, electron beam microscopes, space telescopes, spaceships and

integrated circuits among others. The relationship among the three valuables can be presented by a triangle as shown below.



This relationship shows that science needs society and society cannot function without technology.

Summary

We cannot divorce ourselves from the applications and utility of scientific knowledge. Physics plays a very major role in nation building. There is need for physics teachers to utilize the opportunities available to develop well-grounded citizens in all aspects of physics who will in turn develop this nation and the world at large.

The understanding of different themes of the sciences

Revision Exercise 1

1. By use of examples, explain how the study of physics helps in technological advancement.
2. Models are useful resources in the teaching of physics. Mention five examples of models used in physics and in each case, explain the concepts and skills learnt.
3. Differentiate between *process science* and *product science* and their implications to the teaching of physics.
4. Using an example, explain how a physics teacher would incorporate the four themes of sciences in one topic.
5. Explain how the study of physics differs from the study of other subjects.
6. Mention six sources of knowledge and how each of these sources relates to the study of physics.
7. The current approach to the teaching of science is emphasis on the process skills.
 - a). Explain clearly how each of the following process of generating the scientific knowledge can be implemented at secondary school level.
 - i. Observation
 - ii. Experimentation
 - iii. Speculation
 - iv. Imagery
 - v. Intuition

b). Explain at least eight different ways in which a physics teacher can enhance the learner's power of imagination.

8. A fundamental approach to physics teaching is the emphasis on learning theories.

a). Explain how each of the following influences the teaching of physics

- i. Developmental theories of learning
- ii. Behaviorist theories of learning
- iii. Constructivist theories of learning]
- iv. Social theories of learning

b). Metacognitive theories have proposed a variety of techniques for enhancing concept formation. These techniques include; word association where the relations between the words that represent different concepts are constructed; concept maps; concept trees and V- diagrams.

- i) Distinguish between concept maps and concept tree
- ii) Explain the meaning of Heuristics

- iii) Explain the characteristics of V-diagram

LESSON 2

RECENT DEVELOPMENT OF PHYSICS AND ITS PEDAGOGICAL IMPLICATIONS

2.0 Introduction

In this lesson, am going to discuss the changes that have taken place in physics education since Kenya received her independence in 1963. These changes were necessitated by the need to have education that meets the aspirations of the nation.

When Kenya became free from the colonial masters, she carried on with the education system that was in existence then. In order to meet the new goals of eliminating poverty, ignorance and diseases, the curriculum that was to achieve this had to be put in place.

2.1 Objectives

By the end of this lecture you should be able to:

- Define the term innovation
- Distinguish between internal and external factors that necessitated changes in the curriculum
- Explain the reasons why curriculum needs to be reviewed
- Describe the phases of curriculum innovations in Kenya

2.2 Meaning of Innovation

Innovation generally means to make changes or to introduce something new. When curriculum undergoes some innovations, some topics may be added or removed. The structure of the topics may also be changed.

2.3 Changes in Science and Mathematics Curricula

Science and Mathematics education have experienced some fundamental innovations since independence in terms of:

- a) Content-this refers to all the topics included in the syllabus.

- b) Teaching materials-refers to instructional resources, including textbooks, apparatus, and media
- c) Teaching methods- this includes both the teaching methodologies and the approaches used
- d) Assessments-refers to the process of including value judgements of the learners' performance in the learning process. Both formative and summative evaluation will be considered.

2.4 Phases of Curriculum Innovations

Having looked at the meaning and areas of curriculum innovations, we now look at the phases that have taken place in Kenya so far.

There has been four main phases of curriculum innovations in Kenya since her independence in 1963. These phases are summarized in table 3 shown below.

Table 3: Phases in Kenyan Education Sector

	Phase	Period

1	Experimental/latent phase	1963-1967
2	Adoption phase	1968-1980
3	Adaption phase	1981- 2002
4	Ownership phase	2003-date

The changes introduced were brought about by internal and external factors.

2.5 Reasons for the changes

Let us examine some of the reasons that brought the changes that we are going to discuss in the preceding session. We have two main factors considered as internal and external factors

2.5.1 Internal Factors

The internal factors are within the country. The main consideration for the change is to improve the Education System with the aim of improving the lives of the citizens. Education is meant to serve the aspirations of a society. After independence, it was the opinion of the educators that the education system was not serving the nation adequately since its graduates were not well prepared to face the challenges of work.

Furthermore, prior to independence, there were different curricula for different groups, one for Europeans, another one for Asians and another one for the Africans. There was a Pure Science (physics, chemistry and biology) for the Europeans that were meant to prepare them to take managerial jobs in the society. The Asians did the Physical Sciences. This system trained them to provide skilled manpower that enabled them to work in industries. The Africans did the General Sciences, which was a combination of physics, chemistry and biology. They ended providing the manual labor and therefore could not be remunerated well as their counterparts, the Asians and the Europeans. There was need to eliminate this disparity and this necessitated change in the curriculum.

2.5.2 External Factors

During this period of the 1960s, technological advancement in the developed world was moving very fast. The Europeans were trying to catch up with the Russians in terms of space race. They had come up with the Nuffield Science Program whose aim was to impart the right knowledge, skills and attitudes so as to produce scientists who will in turn take the nation to higher levels of technological advancement. To achieve this goal required change in the curriculum.

Kenya borrows heavily from their colonial masters. As the changes were taking place in the United Kingdom, there was felt a need to catch up with the developed world. Education was to be the vehicle for that change. There was need to review the curriculum so that it could serve this purpose.

During this period, the Cambridge University Examinations Syndicate (CUES) set up the examination done in Kenya. There was need to customize the examination to reflect the local needs of the nation. Towards this end, the Kenya National Examinations Council (KNEC) was established to do the work that was previously done by the Cambridge University Examinations Syndicate (CUES). The development of the curriculum was also shifted from CUES to KIE, the Kenya Institute of Education.

2.6 Phases

We shall now examine in detail the changes that took place in these phases.

2.6.1 Experimental/latent Phase (1963-1967)

The first phase is referred to as the experimental phase or latent phase.

The table 2 below shows a summary of the changes that took place during this period.

Table 2: Changes during Experimental Stage

Content	<p>The content in the existing curriculum consisted of General Sciences, Physical sciences (physics and chemistry combined) and the Pure Sciences (Chemistry, Physics and Biology)</p> <p>Basic concepts were taught in Forms one and two while the elaboration of concepts done in Forms three and four.</p> <p>The Cambridge University Examinations Syndicate developed the syllabus.</p> <p>During this phase, School Science Project (SSP) trial materials were developed. Nuffield Science Program in the United Kingdom influenced this.</p>
Teaching methods	<p>Initially the teaching methods used were didactic i.e. lecture method.</p> <p>Experiments were done to prove facts and observations. They were not done for inquiry purpose.</p> <p>The changes brought were the inductive/discovery approach where processes of acquiring scientific knowledge were emphasized.</p> <p>Experimentation, record keeping, making inferences and problem solving were emphasized.</p>
Teaching materials	<p>Initially only teachers' textbooks were available but during this stage, pupils manuals and teachers' guides were developed</p>
Assessment	<p>Assessment was initially done through essays and structured questions.</p> <p>Field and Experimental data notebooks were kept and assessed.</p> <p>Questions based on experiments and its</p>

	applications were now introduced
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It can be noted that the changes involved the content, teaching methods, learning materials and assessment components. Though the inductive method was suggested, it was noted that most teachers retained their old methods of using the lecture method. This happened because they were not in serviced and preferred to use the method best knew most.

The introduction of pupils manuals and teachers guide was good. This improved the teaching/ learning process. At least teachers were well directed on the best methodology to use these guides while at the same time, uniform activities for all the learners was now possible because of the use of the pupils manuals.

2.6.2 Adoption Phase

The second phase is referred to as the adoption phase. In this phase, some of the content in the experimental phase were adopted while other changes were introduced. The table below gives a summary of these changes.

Table 4: Adoption Phase (1968-1980)

Content	The content in physics, chemistry and
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	biology was not different from the traditional one that was given in the Experimental stage.
Teaching methods	The Inquiry approach was emphasizes though most teachers continued to use the didactic approach. This was because the in servicing of the teachers was not done and they were not well prepared for the envisaged changes.
Teaching materials	New teachers' guides and pupils' manuals were developed. Textbooks for the pupils were also developed.
Assessment	Practical examinations were introduced; hence manipulative skills were now assessed.

It can be observed from the table that there was no change in terms of content for the pure sciences during this stage. What was removed from the syllabus was the general science that was not serving the intended purpose. The curriculum for this course of the general science was very shallow and only covered basic concepts.

The inquiry approach was emphasized but ultimately the teachers did not embrace the idea. They continued to use the old styles of teaching particularly the didactic approach which involved the talk and chalk method. This method is teacher centered and limits the participation of the learners. One of the reasons for this lack of shift was due to lack of forum for sensitizing the teachers.

The practical examinations were introduced during this period. Initially, questions involving practical work were assessed theoretically. A question involving the concept of Hooks law will be set as follows:

Onyango performed an experiment and collected the following set of data.

<i>Force in N</i>	<i>10</i>	<i>20</i>	<i>30</i>	<i>40</i>
<i>Extension in cm</i>	<i>3.5</i>	<i>7.1</i>	<i>10.5</i>	<i>14.2</i>

- a). Draw a graph of force against extension*
- b). From the graph, determine the slope*

The learners were not involved in the performance of the experiment but questions involving the interpretation of the results were included. This way, the learners did not have the chance to develop the manipulative skills. There was

need therefore to introduce the practicals so as to inculcate these skills during the learning process.

2.6.3 ADAPTION PHASE (1968-2002)

The third phase is the adaptation phase. The changes that were introduced during this phase are summarized in the Table 4

Table 4: Adaptation Phase

Content	Between 1981 and 1984 Kenya School Mathematics (KSM) project was launched and School Mathematics Project (SMP) abandoned The curriculum was also reviewed. In 1986 the new 8-4-4 curriculum was launched The content given lacked structure and was overloaded
Teaching methods	Inquiry approach was emphasized but teaching basically remained didactic
Teaching materials	New pupils manuals and teachers' guides were developed
Assessment	Kenya Certificate of Secondary Examination (KCSE) was launched. It involved practicals, essays and structured questions.

It is within this period that 8-4-4 system of education was introduced in 1986. This involved eight years of primary education, four years of secondary education and four years in colleges or universities. The intention was to produce graduates at every level who were to be self reliant and also prepared for world of work. This ambitious program led to overload in the curriculum where the learners were expected to learn too much within a short period of time.

The mode of assessment was changed. A-level examinations were abolished and the Kenya Certificate of Secondary Examinations (KCSE) was introduced to replace the O-level exam called the Kenya Certificate Examinations.

2.6.4 OWNERSHIP PHASE (2003 - 2007)

The fourth and last phase for our discussion is the Ownership phase. This is the most recent that discusses the changes that have taken place in physics curriculum from the year 2003 to 2008.

When the new **NARC (National Rainbow Coalition)** government came to power in 2003, many Kenyans were debating whether the 8-4-4 system of education should be abolished or not. Following a survey that had been done in 1999, it was agreed that there was no need to abolish the system but to revise the curriculum of the existing 8-4-4-

education system. The government decided to own what the previous government, with some modification, hence, had developed. This has led the phase to be referred to as the term **Ownership Phase**.

2.7 Rationale for the Review of the Curriculum

Let us now examine the rationale that was used in reviewing the current 8-4-4 syllabuses that is currently in use in our school system.

The following issues were the basis for the changes made in the Physics Curriculum:

- Some objectives were unrealistic and not easily achievable within the given time and resources
- The subject's content was overloaded and therefore learners were not mastering the basic concepts.
- Some of the content was beyond the scope of the learners
- There were unnecessary overlaps within the subject and at different levels.
- Most schools were not adequately equipped for the implementation of the curriculum especially in the practical skills.
- Many of the teachers were not adequately prepared for the implementation of the curriculum.

- The curriculum was not adequately preparing its graduates for further education, training and the world of work.
- The curriculum was not addressing vital issues that have emerged since the last curriculum review. These include industrial transformation, environmental education, human rights, health issues like HIV/AIDS and others like the need to meet the *Millennium Development Goals* and *Vision 2030*.

These changes were meant to offer the kind of education that serves the aspirations of the nation. It should also be remembered that curriculum innovation is a continuous process since society keeps on changing.

It is with this in mind that another syllabus (Alternative B) has been developed to take care of students perceived to be weak in the sciences. The implementation of this curriculum became effective in Kenya from the year 2009.

Revision Exercise 2

1. Describe some of the external and internal pressures that led to curriculum review after Kenya attained her independence in 1963.

2. The study of physics requires the enquiry approach more than the didactic approach. Discuss this statement explaining whether you concur or not.
3. The 8-4-4 physics curriculum has been reviewed several times since its inception. Discuss some of the factors that led to its review.
4. Explain the four phases of curriculum innovations in Kenya. Explain the key changes that took place in each phase.
5. Explain some of the emerging issues that have been incorporated in the revised physics curriculum

Lesson 3

AIMS, OBJECTIVES AND JUSTIFICATION OF INCLUDING PHYSICS IN THE SECONDARY SCHOOL CURRICULUM

3.0 Introduction

In this lesson we shall discuss the aims and justification of including physics in the curriculum. What will be the effect if physics curriculum was omitted completely in the school system? What will be the effect in the society if all the learners in the country lacked this component of physics knowledge?

3.1 Objectives

By the end of this lecture you should be able to: -

- Justify the existence of physics in the school curriculum
- Explain how the teaching and learning of physics is influenced by
 - the National Goals of Education
 - the aims of secondary school education
 - the general objectives of physics education

3.2 Why Physics?

Let us now examine why physics is included in the secondary school curriculum. The teaching and learning of physics in secondary schools is generally aimed at achieving the following:

1. The National Goals of Education
2. Objectives of secondary School Education
3. General Objectives of the 8-4- physics syllabus
4. Produce scientists
5. Prepare students in related fields of study
6. Produce citizens who have general awareness

In the preceding section, we shall examine each of these areas in details

3.3 National Goals of Education

The teaching and learning of physics should help in the achievement of the National goals of education. The National Goals of Education in Kenya are meant to: -

1. Foster nationalism, patriotism and promote national unity
2. Meet the social, economic, technological and industrial needs of national development
3. Promote individual development and self fulfillment
4. Promote sound moral and religious values
5. Promote social equality and responsibility
6. Promote respect for Kenya's rich and varied cultures
7. Promote international consciousness and foster positive attitude towards other nations

8. Promote positive attitude towards good health and environmental protection

NB. Goals 4 and 8 were introduced in 2003 to cater for the emerging issue like health issues including HIV/Aids, human rights, and the Millennium development Goals (MDGs) and the use of technology in the learning process.

It is important for teachers to have these goals in mind even as they try to achieve the instructional objectives in a classroom setting. For example, when doing an experiment in small groups, the groups should be heterogonous i.e. represent all tribes so as to achieve the National goal number one talking about national unity.

Activity 3.1

Can you think of other methods that can be put in place to ensure that the national goals of education are achieved during the teaching -learning process

3.4 Objectives of Secondary School Education

Secondary school education should provide the learner with opportunities to:

1. Acquire necessary knowledge, skills and attitudes for the development of self and the nation
2. Promote love for and loyalty to the nation
3. Promote harmonious co-existence among the peoples of Kenya.
4. Develop mentally, socially, morally, physically and spiritually.
5. Enhance understanding and respect of own and other peoples culture and their place in co temporally society.
6. Enhance understanding and appreciation of interrelationship among nations.
7. Promote positive environmental and healthy practices
8. Build a firm foundation for further education and training
9. Develop ability for enquiry, critical thinking and rational judgments
10. Develop into a responsible and socially well-adjusted person.
11. Promote respect and acceptance for all persons
12. Enhance enjoyment in learning
13. Identify individual talents and develop them
14. Build a foundation for technological and industrial development
15. Develop into self-disciplined individual who appreciate work and manages time properly

Activity 3.2

Discuss each of these aims and in each case, explain how each case be achieved in the teaching and learning of physics

3.5 General Objectives of the 8-4-4 Physics Syllabus

By the end of the course, the learner should be able to: -

1. Select and use appropriate instruments in the physical environment
2. Use the knowledge acquired to discover and explain the order of the physical environment
3. Apply the principles of physics and acquired skills to construct appropriate scientific devices from the available resources
4. Use the acquired knowledge in the conservation and management of the environment
5. Develop capacity for critical thinking in solving problems in any situation
6. Contribute to technological and industrial development of the nation

7. Appreciate and explain the role of physics in promoting health in society
8. Observe general safety precaution in all aspects of life
9. Acquire and demonstrate a sense of honesty and high integrity in all aspects of life and physics in particular
10. Acquire positive attitude towards physics
11. Acquire adequate knowledge in physics for further training and or education

Activity 3.3

- Discuss some of the activities that are carried out by the students that contributes to technological and industrial development of the nation
- How does the teaching of physics improve critical thinking among the learners? Discuss
- With an illustration, how a physics teacher can help students in acquiring positive attitude towards the subject

3.6 To produce Scientists

The study of physics is meant to lay a firm foundation for those who will then specialize and higher levels of learning. These well-trained personnel will then play a key role in nation development.

Activity 3.5

Many scientific related careers require one to have firm background of physics knowledge. Mention some of the careers that requires one to have done well in physics

3.7 Prepare Students for careers in related fields of study

There are very many fields of study that requires learners to have physics background. Among these fields are engineering, medicine, environmental science, architecture, agriculture and others. The study of physics should achieve this objective.

3.8 Produce Citizens who have General Awareness

Physics is taught in order to have scientifically educated citizens who can follow discussions involving scientific issues and also be in a position to utilize technologically advanced appliances like microwaves, telephones, internet, television and other appliances.

The learning of physics enables the nation to have citizens who have acquired the scientific attitude that helps them to distinguish facts from opinions, form sound judgments about issues and look at new ideas with openness and thereby avoid prejudice.

The acquisition of the scientific method of thought will ultimately enable them to solve their daily problems

Activity 3.6

Mama Onyango bought a radio that was using some dry cell batteries. After some time, the sound that was produced was no coming out properly. She blamed this scenario to her neighbor whom she accused of jealousy. Explain how the study of physics would have enabled this woman to sort out this problem.

3.9 Communication

The process of writing the experimental reports helps the learners to learn how to express them in clear, straightforward and direct language. The use of symbols makes communication faster and effective. For example the formula $F=ma$ shows the relation between force **F** and mass **m** of an object which is having acceleration **a**. The formula shows that force is directly proportional to acceleration since the mass of an object is constant. All this information is summarized by a simple formula.

3.10 Remove Curiosity

People are basically curious to know what is happening around them. They would like to know about energy, solar system, the cause and dangers of lightening, how save they are in the event of atomic explosion and many others.

In some communities, people are afraid to use a tree that has been struck by lightening. They have the erroneous belief that the gods are not happy and that is the reason of striking the tree. Other people see rainbow as a sign from a mystical being in the universe. The mirage on the road on a sunny day has brought some controversy in some communities. The use of complicated machinery and other technologically advance appliances are beyond the understanding of many people.

Physics sheds more light on these issues and the operation and mechanism of the machines and this reduces the curiosity among the peoples.

Activity 3.7

Give five examples of daily life experiences that confirms that people are generally curious and needs answers to their fears of life

Revision Exercise 3

1. The teaching and learning of physics should lead to the production of scientists for the good of the nation.

Explain the extent to which this has been achieved in Kenyan context.

2. Explain the relationship between the general objectives outlined in the 8-4-4 physics syllabus and the national goals of education.
3. Explain with examples how knowledge from a named content area in physics may contribute to national unity.
4. Explain how the attributes of cooperation and responsibility may be fostered through physics teaching.
5. Explain with examples how knowledge from two content areas may contribute to national development.
6. One of the social needs of national development is the ability to appreciate the complexity of technological application. Explain how the teaching of physics would contribute to the fulfillment of this social need.
7. In which ways has physics tried to achieve the following:
 - i). Liberate people from myths
 - ii). Clarification of belief system in Kenya
8. Describe some of the ways in which the learners' interests in physics may be identified.

Lesson 4

TEACHING APPROACHES AND METHODS

4.0 Introduction

All over the world educationalists have over time been struggling to develop approaches and methods that can optimize the attainment of teaching/learning objectives. Every teacher faced with the responsibility of selecting and designing suitable learning experiences to provide optimal learning opportunities for the students. This task is complicated by the nature of the content, the wide range of students' abilities, great variety of teaching approaches and methods, the limited and resources and the teacher factors of attitude. In order to achieve the optimum results the

teacher must make use effective teaching strategies/methods.

There is need for teachers to be aware of the teaching methods at their disposal and how to utilize the available resources to make teaching and learning more effective.

4.1 Objectives

By the end of this lecture you should be able to: -

- Define teaching
 - Explain the components of teaching
- Explain different teaching approaches and methods and how they relate to the teaching and learning of physics

4.2 Teaching

Many educationists have tried to come up with good definition of teaching. There is has no single/universal definition that can define teaching but the answer to “What is teaching?” will give some insight on what teaching is all about.

- (i) “In its generic sense teaching is a system of actions intended to induce learning” (B. Octane Smith; 35:230)

- (ii) “Teaching is what occurs when teachers by virtue of their instructional activities succeed wholly or in part in enabling pupils to learn” (Elliot Eisner; 14:119)
- (iii)** As John Dewey pertinently remarked, one may as well say that he has sold when no one has bought; as to he has taught when no one has learned. This statement suggests that teaching may very well be defined as the direction and guidance of learning (Risk 1958).

4.3 Components of Teaching

It is generally agreed that Teaching has seven basic components. These may be referred to in different ways by different authorities, but they include:

- Teacher
- Explicit curriculum (one which is clear, fully expressed, detailed).
- Aims of the lesson.
- Class/individual learners
- Holistic environment
- Educational/learning activities
- Results/expected outcomes.

Teaching and learning of Science has been a subject of debate for a long time. The debate is often centered on what is taught (curriculum content and relevance) and how it is taught (teaching approach and methodology). The teacher is thought to have very little direct control over

what is taught because this is already prescribed in the curriculum, which also suggests the approaches and methods to be used for teaching. However, it may be argued that the selection of the method of presentation is ultimately the task of the teacher teaching a particular content in a particular class. In exercising this prerogative, the teacher should be guided by all the basic components mentioned above. Good teaching is largely a matter of personal aptitude and requires planning and selection of the approaches and methods that will result in optimum learning.

4.4 Facets of Learning

In the study of science there are three basic facets, which are important to note. These are: -

- Learning science involves the acquisition of scientific skills and knowledge.
- Learning about science leads to the understanding of the history of science
- Doing implies discovering the knowledge of science.

Hence teaching/learning activities aimed at helping students to achieve learning outcomes/objectives that the teacher has set to achieve with the learners must be put into consideration. Such activities should be carefully and

thoughtfully selected. In doing this, the teacher should also be conscious of some of the general aims of Secondary Science education.

Some of these aims for the secondary education include:

- i) Helping the learner to develop a positive attitude towards learning science and mathematics.
- ii) Developing in the learners' capacity for critical thinking in solving problems in any situation.
- iii) Fostering and developing an individual with a scientific way of thinking and one can communicate these ideas with other.
- iv) Enabling the learners make sense of their world by helping them restructure their ideas in useful and usable ways. The learners should build coherent scientific perspectives that they can relate to what they learn and to the world in which they live.

All these factors influence the teaching approaches and methods employed by teachers at different times and in different situations. Hence in deciding which method is appropriate to a particular lesson or series of lessons, the teacher must consider the following aspects of his teaching

situation: the context of the teaching situation (time and space); the number, ability, interest, and previous experience of the students; the nature of the subject matter; the teachers' own abilities and inclination; and what he wants to emphasize in his teaching – skills knowledge, or values, (Hyman, 1970).

4.5.0 Teaching Approaches

An educational approach can be defined as a way of dealing with an educational issue. A teaching approach may be defined as a combination of ways that a teacher uses when presenting the content of a lesson. In this section we shall discuss some of the approaches that are used in the teaching of physics

4.5.1 Didactic Approach

In the early days, teaching of science was didactic which involved the use of lecture method. Students were given rigidly formulated statements, which they had to memorize and regurgitate when required to do so by the teachers. Little or no emphasis was placed on understanding; learners were simply made to cram things. It was believed that the human brain is a blank store where knowledge can be pumped and stored. The method used to teach science differed very little from that used to teach history, geography or classical studies (telling).

4.5.2 Expository Approach

This involves the kind of teaching that is characterized by predominance of teacher talk with little or no involvement of student or practical activities. It is a teacher-centered approach. The teacher gives facts, explains concepts, and gives illustrations. Anything that needs to be taught practically is done through teacher demonstration. Student participation is limited to listening and asking questions and writing notes as the lessons progress. This approach is not considered very effective in the teaching of science. However, it is alleged that there are some topics in science/mathematics that by nature they are difficult to teach practically.

4.5.3 Empiricist Approach

In this approach, the emphasis is on the need to acquire scientific knowledge through observations. Laws are reached by induction. The learner is now given an opportunity to at least handle apparatus and make observations and this helps the learner to develop interest and manipulate skills.

4.5.4 Heuristic Approach

At the turn of 20th century advocates of the *Heuristic approach* of teaching believed that learners could be trained to discover scientific ideas by using faculties of observation,

reasoning and memory. Learners were involved in observation, recording, analyzing data and drawing conclusions on their own. This was a better approach since it involved real enquiry, which lead to understanding of the theory. However, this approach tends to consume more time, hence delay in syllabus coverage.

4.5.5 **The Inquiry/Discovery Approach**

This approach is also refereed to as the *learner-centered approach*.

This approach ensures that there is a high degree of involvement of all who participate. It is systematic in that a set of activities is used, yet highly flexible in that the sequence of the activities can be changed and others can be substituted at any time. The teacher involves students in activities that help in the development of scientific skills such as the ability to make observations, perform experiments, collect data make deductions and present results.

Towards the late 1950s science education in Britain was undergoing some dramatic change. There were the Nuffield science projects, which encouraged the learners to carry out experiments, which would bring about better understanding of science concepts. The philosophy that followed this approach was obtained from the Chinese Proverb that says '***I hear and I forget, I see and I***

remember, I do and I understand'. The learners would carry out experiments then create concepts at first hand in the laboratory, as a means of awakening original thought.

With passage of time, it was realized that despite the many practical activities many of the learners still faced problems understanding science, hence the slogan '***I do and I am even more confused'***'. The teacher's role is to guide students by clarifying instructions where necessary and being available to answer any questions that may arise in the course of the activities.

4.5.6 **Constructivist Approach**

This view takes cognizance of the fact that by the time a learner enters formal education he/she has already interacted with former environment and has developed ideas and concepts in relation to what he has experienced. As a child grows up, it continuously encounters new horizons in terms of knowledge gained, which require explanations either from its parents, family members, or peers. This is social constructivism since the learner is learning from others.

The entire encounter is digested and stored in its memory and becomes knowledge. The entire knowledge may not necessarily be scientifically correct, but the child accepts it as the truth. Learning therefore should be built on the

learner's practical experience while at the same time correcting any misconceptions or learner's alternative frameworks. According to Piaget, an individual interprets reality via intellectual structures characterized by acting schemes that change as one grows. An individual therefore, tries to attain a state of cognitive equilibrium by frequently altering his/her intellectual structures to make it consistent with the new experience. The role of the teacher is to provide guidance by giving students challenges that will help to correct their misconceptions and enable them to draw correct scientific concepts. The teacher can do this through:

- Class discussions (peer groups learning)
- Students' experiments and demonstrations.
- Use of audio visual aids, charts, diagrams and models

In relation to the inquiry approach, this involves a wider range of activities centered on helping students to learn science by:

- Gaining new insight from the outcome of their investigation.
- Modifying their pre-existing ideas in the light of the new insights.
- Constructing their understanding of a scientific concept

The basic assumption is that students have their own explanations of the phenomena encountered in their every day life. This approach helps them to test their understanding using the scientific approach. The activities should encourage the ability to plan and carry out investigations in which students observe, compare, describe, note and express themselves.

4.5.7 ASEI/PDSI Approach

The acronym ASEI/PDSI stands for Activity, Student-centered, Experiment and Improvisation/Plan, Do, See and Improve.

Recent studies in science education indicate that school science and mathematics teaching should by far be learner centered. The teacher's role should be that of a facilitator, guide, counselor, motivator, innovator and researcher. As such it is recommended that there must be as many activities during any one lesson as possible. These must be student-centered activities, involving a lot of improvisations in the experiments. This kind of improvisation will help in demystifying the sciences and mathematics. As well as the learner appreciate the ever-present science in the environment.

Revision Exercise 4

1. Explain how the study of physics helps in promoting good attitude towards good health and environmental consideration
2. Using a named concept, explain how you can use constructivist approach to teach it.
3. a) The traditional approach to science teaching has been the emphasis on the content science, which can either be exposed to the learners or discovered by the learners. Distinguish between
 - i) The Heuristic and Expository teaching
 - ii) Inductive and Deductive learningb). The diagram below shows the combinations between Heuristic-Expository and Inductive Deductive components of teaching.
- c). Choose a suitable topic from the secondary school syllabus and explain how this topic can be taught inducto-deductively (by the simultaneous use of inductive and deductive techniques)

Lesson 5

TEACHING METHODS IN SCHOOL PHYSICS

5.0 Introduction

Having looked at the approaches that are used in the teaching and learning of physics, we now focus our attention to specific methods.

Teaching methods may be defined simply as a way of carrying out actual teaching in the classroom. They are the means by which the teacher attempts to impart the desired learning or experience. The concern is with the way the teacher organizes and uses teaching techniques or skills, subject matter, teaching aids or resources to meet teaching objectives. The particular method that a teacher uses is determined by a number of factors. These are:

- ◆ The content to be taught.
- ◆ The objectives, which the teacher plans to achieve.
- ◆ Availability of teaching resources and the ability and willingness of the teacher to improvise if conventional teaching aids are not available.
- ◆ Evaluation and follow-up activities.
- ◆ Individual learners.

We now discuss some of the methods used in teaching physics

5.1 Lecture (Chalk and Talk) Method

This involves giving factual information with very little or no participation by the learners. This method is considered outmoded due to a number of reasons:

- ◆ It does not offer training for the attainment of scientific skills.
- ◆ Content taught in a lecture is quickly forgotten.
- ◆ Lectures can be boring especially if they are lengthy and if the teacher lacks appropriate communication skills.

However, this method is most effective for transmission of large amounts of subject matter. In spite of this criticism this method is still very useful as an instructional technique as long as it is used appropriately.

In the study of physics, this method should be used sparingly, mostly when introducing a topic or when making conclusion.

Activity 5.1

Discuss the advantages and disadvantages of using the lecture method in the teaching of physics

5.2 **Teacher Demonstration Method**

The purpose of a demonstration is to provide a means by which the teacher can explain or clarify certain parts of the content quickly and economically e.g. it can be demonstrated that metals expand when heated; or that seedling exposed to a unilateral source of light bend towards the light. It is essential that the students

should be involved actively. One way in which this can be achieved is through questioning as the demonstration progresses. Whenever possible the teacher should also give students an opportunity to set up the apparatus required for carrying out a certain procedure. The students should also be organized in such a way that every student is able to observe the demonstration.

Demonstration can also be used to explain in experimental set up before the students begin to set up their own apparatus for individual or group activities. This method is especially useful when the apparatus and/or materials to be used are not enough for the whole class; or when the materials are too dangerous or equipment too delicate to be entrusted to the students e.g. use of high voltage capacitors; experiments involving a mixture of hydrogen and air.

Activity 5.3

Using an example from one topic of your choice, explain how this method can be used effectively

What are the advantages and disadvantages of using this method

5.3 Practical Work (Class Experiment)

This involves teaching/learning activities conducted by the students under the guidance/supervision of the teacher. The teacher provides the students, either singly or in groups, with the materials and apparatus as well as the instructions to be followed in performing the activities. Deliberate effort should be made to enhance group work although individual participation must be assured.

The ability to follow instructions and the use of scientific methods and skills to solve problems with little help from the teacher is an important aspect of learning science.

Lack of laboratory facilities or equipment should not be taken as an excuse to limit practical work.

The teacher (and the students) should collect materials and improvise as much as possible. Where improvisation is not possible, small-scale experimentation should be encouraged.

There are certain basic skills that are essential in order for students to carry out practical work safely and successfully. Examples of such skills include:

1. Ability to read instruments (measuring cylinder, thermometers, rulers, pipettes, burettes, among others) accurately.
2. Correct use of equipment and apparatus (magnifying glass, microscope, balance, vernier

calipers ammeter, voltmeter, Bunsen burner and others).

Successful practical work depends on a number of factors that include the following:

1. Preparation before the practical period.
2. Trying out of activities to make sure that the materials used will give the expected results.
3. Clarity of the instructions-language should neither be ambiguous nor include terms that are unfamiliar to the students. If such terms must be used they should be clearly defined.
4. Effective guidance and supervision by the teacher.
5. Group size and composition.
6. The ability of the teacher to establish a link between the practical work and the concept to be learnt (bridge).
7. Briefing on any precautions to be taken to ensure the safety of the students and the equipment.

General Consideration for experiments

We now consider some issues that are essential in effective experimentation.

5.3.1 Purpose

Every experiment should have a purpose. The general aims for experiments are: -

1. To promote scientific method of thought and enquiry
2. To develop manipulative skill
3. To train in problem solving
4. To promote the process of finding out facts by investigation and arriving at general principals
5. To verify principles arrived at in other circumstances
6. To provide real situations for observing the changes and effects
7. To help pupils remember and understand principles, laws, concepts etc

5.3.2 Careful Planning

This is essential for successful experimenting. The teacher should first perform the experiment to ascertain that the apparatus work as expected, he/she knows how to handle the apparatus and that the results obtained are reasonable and can be used to make generalization

5.3.3 Thinking

An experiment where the teacher tells the learners everything is not good for the development of young minds. Learners should be given an opportunity to come up with

their hypothesis and ways of verifying them, thereby developing their creative abilities.

5.3.4 Simple Apparatus

Simple apparatus is more preferable than complicated ones especially at lower levels. Teaching should always proceed from simple to complex. The complexity of instruments used should be increased as the learners move from one level to another.

5.3.5 Student Activities

The activities should always be kept at maximum, both during teacher demonstration and class experiments. All the learners should be involved at all the duration of the experiment. When learners are not actively involved, class discipline and control becomes a challenge to the teacher.

5.3.6 Experiments should be performed carefully

As the experiment is done, there will be need for the teacher to ensure that the learners are following the safety rules and regulations, following the directions given for use of apparatus and that they avoid dangerous situation like use of very high voltage that may arise when performing the experiment.

5.3.7 Attention

For all the learners to benefit from the experiment, they must be attentive and also participate fully in observing, recording, calculating, drawing conclusions and making generalizations. The teacher should plan the activities such that all the learners get actively involved in the entire learning process.

5.3.8 Conclusion and Generalizations

These should be made by the learners and checked by the teacher. The learners should be given a chance to suggest other possible ways of verifying the theories.

5.3.9 Suggestions from the learners

Learners need to be encouraged to suggest other ways of analyzing data and other possible ways of testing theories and hypothesis. By doing this, their creative faculties will be enhanced.

5.3.10 Clean- up after the experiment

The students should do this as the teacher supervises at the end of the practical session. There is need for the teacher to plan for this activity, preferably five minutes before the end of the period or lesson.

5.3.11 Follow-up Activities

There is need for a teacher to make follow up after the experiment to ensure that conclusions and generalizations have been made. Giving the learners specific tasks like asking them to draw graphs, answer specific questions or make a summary of what has been done can do this.

5.4 Project Work

The value of project in the learning of science cannot be over-emphasized. Project work enables learners to actually engage in scientific investigation in an area of their own interest. The students learn to appreciate the basic steps in the scientific method. It combines the following skills:

- (i) Observation
- (ii) Identification of a problem
- (iii) Discussion
- (iv) Formulation of a hypothesis.
- (v) Design and investigation
- (vi) Data gathering
- (vii) Data analysis
- (viii) Making deductions
- (ix) Report writing and presentation.

Contrary to popular belief project work need not consume a lot of the time and resource allocated to the subject. There are many opportunities for students to learn science through individual or group project work. The problems to

be investigated may arise from the students' own interest but they may also be suggested by the teacher. Whatever the case, the teacher should make sure that students have sufficient background information before they embark on project work. Teacher supervision and guidance are important pre-requisites for successful project work.

5.5 Field Work (Excursion)

Fieldwork results from a need to illustrate the natural development or technological application of certain topics dealt with in the classroom.

It provides students with first-hand evidence of scientific phenomena and how they impact on every day life. Students learn to appreciate the sciences not only as subjects in the curriculum but also as part of the real world where science is applied in seeking solutions to human problems and explaining natural phenomena. Students may also get an opportunity to interact with experts in particular fields of science. Some of the places where fieldwork/excursion can be done include:

- Factories
- Rivers, lakes and seashores, ponds, forests and other natural ecosystems.
- Parks and game reserves.
- Water treatment plants
- Museums and herbaria
- Research laboratories

- Agricultural research stations.
- Weather monitoring and forecasting stations.
- Plantations.
- Mines and quarries.

Fieldwork is difficult to organize, but if well planned, it can be effective method of teaching and learning some aspects of science. It need not necessary be conducted in a place that is far from school. The immediate environment of the school may offer unique opportunities for students to conduct fields, which may help to reinforce what is learned in the classroom. To avoid a situation where students reduce a field trip to sightseeing, the teachers must plan as thoroughly as they plan any other lesson. Specify the objectives, learning activities, evaluation and follow - up activities. Prepare a detailed work sheet (or questionnaire and give clear instructions to student before hand to focus them on key areas of study. It is good to form working groups in advance if you intend to use groups.

More details of excursions and out-of-class learning activities are discussed in chapter seven.

5.6 Discussion as a Teaching/Learning Method_

Discuss an important component of the teaching/learning situation. It allows students to share their ideas. It can be used at the beginning of a topic to ascertain students' pre conceived notions of the subject matter or

towards the end of a topic by presenting students with a new situation and asking them to explain it in terms of what they have just learned. However, discussion in groups might not have much value unless it is followed by presentation of reports.

5.7 Other Modern Teaching Methods

There are other modern methods such as simulation, games, skits, and others. These may be effective in teaching sciences if understood and well used.

1. **Simulation** - This is an imitation of the appearance or character of the real. An example is the use of models to present the real
2. **Skit** - This method involves role-play. An activity is designed such that learners are involved in short comedies or parodies to make a particular concept to be easily understood.
3. Games and puzzles.

5.8 General Considerations when selecting method to use

We now discuss the factors that are essential when making the decision on which method to consider.

5.8.1 Learner Factors

Learners may need to be helped to focus on the lesson topic, based on their abilities, past experiences and the

subject matter. Some examples of the methods to be used based on the learners needs are tabulated 8 below;

Table 8: Type of learners and the appropriate method

Types of Learners	Most Appropriate Methods
Have knowledge and interest	Debate on the topic, Spontaneous reaction to a vital issue (Discussion)
Low knowledge and high interest	Ask strategic question and use discovery method
High knowledge, low interest	Use simulation/skit followed by analysis
Low knowledge, high interest	Show a video, followed by discussion
Type of subject	
Large amount of subject matter	Use transmissive methods such as lecture or group reports
Selected material to be scrutinized	Use analysis methods where a small group analyses the material. Get feedback using question and answer

5.8.2Teacher Factors

Effective teaching is intricate. It goes further than thorough planning, choice of approaches/methods and

preparation of teaching/learning materials. Ultimately, effectiveness is highly dependent on two teacher factors. These are mastery of subject content and interpersonal skills.

5.9 Conclusion

Knowledge and skills alone will not make either teachers or the student effective, efficient or happy in carrying out their tasks. It is through effective change of attitude combined with knowledge and skills that the performance in the science will improve.

Revision Exercise

1. Explain the qualities of a good teacher
2. The teaching of physics involves an integrated use of the following techniques
 - i). Questioning techniques
 - ii). Stimulus variation
 - iii). Set Induction
 - iv). Use of examples
 - v). Group Discussion technique
- a). Explain the characteristics of each of the above techniques

Lesson 6

PHYSICS PROJECTS IN SECONDARY SCHOOL

6.0 Introduction

The project approach is a method of individualized instruction in science. It has a unique application in the learning process in that it emphasizes the application of the knowledge learnt and leads to enhancement of the manipulation skills.

It provides the learner with an opportunity to carry out investigations on a given topic area through the application of the acquired scientific knowledge and skills. Each learner is given a chance to achieve certain goals according to his ability and interest.

6.2 Definition

A project is a scientific, practical problem solving exercise in which the student is given total responsibility from the selection of the problem to the appraisal of the work carried out and the completion of the final report.

A project can also be defined as a student centered activity with a wide practical scope.

6.3 Objectives of Projects

Projects in physics are meant to achieve the following objectives: -

1. To arouse and sustain interest, attitudes, open mind and curiosity in sciences. The attitudes to be developed include cooperation, leadership, honesty and curiosity.
2. To develop creative thinking and problem solving ability
3. To promote aspects of scientific thinking and the scientific method
4. To develop a range of practical skills like manipulative, process skills, social and mathematical skills.

6.4 Skills and Abilities to be developed

The use of projects in physics instructions is important because a number of skills and abilities are accomplished. Among these skills are: -

—

1. The recognition and formulation of a problem to be investigated.

This involves the tenability of hypothesis and postulates, the identification of variables to be studied and the identification of variables to be controlled

2. Designing and planning of experimental procedures.

This involves the choice of experimental conditions like the use of apparatus, measuring techniques and procedures; the arrangement for controlling and variation of variables and the sequencing of operations

3. Setting up and prosecution of the project work involving, which involves methodical working, correctness and safety of experimental techniques. Manual dexterity in the execution of project work and the orderliness and organization of the project.

4. Organization and measuring skills. These includes accuracy and precision, reliability and observation and care and reliability in the collection and recording of data and observation

5. Interpretation and evaluation of experimental data and observation. This involves the tenability of conclusions

and inferences drawn from experimental data. The relevance of data to the problem under investigation and the evaluation of limitation and potential error sources associated with experimental procedures.

6.5 Characteristic of a Good Project

A good project work should have the following characteristics:

1. It should have a problem solving activity done by investigation method
2. Involves identification of problems in an area of specific interest and selection of a limited topic area for investigation.
3. Design of the investigation that includes selection of apparatus, method, observation and analysis of results
4. Originality of thought
5. Accuracy and significance of the inferences made
6. The activities involved are largely pupil-centered. This makes learning more active and makes the learners responsible for their results.
7. Accuracy of investigation is encouraged
8. The inferences made should be related to the background knowledge
9. Should have suggestion for further investigation
10. Have bibliography and acknowledgement

6.6 Areas to Plan for Before Giving a Project_

Proper planning is essential to ensure the success of project work. There is need to plan for the following areas: -

1. Identify the objectives to be achieved
2. Decide the time required to complete the project
3. Make a marking scheme to be used
4. Decide how to test the actual operation of the project
5. Quantify the pre-requisite knowledge required for project undertaking

It is at the start of project work that students need the most guidance and assistance. There is need for the teacher to give proper guidance concerning all the areas that requires to be tackled.

6.7 Assessment of Project Work

The success of a project depends to a large extent on the learner's effort and the supervision of the teacher. Some of the achievements are assessed explicitly while others are assessed implicitly.

Some of the skills assessed in a project include: -

1. Identification of a problem
2. Formulation of hypothesis
3. Ability to make observations

4. Designing of investigation
5. Data gathering techniques
6. Methods of data analysis
7. Making deductions
8. Report writing and presentations

6.8 Assessment Areas

Some of the areas that are assessed in school projects include: -

a) Planning Stage

This area is assessed in order to ensure that students understand: -

1. The problem to be investigated
2. Safety precaution when controlling the variables
3. Methods of data gathering
4. Preparation of appropriate materials for the project

At this stage marks are awarded for: -

1. Knowledge about the topic shown in the theoretical framework
2. Project proposal
3. Originality of thought
4. Report presentation

b) The Experimental Stage

Checking the accuracy of the data observed assesses this stage directly and indirectly. The data should be enough to allow for conclusion to be made and generalizations. In some cases the accuracy is determined by calculating the percentage error of the results obtained.

Direct assessment involves actual checking of the operations of the project.

c) Report Writing

The report format can have the following structure.

- **Title, name, Class and Date**

This information appears on the top page and should be clearly written in bold and capital letters.

VERNIER CALIPERS

A Project submitted in partial fulfillment of the
Requirement of the Bachelor of Science of
Kenyatta University

By

Evanson Onyago Kalonzo

Reg. No. E37/2999/2006

Submitted to
Dr. Muriithi E.M
Department of Educational Communication and
Technology
Submitted on
26th June 2008

- **Aim**

This is written in behavioral form i.e. to construct a well functioning hydrometer using the locally available materials.

- **Introduction**

This contains definitions and brief history of the development of the project. Any other literature that can introduce the project well can also be included.

- **Theory**

This includes short physics concepts forming the basis of the project. Formulae can be included at this point.

- **Materials**

All the materials and resources used are mentioned in the order they are required. The references used are also indicated.

- **Procedure**

The procedure should be written in past tense third person pronoun. A diagram can be included.

- **Applications**

This contains results of any readings made on testing of the final product of the project. The performance of the final project should be included.

Tables and diagrams can also be include

- **Difficulties Encountered**

After mentioning the difficulties encountered, suggestions for improvement should be made. It is important to note that shifting blame is not necessary. Students sometimes like blaming the institution and the administration for not providing them with the required materials. This should be avoided as most of the projects need the locally available materials and where some materials need to be bought should be at minimum cost.

- **References**

The references from books should include title, author, edition, and pages

Acknowledgements

For any achievement, one must have drawn some aspirations from other people. It is good to acknowledge them in the last page of the report.

Revision Exercise 6

1. Explain the importance of school projects in the learning of physics.
2. Choose a project from the physics syllabus and make a detailed report of the project undertaken.
- 3.

Lesson 7

FIELD TRIPS AND OUT- OF-CLASS LEARNING ACTIVITIES

7.0 Introduction

Teaching of science depends largely on theories and lectures with demonstrations in the classroom, and on individual and group experiments in the laboratory. It should not be forgotten, however, that science, including Physics, becomes useful and even more interesting when it is brought out from the artificial situation of a classroom or laboratory.

Many of the experiments performed in the lab are only treating models of real situations and arrangements dealt with in other paths of life. Most theories owe their existence to observations of phenomena in nature or practical life, or to challenges and difficulties requiring further understanding to be mastered. So it is important for teachers to take their students out in the field, even if it will require extra work and activities outside regular school hours. This experience will help the learners to have a deeper understanding of reality and also help them to develop more interest in different topics and understand their practical applications.

In addition a teacher is able to gain in personal contact and understanding towards his/her students, something that is otherwise difficult in a regular school situation.

7.1 How to Get Out

Basically there are three different ways of taking students out into nature where they experience practical application of knowledge learnt

(i) Excursion

These are well-organized school activities and are compulsory for the whole class. The teacher is the obvious leader and is responsible for the whole exercise from planning to execution of the activity.

(ii) Voluntary **activities**

These include organized activities like science clubs and other independent activities. The students take part according to their interests. This is normally done after school hours. The subject teacher may then come in as a sponsor or advisor for club or activity group.

(iii) Individual **Activities**

Each student learns according to his/her interests. The student is involved in making observations, investigations and recordings of situations related to physics. This can be done either at home, in school or wherever the students feel comfortable. The role of the teacher is to guide the students as they undertake the activities.

7.4 Excursions

These are generally very common for students taking biology, geology and geography. They are not very common for physics and chemistry students. There are, however, quite a number of interesting possibilities in addition to the classical 'visit to a factory' where students can visit.

As a teacher one must remember that when suggesting an excursion for the students of his/her subject, s/he is also responsible for planning of the whole excursion, including advance information to students, guidance during the excursion and the follow-up activities after the excursion.

The teacher needs to obtain permission from the school administration, arrange with the places/institutions to be visited, organize for transport, food, drink, and accommodation if need be and keep the whole student group under control. The amount of work that has to be put into this depends on the kind of excursion being planned.

7.4.1 Short Excursions

These may last for one to three periods and have the advantage of being easy to plan and organize. Usually they do not involve problems of getting permission from the school administration, organizing for meals and are not expensive.

The teacher can manage them during his/her regular subject periods, and may not need to request other subject teachers to forgo their lessons as the excursion progresses. Such excursions are normally concerned with one topic only.

There are many places that can be visited by physics students. Some of these places include: -

- a. To the water pump (or other simple pumping station) in connection with teaching of pressure
- b. To shore (lake or sea) to investigate waves, floatation currents, fishes (stream-lined)
- c. To a river or stream, investigating currents, making water turbine, Doppler effect on water waves, study vector-addition and other related topics.
- d. To a power station (or a secondary station) to look at generators, turbines, transformers and instruments.
- e. To garage or service station to learn about cars (cooling system, electric system, motor, brakes and other related topics.
- f. To any factory, studying machinery, welding, ovens, electric, chemical and mechanical processes

- g. To a telephone exchange, a radio station, electronic workshop (TV, radio) to study applications of electronic devices.
- h. To a church, studying organ pipes, bells, and other concepts.
- i. To the roadside observing motor cars (turbulence in air (dust) Doppler effect on motor noise, friction, use of different gears and stability of overloaded matatus.
- j. To anywhere in nature:
- k. Making up a fire to study air streams, convectional currents, radiation, wavelength of light, issues related to temperature, expansion of gases/liquids in a sealed tin, and cracking of stone/glass by sudden temperature changes.
- l. Make a water barometer (nearly 10m high) or a water supply system.
- m. Use the sunshine to study absorption/reflection of radiation, geometrical optics (mirrors, lenses, shadows, diffraction refraction and other related concepts.
- n. A thousand other things, which a teacher or students may think of, depending on what is available around the school.

7.4.2 Day Excursions

These excursions normally last from early morning to late afternoon or evening. The success of these excursions usually requires some planning and effort.

There is need to involve other teachers in the school because their lessons will be involved. There is need to plan for transport and meals. Consultation with the hosting institution is necessary.

7.4.3 Long Excursion

These are rarely (or never) planned for physics alone but normally involve several subjects. All subject teachers concerned then do the planning jointly. The planning is further complicated by need to take care of accommodation, transport and food requirements.

There is needed to leave ample time for each part of the program because transport from one place to the next may require ample time. Most activities require more time than is normally expected.

7.5 What to consider when planning for an excursion

Before venturing in the planning for an excursion, it is important for the teacher to consider the following points: -

- (i) Objective of the trip

- (ii) Time for the trip
- (iii) Destination
- (iv) Stakeholders to be involved like the school administration, other teachers, host of the visiting team and others
- (v) Financial implications

When planning it is necessary to ensure that: -

- (i) The relevant topic in physics has been covered
- (ii) The teacher makes a visit to the place in advance to familiarize himself before taking the students
- (iii) He highlights the physics concepts to be studied to the students as per the stated objectives
- (iv) He gives an introduction before the excursion starts, give a brief on what to look for and suggest possible questions to ask during the excursion
- (v) Guide the learner on how to summarize and report about the excursion

After the trip, it is necessary to have a follow up. This can be done in the form of a: -

- (i) discussion
- (ii) quiz
- (iii) report

7.6 Importance of field trips

Field trip helps the learner in a number of ways. The includes

- (i) Developing interest, motivation, stimulation and appreciation in some areas of science.
- (ii) Improve learners' skills in observation and perception
- (iii) Assist in developing an interest in a given career
- (iv) Improve the retention of knowledge

7.7 Science Clubs

These are popular and active in many schools throughout the world. Basically the students, who elect their own board and also decide the program and activities to be undertaken, manage them. Usually a science teacher at the school is chosen or appointed by the sponsor to be the patron of the club. Keeping in mind that this is a voluntary activity for the students, the sponsor is expected to consult widely before making decision involving the activities to be taken and also when selecting the patron of the club.

There are different types of clubs, but they can be listed under four different heading:

- (i) Lectures demonstrations or film shows presented by individuals, either club members or guests.
- (ii) Project-often involving practical work, making of equipment, apparatus etc. to take for instance to an exhibition
- (iii) Visits, trips or excursions outside the school.

- (iv) Exhibitions of member's work/projects in connection with school open days or science congress.

7.8 Individual Activities

These are not very often organized and planned by the teachers, but are based on the student's own interest and study. During the teaching of a certain topic, the teacher should in general always suggest activities related to it, where the students individually can observe, investigate further or apply the principles taught in class. This applies to all fields of physics, e.g. astronomy, heat electricity etc. and, may constitute the beginning of a life long hobby for the students.

The role of the teacher is basically to give suggestions, guide and counsel the students as they undertake these individual activities.

Activities

- 1.** Explain how you would plan for an excursion lasting one day

2. What are the importance of excursions
3. Discuss some of the areas that your physics students can visit. In each case, explain some of the concepts they can learn

Lesson 8

LABORATORY SAFETY AND DISCIPLINE

8.0 Introduction

Teaching in the laboratory situation demands that a teacher acquire an awareness of the possible hazards and ways of dealing with them.

Safety is a positive activity that affects the tasks that the pupils and the teacher engage in. The safety conscious teacher is one who is aware of the potential hazards and who takes appropriate preventative measures when planning his lessons. The lesson plan should identify not only the most likely accident in any teaching situation but also credible accident that could happen.

The teacher should also realize that the greatest danger in the laboratory is ***an ignorant and/or careless teacher.***

8.1 Teachers Responsibilities

In order to ensure that security is maintained a good teacher need to consider the following:

- Follow instructions that are often provided with any/new equipment.
- Seek information from other people when in doubt. Such information can be sought from another teacher or the head of the department.
- Think before acting. If he is not sure he should ask. Careless teachers usually don't.
- Avoid panic in case of accidents.
- Use the safety precautions and devices available including the first aid kit.

It is worthy to note an ignorant or careless teacher is the greatest danger that students can be exposed to in the laboratory.

8.2 Common Hazards in the Physics Laboratory

We now discuss some of the hazards that commonly take place in the laboratory and need to be avoided

8.2.1 Toxic Materials and Gases

All chemicals should be treated as poisons since the range of toxic materials is quite large.

All known poisons should be labeled and kept under lock and key.

Toxic materials can be introduced to the human body by being inhaled, handled or ingested.

8.2.2 Caustic and Corrosive Substances

Acids -Nitrate phosphoric (v) and concentrated Sulphuric acid.

- There is need to exercise care when handling them.

Bases -Sodium, potassium Hydroxides and ammonia.

Other Substances -that yield corrosive materials with water includes

Chlorides, Phosphorous Oxides, Alkali metals and their oxides -Bromine and phosphorus.

Comments

It is always advisable to use a fume cupboard when use of gases is involved in order to avoid inhaling of poisonous gases. All the chemicals should be cleaned immediately if they spill on the benches so that they don't spoil them. Foods and drinks should not be consumed in the lab. Use of gloves is necessary when handling the chemicals for security reasons

8.2.3 Fire

Some common causes of fire in the school laboratory are: -

- a) Use of bare wires carrying large currents
- b) Large Voltages can cause shock and possibly death.

To take the required precaution, there is need to ensure that: -

- (i) Open - live circuits should be avoided under all circumstances.
- (ii) Metal casings of electrical devices should be earthed.
- (iii) In case of shock, disconnect the victim with a dry wooden structure because dry wood is not a conductor, and/or switch off the mains supply.

When making electrical connections, there is need to ensure that:

- (i) the correct fuses and switches are fitted in the live circuit.
- (ii) the switch is off before plugging in
- (iii) apparatus are checked to ensure absence of loose or bare wire before they are plugging in.
- (iv) avoid using bare wet hands when handling electrical appliances so as to avoid electrical shocks.

Other hazards

Other hazards likely to occur in a physics laboratory are summarized Table 8.1

Table 8.1: Common Radiation Hazards and Required Precautions

Causes	Hazard	Precautions
Radioactive Substances e.g. Cobalt - 60	Over exposure causes cumulative tissue damage.	<ul style="list-style-type: none"> - Use low activity samples. Pupils below 16 years must not be exposed to such or similar sources. - Store separately preferably behind a lead screen

		or concrete blocks should not be allowed to come into contact with skin or food.
Ultra-Violet Lamps	Damage to the retina and the skin	- Avoid direct viewing of the sources. View only when properly shielded.
Laser light (Amplifications by Stimulated Emission of Radiation).	Damage to the eyes (retina) if viewed directly may cause blindness.	- Not commonly found in Kenya schools but where found only experienced teachers should handle them.
X-rays	Over exposure causes tissue damage	Not found in Kenya schools since they are not used for teaching purposes.

8.2.5 Electrical Hazards

When using mains electricity accidents occur when people come into contact with bare/naked wires.

(a) Spark fires occur in: - current-carrying cables.

These can occur when current is switched on or off from very high voltages in transformers.

8.2.6 Mechanical Hazards

Equipment with moving parts should be used properly. There must be enough room for safe storage for devices such as handsaws, gas cylinders and glassware.

8.2.7 Splintering Glass and Wood

(a) Glass and wood are particularly dangerous because they cannot be easily detected once they lodge in the human body.

- Glass expands unevenly when heated.
- Liquids in spherical bottles can cause fires by focusing them to sunlight.
- Glass tubing should be carried vertically and should never be stored overhead. Glass should be cut in a cloth.

(b) Careless handling of wooden splints can lead to cuts and other accidents.

In case of cuts: -

- (i) The wound (s) should be cleaned thoroughly using clean water.
- (ii) Stop the bleeding by applying pressure to the bleeding spot.
- (iii)** Send them doctor for further check and dressing of the wound (s). Care must be exercised to remove all the stray splints to avoid other students getting hurt.

8.2.8 First Aid and Safety Devices

Every Physics laboratory needs to be well equipped with **First Aid Kits** that are used in the event of an accident. It should be constructed in a way that possible hazards are prevented. The teacher must be provided with: -

1. Proper storage facilities in the laboratory for: -
 - (i) Poisons
 - (ii) Radioactive substances
 - (iii) Delicate apparatus
 - (iv) All other apparatus when not in use.
2. Operation instructions for complicated equipment. This is a must for new teachers and all equipment should be kept in good working condition. There is need for teachers to refer to instruction manuals frequently in order to ensure that proper connections of instruments are done.

Teachers should not be shy in consulting other teachers or lab technicians when in doubt.

3. Safety devices and chemicals in case of accidents such as fire. These include buckets of sand, fire extinguishers, blankets, water hose reel and other fire extinguishers that are serviced regularly.
4. Warning signs that should be noted by both teachers and pupils – labeling should be Accurate to avoid confusion.
5. A discipline code for dealing with wastes, solid and liquid, by providing appropriate disposal containers or areas.
6. First aid facilities for dealing with minor cuts, abrasions, poisoning, sprains, fainting etc.
The first aid kit must be stocked regularly.

It is important for the teacher to note that accidents in the laboratory ***are caused, and do not just happen.*** The teacher is responsible for the safety of the pupils as well as his own. The teacher should always act **swiftly and methodically**. He should not panic; maintain discipline even in the event of an accident.

Students should be encouraged to consider their actions carefully especially when in the laboratory so as to avoid or

minimize the accidents. They should always think before they act. They should concentrate on what they are supposed to do without distracting others. Making noise or shouting should be avoided in the laboratory.

Lesson 9

PLANNING FOR PHYSICS TEACHING

9.0 Introduction

Effective teaching requires a teacher to have the following documents

- (i) Syllabus
- (ii) Scheme of work
- (iii) Lesson plan
- (iv) Record of work book
- (v) Progress report

9.1 Syllabus

The syllabus of a particular subject is a document, which contains or gives the subjects' content in form of broad topics and their subtopics. It defines what should be taught in that subject to a specified level or a certain period of time, which may be a year or four years.

It also contains the national aims of education and the general objectives of the subject. From the aims and the objectives, the teacher formulates the specific instructional objectives for each lesson, which he teaches for that course.

A syllabus is a very important teaching tool. It is what gives the teachers the authority to be in class. In Kenya, the Kenya Institute of Education (KIE) produces syllabuses. As a teacher, you should have the skills of using the syllabus and come up with a scheme of work.

9.1.1 Introduction in the syllabus

What needs to be achieved is well spelt out in the introduction of the syllabus. The syllabus is meant to lead to an all round individual mentally, socially, spiritually and morally. In the introduction, teachers are encouraged to use the right teaching methodologies so as to achieve the syllabus' objectives.

9.1.2 What to teach

The syllabus gives an outline of all the topics that need to be covered within the stated period of time. As the teachers go through the syllabus, they should have the National Goals of education in mind. The same applies to the general aims of teaching the subject as stated at the beginning of the syllabus.

9.1.3 Interpretation__

By proper interpretation of the syllabus, a teacher is able to select and use the right approaches and methods of teaching. Likewise the right resources including the right textbooks are then selected.

9.2 Scheming For Physics Lessons

A scheme of work is the pattern the teacher follows when teaching. It is a detailed time plan for the subject content, which is to be taught. It gives the sequence of topics or subtopics, as they will be taught during the certain period; for which the scheme is planned.

It is necessary to have a scheme of work for every level taught i.e. have a scheme for form one, another one for form two all the way to form four. Each level can then be subdivided into the school terms.

Before and during the preparation of the schemes of work, you should consider the following points carefully:

- Familiarize yourself with the topics and sub-topics in the syllabus
- Establish the number of teaching weeks available per term
- Find out the number of lesson allocated per week
- Analyze the general objectives of the course
- Decide the key methods of teaching
- Check on the learning resources that are available

9.2.1 Reasons for Scheming

We now consider the reasons for scheming. There are several reasons why teachers should make the schemes of work. Some of these reasons are: -

(i) To give a logical Order of teaching:

This should follow a logical sequence, a hierarchical approach from the simple to the more complex topics/concepts; also known as the spiral approach.

(ii) To allocate time for each topic

Time for each topic is allocated in terms of weeks, and lessons for the various subtopics. The time allocated is normally given in the syllabus. Teachers should scheme with this

time in mind. However, some adjustments can be made depending on the nature of the topics.

(iii) To give the depth and breadth of treatment

The depth and scope of covering a given topic is not explicitly indicated in the syllabus. However, this can be implied by the objectives given in each topic. In some cases, direction is given by terminologies like qualitative and quantitative, which are put in bracket. By use of the objectives in the syllabus, suitable learning experiences and examples are selected and organized for each subtopic. Teachers should understand the meaning of the terminologies used. Terms like defining, describing, computing, analyzing and others show the scope of teaching expected from the teachers.

(iv) To outline of teachers and learners' activities:

An outline of experiments and other activities to be undertaken are specified. Examples of these activities are experiments class experiment, teacher demonstration, individual vs. group work, problem solving, class discussions, and others. These activities should be stated clearly in behavioral terms.

(v) Organization of Teaching Resources

When the required resources are known, then planning for their acquisition becomes easier. These are acquired in advance and thereby avoid rushing to get them in the last minute when teaching is taking place.

(vi) Objectives

The objectives for each lesson are clarified during scheming and this helps in the preparation of lesson plans.

(vii) Content vis-à-vis assessment organization

A general outline of content and the corresponding tests, quizzes and projects is planned well ahead

9.2.2 Points to consider when Scheming

i) Content:

This is given as topics and sub topics in the syllabus.

From these the teacher should derive a logical sequence of ordering the topics.

ii) Learners needs:

These are derived from the general objectives stated for the different topics and subtopics in the syllabus. The age and the background of the learners also determine the learners' needs.

These needs determine the types of learning experiences that the teacher will select.

iii) Time available

By considering the number of lessons per week, number of teaching weeks per term and for the whole year, the topics to be taught can be divided into suitable units. Time availability will influence the number of experiences that may be used to illustrate a given concept.

9.2.3 Scheming Procedure

When scheming, the following steps can be followed;

- ii)** Divide the topics for a given year into the various terms, I, II and III proportional to the teaching time available.
- iii)** Allocate time to each topic, subtopic, test or quiz for each term.
- iv)** Order the topics per term in the order of their levels of difficulty, from the easiest to most difficult.
- v)** Arrange the topics for given term in a suitable scheme format.

9.2.4 Schemes Formats

The scheme format should have the following administrative information on the top page.

Teacher: _____, School: _____; Form.....

Subject: _____ Term: _____ Year: _____

Lessons per week: _____ No. Of Pupils:

Coop: Teacher: _____ HOD: _____

Summary: _____

This information is the administrative information. After this the teachers organizes the topics, sub topics, objectives, learning activities, references and remarks in the acceptable scheming format. The order may appear as shown in the preceding page

Week Date	Less on No.	Topic / Subtop ic	Objecti ve	Teachin g Learnin g Activity	Apparat us /materia ls	Referenc es	Rema rk
4 7- 11/05	1						
	2&3						
	4						
514- 18/05	1						

	2&3						
	4						

9.3 Lesson Plan

A lesson plan is a detail of activities to take place during the lesson. It guides the teacher on what to be covered during the teaching/learning process. It is derived from the scheme of work.

9.3.1 Importance of a lesson

There are several reasons for making a lesson plan. Among these reasons are: -

- (i) It guides the teacher what is to be taught and why, thus avoiding vagueness and irrelevance when teaching.
- (ii) It enables the teacher to familiarize himself with the material to be taught beforehand.
- (iii) It enables the teacher to prepare teaching aids and to consider interesting activities for the learners in advance
- (iv) It helps the learner to plan his lessons in advance and thereby give him time to think about the best ways to cover the topic in an interesting manner.

- (v) It gives an orderly pattern of handling teaching and learning materials.

9.3.2 Components of a lesson

A good lesson plan should have the following;

Rubric

The rubric includes the general administrative information like name, school, class, form, date, number of students, and registration number for student teachers on teaching practice etc

Topic/subtopic

The topic and subtopic are derived directly from the syllabus.

Specific objectives

The lesson objectives should have the following characteristics: -

1. Objective should be in terms of what the syllabus is expected to achieve paying attention to appropriate levels of content to be learned.
2. Objectives may be focused on understanding knowledge, developing ability/skills and/or developing attitude

3. Objectives should have a clear link between theory and practical activity
4. Objectives should be clearly and precisely stated in terms of student behavior which is observable using words such as; state, describe, define, discuss, compare, relate, outline, examine, plot-graph, observe, apply, correct, organize data, make a table, interpret data, record, identify, write, explain, carry out experiment, determine, design experiment, investigate the conditions, prepare, arrange, trace, select and use, handle, make, recall, name, predict, derive the formula, illustrate, differentiate, classify, distinguish between, solve the problem, think critically, estimate, draw patterns, set up etc

Introduction

The plan should have a definite and brief introduction. The introduction provides for a favorable learning atmosphere.

This can be done by: -

1. Revising the previous lesson and linking the knowledge to the new topic
2. Giving clear statements of what the teacher wants the students to learn

3. Giving a relevant and stimulating story which will arouse interest and curiosity of the students

Lesson development

This indicates the content area to be covered and the activities to be undertaken. The content is usually divided into several steps. Each step contains one main activity or idea and shows clearly the and how the activities will be done.

Conclusion

The plan should have a conclusion where the main points are encapsulated.

Teaching/ learning activities

The activities to be undertaken should be clearly shown. Several activities can be included in one lesson, where applicable. Some of these activities are class experiments, problem solving, teacher demonstrations, graph drawing etc

Resources

These can be derived from the schemes of work. They include apparatus, materials and references.

References

This includes textbooks, science journals; videos etc.
textbook references should have author, title, edition and page.

Remarks

This column is filled after the lesson has been taught. The remarks given should be realistic and objective e.g.
objectives were achieved, more time required to cover the topic, very exciting when performing the experiment etc.

Lesson Plan Format

There are several formats that can be followed. Below is one such example.

Subject.....Name.....

Topic.....School.....

Class.....

Sub-topic.....No of students.....

Date.....

Specific Objective

At the end of the lesson the learner should be able to: -

A)

.....

B).....

C).....

Step and time	Content	T/L Activities	Apparatus	References	Remarks
Introduction (5 Min)					
Lesson Development (20 min)					
Application (10 min)					
Assignment (2 min)					

Example of an ASEI Lesson plan

Subject: Physics.**Name**.....

Topic: Electromagnetic Induction

School:.....Class:.....

Sub-topic: Simple experiments to illustrate
Electromagnetic Induction

No of students: 40...**Date:** 20th May 2008

Lesson Duration: 40 Minutes

Rationale:

Dry cells and accumulators are known to be sources of electricity but in small amounts. However, the amount of electricity required for domestic and industrial use is large and therefore there is need to understand how it is produced.

Specific Objectives

By the end of this lesson, the learner should be able to perform and describe simple experiments to illustrate electromagnetic induction.

Prerequisite Skills/Knowledge

Magnetic and Electric current

Teaching and Learning Materials/Resources

Galvanometer; center zero G; bar magnet; horseshoes magnet; copper wire and connecting wires.

STEPS	Teaching/Learning Activities	Learning Points	Remarks
Introduction (5 minutes)	Teacher asks Questions to learners: i) What are the common sources of electricity in our schools and homes? ii) How is the electricity produced in each case? iii) Why can't we use dry cells for lighting? Teaching defines electromagnetic induction.	- Electrical energy can be produced from magnetic fields. ■ Electromagnetic induction is the production of electricity from magnetic fields.	
Development (27 minutes) Stage 1 (3 minutes)	The teacher asks the learners to suggest how they can show that electricity is produced from the magnetic fields.	■ The needle of the G deflects one way when connecting wire moves down and the other way when it moves up in the U-magnet. ■ The needle of the G shows zero when	

Stage 2 (3 minutes)	The teachers the discuss the functions of the apparatus the learners are going to use i.e. connecting wires, horseshoe magnet, PVC pipe, Copper wire and galvanometer centre zero.	connecting wire is held stationary in the U-magnet.	
Stage 3 (10 minutes)	Teacher sub-divides the learners in groups and gives the worksheets.	<ul style="list-style-type: none"> ■ The needle of the G moves one way when a pole of a bar magnet is pushed into the coil and moves the other way when its moves away from the coil. 	
Stage 4 (5 minutes)	Groups report to class their observations.	<ul style="list-style-type: none"> ■ The needle of the G shows zero when a bar magnet is held stationary inside the coil. 	
Stage 5 (3 minutes)	Teacher asks the learners what the deflection of the needle of the galvanometer means,	<ul style="list-style-type: none"> ■ The deflection of the needle shows that electric current flows in the circuit. This current is called induced current. 	
Stage 6 (1 minutes)	The teacher asks what could be the Cause of the induced current.	<ul style="list-style-type: none"> ■ The induced current is caused by an induced electromotive force e.m.f. 	
Conclusion (5 minutes)	Teacher asks the learners to make conclusions from their observation. Teacher summarizes the lesson	<ul style="list-style-type: none"> ■ An induced current flows only when there is relative motion between the magnet and the conductor 	

- (b) Hold the connecting wire and move it in and out with the magnet. Write down your observation(s) made on the galvanometer.
- (c) Move the connecting wire in to the U-magnet then stop midway then move it out. Write down the observation(s) you made on the galvanometer.
- (d) Conclusion.

Lesson 10

TEACHING RESOURCES IN PHYSICS

10.0 Introduction

In one way or another, the physics teacher: -

- (i) Requires thorough knowledge of the topic that he is to present during a lesson.
- (ii) Needs to be aware of various methods of presentation of certain topics in Physics.
- (iii) Requires being conversant with the emerging trends in the teaching of Physics. (E.g. classroom instructions and assessment procedures)

- (iv) Requires some knowledge of current developments pertaining to certain 'topical theories' in Physics like the study of 'black-holes' in Astronomy and the new branch of Cosmology.

The Physics teacher will thus require some **resource**, to which he can use in extracting the relevant information he requires.

Whenever the information extracted finds itself used directly or otherwise in the teaching of Physics; then the source of such information is said to form part of teacher teacher's **teaching resources in physics**.

Teaching resources in Physics are many and varied. We can, however, classify those under two main headings: -

1. Physical Resources
2. Human Resources

Some of the physical resources are: -

- (i) Physics textbooks
- (ii) Physics Lab Manuals
- (iii) Physics periodicals
- (iv) UNESCO publication
- (v) Others (wall charts, films, slides, radio, TV)
- (vi) Laboratory

- (vii) Calculator
- (viii) Textbooks
- (ix) Print and non-print media
- (x) Physics Kits

Some of these resources are found in schools while others are found in Resource Centres

10.1 Non-print Media

Non print media includes films, film strips, overhead projectors, computer discs, floppy discs, slides, audio visual recordings, models, chips, bulletin boards, displays, television and computers.

These media are powerful tools for teaching physics. They can be used effectively and efficiently to teach many concepts.

10.2 Text Books

The Kenya Institute of Education (KIE) and the Ministry of Education (MOE) prescribes a number of books to be used by the pupils and teachers.

A number of books, however, are available that have been written with some level or depth of Physics syllabuses in mind.

The choice of a textbook for a particular physics syllabus will thus depend on the physics teacher concerned.

Text books not only provide one of the main sources of Physics teacher's subject matter for teaching purposes, but also a learning source for the pupil, in addition to standard text books.

10.2.1 Guidelines on Choosing a Good Textbook

- (i) The textbook must conform to the existing curriculum. It must adequately cover the required syllabus topics, concepts and skills.
- (ii) The content in the book must be relevant to the specific objectives, accurate and to the level of the learners.
- (iii) The content should be properly organized in a good and logical manner
- (iv) The book should promote positive social cultural values and attitudes towards the environment. There should be a systematic emphasis on skills development
- (v) The language used in the textbook should be accurate, correct and appropriate to the level of the learner in terms of vocabulary and structure

- (vi) It should have adequate exercises and activities for the learners. The assessment must be appropriate and relevant to the syllabus and use a wide variety of methods. It is also important that the instructions and questions must be clear.
- (vii) The book should have adequate and varied illustrations. The illustrations must be relevant and well positioned in the book. Captioning, numbering and labeling should be well done.
- (viii) The book should be proportionate and be of good size.
- (ix) A Physics textbook selected should have SI units and has adopted IUPAC system of Nomenclature.

The Physics teachers may also require consulting the following books:

(i) Supplementary Books

These are normally written to supplement the deficiencies of the subject matter not easily found in most standard textbooks.

(ii) Revision Books

Normally present Physics in a concise form. Expedite for revision purposes.

(iii) **Teacher's Guide**

Not many exist in Physics. Normally to be found in subject syllabuses specifically following a given Pupil Manual, as in SSP Physics.

(iv) **Laboratory Manuals**

Experiments form an integral part of the teaching of Physics. Apart from providing 'learning experiences', for the pupil, they also serve to illustrate 'part' of the 'scientific method'.

A number of school experiments can be found in standard textbooks.

Detailed experimental guides, however, experiments have to be by improvisation. Lots of experiments can be done by very simple, locally available improvised equipment. 'O' course this requires much of the Physics teachers' ingenuity, stamina and innovation. An expedience can, however be made of the material that is to be found in **UNESCO source book for science teaching series**.

School Equipment Production Unit (SEPU) Kits may be used along with the experiment manuals.

(v) Periodicals

These are publications that are issued at regular intervals fortnightly, monthly, half-yearly, and others.

The subject matter contained in them varies from one type of periodical to another, depending on the aims and objectives of those responsible for the publications.

Most of these periodicals are those publications associated with some “society” or “association”, of science (physics) teachers. Relevant material will range from teachers’ classroom experience to evaluation of curricular and some ‘vigorous physics’.

Periodicals in Physics are to be found under the names: -

(a) Bulletins

There are many bulletins that can be used for the purpose of teaching physics.

(b) Journals

Examples are

- i. Journal of Physics Education
- ii. American Journal of Physics.

iii. The Physics Teacher

(c) Physics Readers

These include collection of some of the best articles and book passages on Physics.

(vi) UNESCO Publications

These normally contain sources of ideas on aims, practice and trends in the teaching of Physics. Examples are

- Teaching School Physics
- New Trends in Physics Teaching
- Source Book for Science Teaching
- Current Trends in Scientific Research.

(vii) Others sources

A number of other resources can serve as a very useful teaching resource. Among these are

(i) Wall Charts

There are several on different topics like optics, astronomy, electronics, electricity and mechanics. These are readily available from major bookshops

(ii) Newspaper

Some articles on some topical issues in physics appear frequently in many newspapers.

(iii) Films and Slides

Films and slides relevant to teaching certain topics in Physics are normally available in several Embassies and the UNESCO library.

(iv) TVs and Radios

Some programs can be useful in the study of physics.

10.3 Human Resources

These are the facilitators of learning and they include the teacher and the lab assistant.

Resource persons from the community can also be helpful. Experts can also be invited to the school as a guest speaker. Some of these experts include professionals like lawyers, engineers, doctors, KIE and KNEC staff, university staff, architectures and many others.

Experts play an important role when students go out for excursions. They show the students what experts do in the application of scientific knowledge and also act as role models for the students to emulate.

Lesson 11

EVALUATIONS AND ASSESSMENT

11.0 Introduction

It is relatively simple to measure and test Physics facts acquired by a pupil, but that alone is not evaluation; that

does not tell us how well the child understands or reasons or what he thinks about a topic. Evaluation is **not** simply to:

- (i)** Indicate what areas of physics a pupil studied.
- (ii)** Classify students as a pass or fail, good or bad arrive at numerical or alphabetical grades.
- (iii)** Test fact memorized.

11.1 Assessment

Assessment is the process, which will show the teacher whether there has been a change of student behavior. It can be done on the form of oral or written test.

11.2 Evaluation

Evaluating is the process of judging the suitability of actual behavior being shown or the process of examining the operations that are performed. It is part of learning and teaching process that establishes whether the intended objectives have been achieved. It gives an accurate picture of a student's performance at any given time. It also provides framework on which specific objectives are achieved and students' progress expressed.

Evaluation is: -

- (i)** A continuous process

- (ii) An integral part of teaching
- (iii) Related to the aims and objectives of Physics teaching.

11.2.1 Methods of Evaluation

Formative

This is done during the teaching learning process. It may come weekly, monthly, termly or yearly. It can be done as quizzes, assignments or end-of-term exam.

Summative

This comes at the end of the course. This includes mocks and final exam like the Kenya Certificate of Secondary Examinations (KCSE).

Evaluation is carried out in the following areas: -

- (i) Theory
- (ii) Practical work
- (iii) Project work
- (iv) Attitude issues

11.3 Examinations

Good examinations, tests and quizzes are supposed to do the following:

- (a) To measure pupil's knowledge of facts, principles, definitions, laws, experimental methods etc
- (b) To measure pupils understanding of the work of the course.
- (c) To show the teacher what the pupils have learnt
- (d) To show pupils what they have learnt
- (e) To assess effectiveness of instruction
- (f) To motivate pupils to improve in their work
- (g) To discover individual problems and weakness with a view to making appropriate corrections.
- (h) To locate or identify weak areas in the teaching-learning situations.
- (i) To make comparisons among pupils.
- (j) To certify a necessary level for employment in jobs after pupils leave school.
- (k) To help education administrators select pupils for limited places in post secondary institutions (e.g. Universities)

Types of Examinations

An assessment can either be: -

- (i)** Objectives
- (ii)** Structured
- (iii)** Essay

a) Objective Test Items

An objective test is one in which the questions or 'items' as they are usually called, are asked in such a way that for each of them, there is only one predetermined correct answer (the key) out of 4 responses given. There are two types of objectives questions.

- . Multiple choices
- . Multiple completions

b) Multiple Choices

These items consist of a Stem either in the form of a direct question or an incomplete statement. As an answer four **responses** (A, B, C and D) are given, from which a candidate is asked to select the one (**the key**), which he considers to be most correct or suitable. The incorrect responses or options are called the **distracters**.

Example 1

Which of the following is a vector quantity? (**Stem**)

- | | |
|-------------------|-------------|
| A. Mass | RESPONSE OR |
| B. Velocity - key | OPTIONS |
| C. Distance | |
| D. Power | |

A, C and D are called **distracters**

In preparing **Multiple Choice** items the following points should be remembered:

- (i) The stem and options should be free from ambiguity.
- (ii) The item should test a **single** idea or concept. The purpose of the item must be kept clearly in mind.
- (iii) There must be only **ONE** correct response.
- (iv) The working of the stem must not suggest the answer to the candidate.
- (v) Avoid the use of distracters in one question, which may help the candidate answer another.
- (vi) Avoid the use of double negative. “It is **not** true that sound is **not** a form of energy’ is confusing.
- (vii) An item can be made difficult by making the distinction between the options **FINER**.
- (viii) Information that can be placed in the stem should not be placed in the options.
- (ix) Try to make the options the same length. Do not make the correct answer longer than the distracters.
- (x) A good distracter may contain an incorrect statement that may sound plausible to the untrained or a statement that is true but does

not relate to the question or a common misconception.

Example 2

A stone of mass 1 kg is dropped from a certain height and has a velocity of 5 m/s on reaching the ground. Assuming that air has no resistance what was the gravitational potential energy of the stone at the moment of release?

- A. 5J
 - B. 12.5 J
 - C. 25 J
 - D. 2500 J
- KEY B

EXAMPLE 3

A uniform metre rule can be balanced when it is supported at the 40cm mark provided that downward force of 0.5N is applied at the 20cm mark. What is the weight of the meter rule?

- A. 0.2 N
 - B. 0.33 N
 - C. 0.5 N
 - D. 1.0 N
- KEY: D

c) Multiple Completions

Items of this type either contain a direct question or an incomplete statement followed by several responses. One or more of these responses may be correct. The candidate has to consider each of the responses and to decide how many of these responses apply to the question. The answer sheet is marked according to the key provided below:

- A. (I) and (ii) only correct
- B. (Ii) and (iii) only correct
- C. (I) and (iii) only correct
- D. (I), (ii) (iii) all correct

Example 4

Which of the following are characteristics features of sound?

- (i) It is generally caused by vibrating bodies,
- (ii) It is conveyed by a longitudinal wave motion,
- (iii) It is transmitted by molecules of gas moving

steadily towards the ear. Key A

EXAMPLE 5

Photographic plates may be used to detect

- (i) X-rays
- (ii) Ultra-violet light
- (iii) Infra-red radiation

Advantages and Disadvantages of Objective Testing

Objective testing is not superior to other types of testing. What can be done is to assess the advantages and disadvantages of objective testing compared with other types of testing and thereby seek to establish how far objective testing can be used in Physics teaching.

The main **advantages** of objectives testing are: -

- (a) Because the items are short it is possible to include a greater number of items than would be possible using other types of examination. A greater number of items – like a greater number of physical measurements – give results of greater precision i.e. it increases the **reliability** of the test.
- (b) A wide range of the syllabus can be covered because the pupil can answer a large number of items in the time allowed without being given a choice of items.
- (c) In objective testing there is almost complete marker reliability; this is not so in other test forms.
- (d) Marking of objective tests is much more rapid than with any other type of test. Objective tests can be either machine marked or hand marked by unskilled

personnel. This is a valuable saving of time and money when the number of candidates is very large e.g. in a National Examination.

- (e) The teacher can readily use objective examinations for diagnostic purposes during the course. The rapidity of marking gives the teacher the information he requires and gives it in a useful form more quickly than it could be obtained using other types of examinations.
- (f) Pre-testing on a sample of students before the questions are used in an examination can be arranged more readily than with conventional (essay) questions. By pre-testing examiners can remove faulty or ambiguous questions and obtain fore knowledge of the difficulty of each question.
- (g) The ability to answer these questions correctly does not depend on a candidate's ability to express himself/herself in writing.

The main **DISADVANTAGES** of objectives testing are: -

- (a) Objective examinations take much longer to prepare than traditional examinations. There has to be a large number of items.
- (b) Whilst objective type of items may be relatively easily scored the development of good multiple

choice or completion test requires skilled settlers who have been trained in the techniques and a heavy commitment of resources.

- (c) It cannot test the ability of written expression or ability to organize information in a logical order. This is particularly so where the answer takes the form of an extended argument or a numerical problem consisting of several stages of working.
- (d) Objective tests do not stimulate new ideas or the ability to develop and 'open-ended' the situation is already created for the candidates. The ability to exploit 'open-ended' situations is important in physics and has to be evaluated in another way.
- (e) The scores (i.e. marks) gained in objective examinations may become unreliable because the candidates have guessed the answers. For this reason it may be considered necessary to take steps to discourage candidates from guessing.
- (f) There is a tendency to set objective items in Physics which test only the ability to recall knowledge. When most or all of the items test only this ability, in preparing for the test, pupils will 'cram'

knowledge and the higher abilities will be neglected. This is just as likely to occur with other types of examination but it is perhaps more obvious when the items are of the objective type.

(g) Some 'Best choice answers may be' debatable.

Lesson 12

ISSUES RELATED TO TEACHING AND LEARNING OF PHYSICS

12.0 Introduction

The performances of students in physics have been poor over the years, as seen from the KCSE results. This can be attributed to ineffective classroom practices arising from the following factors. These can be classified as: -

- (i) Teachers factors
- (ii) Students factors
- (iii) Resources factors
- (iv) Attitudes

12.1 Teachers Factors

a) In some instances teachers have been noticed to have

- Poor mastery of content
- Lack basic practical skills and innovativeness

- Neutral attitude manifested in theoretical, teacher-centered-

approach to teaching

- Failure to plan work properly
- Missing of lessons
- Lateness in class
- Some do not mark exercises.

b) Low morale, which is attributed to

- (i) Poor remuneration
- (ii) Working conditions
- (iii) Unsupportive school administration

c) Complain about lack of resources though sometimes these are available and remain unutilized.

12.2 Students Factors

- (i) Poor reading and writing skills
- (ii) Poor reading culture
- (iii) Negative attitude to school in general and physics in particular.

The negative attitude is manifested in:

- (i) Poor performance,
- (ii) Untidy work,
- (iii) Missed lessons,
- (iv) Absenteeism, Indiscipline

- (v) Low morale and general dislike for the subject

12.3 Teaching/learning resources and facilities

It has been found that in some instances: -

- (i) Teaching and learning resources and facilities are in constant short supply.
- (ii) Laboratories are rare, and may not have equipment or chemicals. Very often they exist as empty room
- (iii) Textbooks and writing material are also in short supply.

When some teachers are unable to carry out experiments or Teacher Demonstrations successfully, they rely on the laboratory technicians.

12.4 Attitudes

The efforts made by both teachers and the students are closely linked to their attitudes.

12.4.1 Definitions of Attitudes

- (i) Habits and reflex actions, which indicate our values, consciousness and personal acceptance of a way of life.
- (ii) Settled way of thinking or feeling about someone or something.

- (iii) The frame of mind i.e. the direction in which our mental as well as emotional compass is set, that ultimately sustains us in our efforts determines the effectiveness of our work.

Attitude is our mental deep-seated orientation towards life in all its aspects, intellectual emotional, social and individually.

The seat of attitudes is in the subconscious level of the mind and only revealed through projections in our expressions and deeds.

In case of teachers, attitude towards teaching may be revealed in response to the question.

“What is teaching to you?”

To some teaching is

- (i) An opportunity to meet ones and gratify desires.
- (ii) A burden to be shouldered
- (iii) A job you drifted into
- (iv) A way to earn a living etc

12.4 Exhibitions of negative attitude by teachers

This is done through:

- (i) Caring little about the lesson and thus any achievement in the lesson is just incidental
- (ii) Making no conscious effort to make the lesson interesting.
- (iii) Having inadequate lesson activities
- (iv) Providing little opportunity for the pupils to develop problem solving skills, self-expression skills and critical thinking.
- (v) Being impatient and harsh to slow learners.

12.5 Origin of Pupils' Negative attitudes

These originate from

- (i) Inappropriate peer influence and particularly induction at form one entry for those in secondary schools.
- (ii) Inappropriate influence from homes environment (parents, brothers, sisters, community) that view the subject as difficult.
- (iii) Poor learning conditions
- (iv) Poor teachers attitudes
- (v) Inappropriate teaching methods
- (vi) Poor motivation by teachers

Negative attitude are projected through tendencies such as

- (i) Sleeping during the lesson
- (ii) Negative comments about the lesson

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