BORNO STATE UNIVERSITY, MAIDUGURI

DIVISION OF GENERAL STUDIES

GST 221: HISTORY AND PHILOSOPHY OF SCIENCE**)**

(UNITS 2)

Introduction

History and Philosophy of Science tries to explain the nature of scientific investigation and how science is seen from various philosophical assertions. The course tries to uncover the history and contributions of various branches of natural sciences to human development and problems encountered. The course enables students to understand and appreciate evolution of science, the nature of scientific discoveries made, its classification and its contradictions. The course enables students to identify and define key scientific concepts and classification

UNIT 1: History and Philosophy of Science

1. Introduction

Philosophy is the body of principles that generate knowledge about a phenomenon in the universe. When philosophy is viewed as an academic discipline, it requires training background in order to be relevant in the context of the specialization. Philosophy is an investigation process into the social reality of man and his environment.

1.1 Meaning of Philosophy

Philosophy is described as a set of principles that produces knowledge about a phenomenon in the Universe. According to Azenabor (2001), philosophy is the study of principles underlying conduct, thought and knowledge. He also described philosophy as an academic discipline and as an intellectual enterprise. However; Lamont (1975) observed that philosophy is concerned with issues about life and living in the world around us.

1.1.1. Philosophy of Science is defined as a branch of philosophy that studies the philosophical assumptions, foundations and implications of science. Debate is robust within the discipline and much remains inconclusive, because for nearly every assertion advanced, a philosopher can be found who will disagree with it.

1.2 Science

Science is viewed as a body of knowledge usually derived from empirical evidence. It is a system of accumulating knowledge using observation and experimentation to describe natural phenomena. It is an accumulated body of knowledge that humanity has gained over the years using that system. In short, science refers to any systematic field of study or the knowledge gained from it. This definition means that the purpose of science is to develop general laws that explain how the world around us works and why things happen the way they do. How do we accomplish such a feat? That's where the "accumulation and classification of observable facts" comes in. The practice of science involves experimentation and observation. Scientists observe the world around them and collect facts. They also design experiments that alter the circumstances they are observing, which in turn lead to the collection of more facts. These facts might eventually allow scientists to learn enough about the world around them so they can develop ideas that help us understand how the natural world works.

1.3Knowledge

Knowledge refers to familiarity with facts that are organized into principles of human behaviour. Knowledge Development is an evolutionary process that has no end once it is started. Many people believe that knowledge comes from science. This assertion may not be true because much of the knowledge is derived from everyday experiences and not from the application of scientific knowledge.

If there is anything of which science consists, it is a method or set of methods. Therefore, the study of scientific method (known as **methodology** of science) is at the focal point of the philosophy of science.

1.4 The Scientific Method

In science the mode of generating knowledge is referred to as the scientific method and it is the logical and rational order of steps by which scientists come to conclusions about the world around them is referred to as the scientific method. The scientific method helps to organize thoughts and procedures so that scientists can be confident in the conclusions they reach. In this section, the focus will be to discuss the nature of the scientific method beginning with the origins of modern science in the search for a new method of inquiry. Our goal will be to determine whether we should believe in what science tells us or be skeptic about them.

1.5 The scientific method has four main stages.

Observation; this is the only acceptable method of learning about a natural law and it is achieved by taking **measurements** (i.e. gathering data). Continuous observation leads to the formulation of hypothesis.

Hypothesis; is formed for explanation of phenomenon. A scientific hypothesis is an idea or tentative statement that can be tested by observations or experiments, about the natural world. In order o be considered scientific, hypotheses are subject to scientific evaluation and must be falsifiable, which means that they are worded in such a way that they can be proven to be incorrect.

Experimentations; carried out by various groups of independent researchers to prove or disprove the predictions of the hypothesis. In scientific research, it is important to know that we

do not set out to 'prove' a hypothesis, we only test it. Not only is this more intellectually honest, but it is essential in deciding whether it is correct or not.

Conclusion; is a prediction from that experiment about the hypothesis. The two common methods that are usually used for predictions are:

a. Induction; scientific method uses inductive reasoning. It is a principle of reasoning that sanctions inference from the observation of particular instances to a generalization that embraces them all and more.

- There is **induction by enumeration** which is where we simply observe that some large number of instances of some phenomenon has some characteristic, and then infer that the phenomenon always has that property.
- There is also **induction by elimination** whereby competitors are eliminated or falsified.

  Generally, inductive methods have no conclusive verification.

b. Deduction**; d**eductive reasoning derives conclusion from a set of pre-existing premises. Deduction formulate hypothesis by falsification.

1.6 Scientific Theory

When a hypothesis or groups of hypotheses have been proved by various independent groups of researchers at various times, the hypothesis is accepted as a **scientific theory.** To scientists, a theory is a coherent explanation for a large number of facts and observations about the natural world. A theory is:

• Internally consistent and compatible with the evidence

• Firmly grounded in and based upon evidence

• Tested against a wide range of phenomena

• Demonstrably effective in problem-solving

1.7 Scientific Law

When overwhelming evidence is obtained over a period of time to support scientific theory, the theory becomes a **scientific law**. A scientific law is a description of a natural phenomenon or

principle that invariably holds true under specific conditions and will occur under certain circumstances.

1.8 History of Science

The term "science" is a Latin word for 'knowledge': *scientia*. Science was called *natural philosophy or pre-modern science* until the 1840s. Without a historical perspective, however, you will not fully appreciate what science is. According to history, the first true scientists were ancient Greeks between 600 B.C. and 500 AD. However, before them many cultures like the ancient Egyptians, Mesopotamians and Chinese had collected observations and facts, but had not tried to use those facts to develop explanations of the world around them.

Thales, **Anaximander**, and **Anaximenes** stood out among these Greek scientists. **Thales** studied the heavens and made effort to give an explanation for the movement of the heavenly bodies (the planets and stars). He was able to correctly predict "short-term disappearance of the sun." which of course was a **solar eclipse**, an event in which the moon moves between the earth and the sun, mostly blocking the sun from view.

Anaximander was the first scientist who tried to explain the origin of the human race without reference to a creator. He explained that all life began in the sea, and at one time, humans were actually some sort of fish. Charles Darwin later restarted the idea, and it is today called evolution.

Anaximenes believed that air was the most basic substance in nature. In fact, his belief was that all things were constructed of air. His thinking is that when air is thinned out, it grows warm and becomes fire, and that when it thickened, it condenses into liquid and solid matter. These ideas were found to be wrong; nevertheless, his attempts to explain all things in nature as being made of a single substance led to the concept of **atoms.**

Leucippus was another Greek scientist who built on the concept of **Anaximenes** and proposed that all matter is composed of little units called "atoms." He is known as the father of atomic theory.

Three other notable scientists from Greek during this period are **Aristotle**, **Archimedes** and **Ptolemy.**

Aristotle's greatest work was in the study of living things. He was the first to make a large scale attempt at the **classification** of animals and plants. Although Aristotle was known for a great number of wonderful advances in the sciences, he was also responsible for a great deal of nonsense that hampered science for many, many years. For example, he believed that certain living organisms spontaneously formed from non-living substances. This idea was called **spontaneous generation,** and the idea is that living organisms can be spontaneously formed from nonliving substances.

Archimedes is best known for his work with fluids when he showed how one could predict whether or not an object would float in a liquid.

Ptolemy studied the heavens and assumed that the earth was at the center of the universe, and that the planets and stars orbited about the earth in a series of circles. This system is called **geocentric system**. In this system, the earth sits at the center of the universe and does not move. This system was considered the correct explanation for the arrangement of planets and stars in space until about the 1700s.

1.9 Classification of Science

Science is classified into three:

1. Natural or physical science also called pure science deals with matter. This includes the natural sciences, such as mathematics physics, chemistry, biology, Zoology, Agric etc.
2. Social Science deals with human behaviour e.g. Economics, Psychology, Sociology etc.
3. Applied Science deals application of basic laws and principles for solving real life problems e.g. engineering is based on laws and principles derived from mathematics and physics while Business Administration is derived from economics and Sociology.

1.10 Kinds of Human Knowledge

There are three kinds of human knowledge as explained by (Boulding, 1978)

1. Folk Knowledge: this kind of knowledge is gained through everyday experience which may or may not be based on testing. It can be acquired through personal experience or from the experiences of respected people in the society.

2. Literary Knowledge: this kind of knowledge is based on symbolic reality. It is also created in an abstracting process in which essentials realities are sieved from human experience and used to explain the potential of human capabilities. Literary knowledge is not based on testing.

3. Scientific Knowledge: this kind of knowledge is formed by the characteristics of both literary and folk knowledge. According to Boulding, the major activities of empirical science involves description, testing and the end product is the expansion of knowledge.

Azenabor (1988) revealed that, scientific investigation is based on the principles of reliability, precision, objectivity, testability, valid, comprehensiveness and universality. Scientific method starts with, experimentation, observation, hypothesis/theories, laws, prediction, generalization, repetition and testing and objectivity.

1.11 Science and philosophy

Science involves objective experimental study with its theoretical goal as prediction and control of phenomenon under investigation. The method of investigation involves data collection, organization, analysis, interpretation, conclusion and generalization. **Philosophy** is the search for facts, knowledge and social reality that exist in the universe.

1.11Conclusion

The above session explains the concept of philosophy of science. Philosophy of science is defined as a branch of philosophy that studies the assumptions, implication and foundation of science. Science is the knowledge derived from empirical evidence while knowledge is the familiarity with facts. Scientific Method it is the logical and rational order of steps by which scientists come to conclusions about the world. Theory is a coherent explanation for a large number of facts and observations about the natural world. A scientific law is a description of a natural phenomenon or principle that invariably holds true under specific conditions and will occur under certain circumstances.

Summary of Unit 1

In this Unit 1, you have learnt that:

1) Philosophy is a set of principles which produces knowledge about a phenomenon in the universe.

2) Philosophy of Science studies the philosophical assumptions, foundations and implications of science.

3) Science is the kind of knowledge derived from empirical evidence.

a. natural or physical science

b. social science

c. applied science

4) Knowledge is the familiarity with facts. Kinds of human knowledge include;

a. folk knowledge

b. literary knowledge

c. scientific knowledge

5) Scientific Method it is the logical and rational order of steps by which scientists come to conclusion through

a. observations

b. hypothesis

c. experimentation

d. conclusion

6) Theory is a coherent explanation for a large number of facts and observations.

A theory should be

• Internally consistent and compatible with the evidence

• Firmly grounded in and based upon evidence

• Tested against a wide range of phenomena

• Demonstrably effective in problem-solving

7) A scientific law is a description of a natural phenomenon that invariably holds true under specific conditions and will occur under certain circumstances.

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UNIT 2: Introduction to Scientific Research Methodology

2. Introduction

According to the Cambridge edition of the Encyclopaedia Britannica (1911), etymologically, the word research is from the French word chercher, meaning 'to search for 'and the Latin word 'circare' meaning 'to go round in a circle'. Research is an investigation aimed at discovery facts. Any type of investigation that is based on original sources of knowledge is regarded as research. Research is an investigation for the verification of fresh theory or for enriching existing theories by fresh knowledge (Ahmadu, 2003).

2.1 Concept of Research

The term research is a process aimed at producing reliable solution to problems through planned systematic collection, organization, analysis and interpretation of data. It is a purposeful planned activities aimed at investigating and subsequently discovering facts, relationship or problems which characterize a given phenomenon (Bakari and Mohammed, 2007).

2.2 Basic Reasons for Embarking on Research

a. Research can be conducted to satisfy personal curiosity
b. For solving societal problems
c. For the advancement of knowledge
d. For promoting individual, community or national progress
e. For the discovery of relationships among phenomena in the universe
f. For refuting inadmissible view point of scholarly works

2.3 Types of Research

Research is described as either

- **Pure** (Basic) research is a fact finding research that tries to discover a phenomenon or an event. In carrying out pure research, the researcher tries to answer the questions 'what is or what are? For example what is the nature of soil in Zamfara state?

(ii) **Applied** research sometimes called expository research tries to expose an event or phenomenon. It is aimed at discovering why certain events or phenomenon happen, hence, it answers the question 'why'? Under applied research, it is assumed that the problem of

investigation exist or has been already established. For instance, a student of the department of **radiography,** who excelled in year one, two and three with '**A' grades** failed year four, and the department wants to know the cause of the failure. The study carried out to know why, is certainly, an applied research.

Pure and **applied** researches are the two main types of research, however, should not be regarded as classification of research.

2.4 Main Classifications Research;

2.4.1 Survey research; studies the population or the phenomenon under investigation. Under survey research the researcher is faced with all the issues or objects in the population. Therefore, the survey researcher selects or samples from the population from the objects of the population using some techniques of sampling. The samples should be drawn carefully for intensive study of the characteristics of the population. The techniques used in selecting the sample will determine the ability of the researcher to generalize his findings for the whole population. Statisticians advised that the strict rules of random sampling techniques should be maintained by the researcher for the valid generalization of the findings of the sample for the entire population.

The method of investigation in survey research begins with data collection, organization, analysis, interpretation, conclusion and generalization.

1. Mail Questionnaire carries carefully structured instructions and questions seeking for an answer that is sent to respondents who may not have the opportunity of seeing and asking for clarification from the interviewer.

1(a) Characteristics of mail questionnaire

i. It only operates in a literate community
ii. The research is expected to be very effective in communication techniques
iii. It is accompanied by a covering letter, containing purpose of the study and use of the findings and it ends by seeking for the respondent's cooperation.
iv. It is accompanied by stamped self-addressed envelope for returning completed questionnaire
v. It carries a promise of confidentiality

2. Personal interview involves a person seeking the information called the interviewer and the person giving the information called the respondent. The interviewer meets the respondents

and asks questions and records the response himself. The topic and the pattern of discussion are guided by the interviewer.

3. Observations are used in some study situations where the researcher can collects data on watching and recoding information. Observations include motoring behavioural activities and conditions of sample objects. On behavioural observation is used in recording physical processes and conditions such as weather to see if its rain, was bright, or cloudy. Behavioural observation is used in non-verbal analysis, linguistic analysis and spatial analysis (i.e. how we relate physically to others).

4. Participant observations require the person seeking the information to participate and observe to get the information required from the population of study. For instance a researcher Who wants to conduct a research on the behaviours of prisoners can only get the correct information if he pretends to be one of them and lives with them. Same applied to those studying the behaviours armed robbers and drug barons

2.4.2 Experimental research tries to uncover the nature of relationships among variables. Sometimes experiments can be planned to suit the researcher (i.e. the researcher may manipulates) and the experiment can be performed the way the research wants it, hence the control, rejection and elimination of certain variables existing in the situation. Experimentation is carried out in two ways

i. Field experiment
ii. Laboratory experiment

Under experimental research, laboratory apparatus and equipments are use in the collection of the information and observation of the experiments under investigation.

2.4.3 Ex-Post Facto Research; under this type of research the event of investigation has already taken place. Ex-post facto research means '**after the event**. for instance if there is fire disaster or communal clash in a particular community the government may decide to setup a committee to find out the immediate and remote cause of such disaster or communal clash.

However, all the instruments use for collecting data under survey research can be used for data collection under the Ex-post factor research.

2.5 Research Methodology

Research methodology is described as the overall strategy used by the researcher in collecting and analysing data for the purpose of investigation of problems (Osuala, 1987). Methodology is a scientific ways of carrying out activities that formed the research process. Research methodology is a philosophy adopted by the researcher in carrying out the activities which constitute the research process (Bakari and Mohammed, 2007).

The research process also described the research design is structured in the following order;

i. Formulation of the problem
ii. Data collection
iii. Sample collection
iv. Data analysis and interpretation
v. Research reporting

2.6 Formulation of the Problem

The research process usually begins with formulation of Hypothesis; a tentative statement expressing the relationship between two or more variables that can be verified at the end the findings; the hypothesis should be planned for easy observation and easy determination of statistical tools to be used; it should state the level of probability in which it will be tested.

2.7 Data Collection

A researcher collects information with a view to answering his objectives, testing his hypothesis or answering his research questions. The data could be primary or secondary. The primary data are the information collected in the field for the purpose of the study intended. Data obtained from sources such as records of organizations, internet sources, and other published and unpublished documents

2.8 Sample Collection

A sample is a portion of the population selected for intensive study in order to obtain some knowledge and make generalization about the population it represents. A sample is selected from the population after a clear definition of the population and identifying its characteristics. There are several sampling techniques to choose from depending on the nature of the research problem, the level of precision, purpose of the research and resource availability. Sampling techniques

such as systematic sapling, stratified sampling, purposive sampling, random sampling and host of others are used in sample collection. The use of samples in research minimizes labour, cost and save time.

2.9 Data Analysis and Interpretation

Data analysis is meant to provide answers to your research questions or test your hypothesis by offering some explanation on the outcome from the data. Data analysis also involves prediction and projection. Basically, these also involved some statistical techniques.

2.9.1 Statistical Techniques Used In Data Analysis

a. Descriptive statistics presents the data inform of tables, charts, diagrams, and graphs. However, the measure of central tendencies such as (mean, median, and mode), proportions, percentages, range, variance and deviations are all aspects of descriptive statistics used in answering research questions.

c. Inferential statistics involves predictions from the data using regression analysis, linear programming, and moving averages. It also involves probabilities based on normal, binomials and Poisson distributions used in testing hypotheses.

2.10 Research Reporting

This is the point at which a researcher is expected to determine the extent to which objectives of his research are achieved and see if the research has answered the research questions, prove or disprove the hypotheses. The researcher is also expected to compare his results with other previous researches and offer explanations. The researcher is also expected to discuss the major findings and link the theoretical framework and literature review and make personal judgement.

2.11.Conclusion

The above session discusses the concept of Concept of Research, various reasons for research, its types and classifications. It explains formulation of research problems and statistical techniques available for various types of research analysis

2.12.Summary of Unit 2

In Unit 2, you have learnt that:

1) Research is an investigation aimed at discovering fact or relationship or problems about a phenomenon in the universe.

2) Basic Reasons for Embarking on Research

3) Types of Research

(i) **Pure** (Basic) research is a fact finding research.

(ii) **Applied** research sometimes called expository research tries to expose an event.

4) Main Classifications Research;

i. Survey research; studies the population or the phenomenon under investigation

ii Experimental research tries to uncover the nature of relationships among variables. n two ways

a. Field experiment
b. Laboratory experiment

iii. Ex-Post Facto Research; under this type of research the event of investigation has already taken place. Ex-post facto research means '**after the event**.

5) Research methodology is described as the overall strategy used by the researcher in collecting and analysing data.

6**)** The research process usually begins with formulation of Hypothesis.

7) Data Collection; researcher collects information with a view to answering his objectives, testing his hypothesis or answering his research questions.

8) Sample Collection; A sample is a portion of the population selected for intensive study in order to obtain some knowledge and make generalization about the population it represents.

9) Data Analysis and Interpretation; are meant to provide answers to your research questions or test your hypothesis by offering some explanation on the outcome from the data

10) Research Reporting

This is the point at which a researcher is expected to determine the extent to which objectives of his research are achieved and see if the research has answered the research

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UNIT 3: Introduction to Nigerian Geologic Environment

3. Introduction

This section seeks to explain the distribution of rocks in Nigeria. It tries to explain the processes that formed the earth and specifically the different types of rocks that can be found in Nigeria. It tries to understand the interaction between the physical, chemical and biological systems during its 4.5 billion years history.

3.1 The meaning of geology

The word geology is derived from the Greek words 'geo' meaning earth and 'logia' meaning study. Geology is simply defined as the study of the planet earth, its rocky exterior, its history, and the processes that act upon it. Geology is also called the earth science and geoscience. To study the Nigerian geologic environment, we have to understand the distribution of rocks in Nigeria. **Rocks** are naturally occurring solid materials consisting of one or more minerals. **Minerals** are naturally occurring chemical elements or compounds that are homogeneous (have definite chemical composition and regular arrangement of minerals.

3.2 Types of Rocks in Nigeria

There are **two main types** of rocks, the **crystalline rocks** and **sedimentary rocks** in Nigeria.

The crystalline rocks are divided into three main groups;

- **The basement complex rocks;** These are the oldest rock types (pre-Cambrian age) in Nigeria. They are mainly concentrated in south-western Nigeria, north-central Nigeria around plateau, Kaduna, Bauchi and Jigawa states, and north-eastern Nigeria around southern Borno, Adamawa and Taraba states bordering Cameroon republic. Common **rock types** include older granite, migmatites, gneiss and schist. **Minerals** found in these rocks are gold, iron ore, quartz, feldspar, amethyst and tourmaline.
- **The younger granites;** these are granitic rocks of relatively younger age than the basement complex rocks. They are found around Jos plateau, mainly emplaced into the basement complex rocks forming a ring complex. The main **rock types** are granites and Rhyolites. **Minerals** include tin ore, columbites, and walframite.

The ages of the rocks vary from carboniferous (313 million years) to cretaceous (141 million years).

- **Tertiary-Recent volcanic Rocks;** these rocks are found on Jos plateau and Biu and Longuda plateaux of north eastern Nigeria. These rocks are of the basaltic type ranges in age from 22 million years to 0.7 million years. The most recent volcanic rocks are believed to be related to the Cameroon volcanic zones.

3.3 The Sedimentary; are those rocks derived from the derived from the accumulation and sedimentation of material over a long period of time. They are usually formed in strata.

The Sedimentary Rocks are divided into three main groups

- **Organically formed sedimentary rocks;** this class of rock is derived from the remains of dead plants and animals. When plants and animals die, they decomposed and formed organically formed rocks
- **Chemically Formed Sedimentary Rocks;** this type of rock is derived from precipitation of water bodies such as lake and sea, when such of water dry up, they leave behind some chemical in form of solid. Example of such rock includes potash, salt, gypsum etc**.**
- **Mechanically Formed Sedimentary Rocks; this** type of rocks are derived from disintegration of crystalline rocks due to heating during the day time and cooling during the night. Therefore, as a result alternate of heating and cooling uppermost part of the rocks, cracks will develop at the surface, when rain falls; it will enter the cracks and remove the uppermost parts of the rocks. The material removed are brought down by wind and water actions and filed up as sedimentary rocks. . In such way a mechanically formed rock sedimentary is developed.

3.4 Location of Sedimentary Rocks in Nigeria; the sedimentary rocks are also found in 5 sedimentary basins in Nigeria:

3.4.1 The Sokoto basin is found in north-western Nigeria. It consists mostly of gently undulating plain with an average elevation of varying between 250 and 400 metres above sea level**. Economic minerals** include gypsum, ironstone, clay and lignite.

- **The Benue basin** is formed by tectonic fracture induced by the separation of the South American and African plates during the Jurassic period. It has a length of approximately

800 kilometres bordering the Niger delta in the south and Borno basin in the north. It has a sediment thickness of about 6000metres in some portions. **Economic minerals** include coal, limestone, graphite, tar sand, and marble.

- **The Borno basin** located in north-eastern Nigeria forms one-tenth of the Chad basin. It has altitude of about 350 metres at the western margin and 300metres above sea level within the Lake. It has a sediment thickness of about 3000 metres in some portions. **Economic minerals** include diatomite, gypsum, limestone, Bentonite, marble and kaolin.
- **The Niger delta** is the most economically important sedimentary basins in Nigeria. Over 80% of the country's income comes from it. It is one of the largest deltas in the world. It covers an area of about 70,000km^{2}and has a sediment thickness of between 9000 and 12000 metres. It is well known for its **huge oil reserve.**

3.3.5 The Bida/Nupe basin is about 350 kilometres long linear structure originated from rifting. The youngest sediment in the Bida basin is dated as Maastrichtian. Most part of it is undated and comprised of classic sediments. It has a thickness of about 3000metres.Economic minerals include impure coal and ironstone.

3.3.6 Conclusion

The above session discusses the concept of Concept of geology, type and distributions of rocks and their mineral constituents in Nigeria.

Summary of study session 3

In studying Unit 2, you have learnt that:

1) The meaning of geology

The word geology is derived from the Greek words 'geo' meaning earth and 'logia' meaning study. Geology is simply defined as the study of the planet earth, its rocky exterior, its history, and the processes that act upon it.

2) Types of Rocks in Nigeria

There are **two main types** of rocks, the **crystalline rocks** and **sedimentary rocks** in Nigeria.

i. **The crystalline rocks are divided into three main groups**;

- **The basement complex rocks;** These are the oldest rock types (pre-Cambrian age) in Nigeria. They are mainly concentrated in south-western Nigeria, north-central and north-eastern Nigeria around southern Borno, Adamawa
- **The younger granites;** these are granitic rocks of relatively younger age than the basement complex rocks. They are found around Jos plateau, mainly emplaced into the basement complex rocks forming a ring complex.
- **Tertiary-Recent volcanic Rocks;** these rocks are found on Jos plateau and Biu and Longuda plateaux of north eastern Nigeria.

ii. The Sedimentary; are those rocks derived from the derived from the accumulation and sedimentation of material over a long period of time.

- **Organically formed sedimentary rocks;** are derived from the remains of dead plants and animals.
- **Chemically Formed Sedimentary Rocks;** are derived from precipitation of water bodies such as lake and sea, when such of water dry up, they leave behind some chemical in form of solid.
- **Mechanically Formed Sedimentary Rocks;** are derived from disintegration of crystalline rocks due to heating during the day time and cooling during the night.

3) Location of Sedimentary Rocks in Nigeria; the sedimentary rocks are also found in 5 sedimentary basins in Nigeria:

- **The Sokoto basin** is found in north-western Nigeria. It consists mostly of gently undulating plain with an average elevation of varying between 250 and 400 metres above sea level**. Economic minerals** include gypsum, ironstone, clay and lignite.
- **The Benue basin** is formed by tectonic fracture induced by the separation of the South American and African plates during the Jurassic period.
- **The Borno basin** located in north-eastern Nigeria forms one-tenth of the Chad basin. It has altitude of about 350 metres at the western margin and 300metres above sea level within the Lake.
- **The Niger delta** is the most economically important sedimentary basins in Nigeria. Over 80% of the country's income comes from it. It is one of the largest deltas in the world
- **The Bida/Nupe basin** is about 350 kilometres long linear structure originated from rifting. The youngest sediment in the Bida basin is dated as Maastrichtian.

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UNIT 4: Introduction to Some Areas of Science and Technology

4. Introduction

The evolution of technology from science had led to the modernization of human society. Scientist and Technologist have a lot of contribution to make towards the development of science and technology for the emergence of better society. In Most developed and developing countries of the word, there are increasing research and development activities in the field of science and technology for rapid national development. Technological changes are constantly shaping and creating the opportunities and problems confronting human society.

Technology has unlimited application for changing society. For instance, refuse waste is used in generating electricity by Grandon Company for 50,000 households in London. Waste water treatment plants produces phosphates fertilizer and methane gas which is also used in generating power for the waste water treatment plant. Nigeria is one of the nations that have been making effort towards her technological development. This effort can be seen in the history of her national policy for technological development.

4.1 The origin of Nigerian technological policies; can be traced to the national development plans, establishment of technological institutions and other viable economic policies.

4.2 The first National Development Plan 1962 – 1968 was aimed at developing the industrial sector of the economy to;

- Stimulate the establishment and growth of industries which contribute both directly and indirectly to economic growth.
- Enable Nigerians to participate to increasing extent in the ownership and management Nigerian industries and trade.
- Broaden the base of the economy and minimize the risk of over dependent on foreign trade
- Secure full employment for her citizens and make the highest use of available resources.

4.3 The Second National Development Plan 1969 – 1974 was aimed at developing Nigerian economy through massive industrial expansion. The emphasis was geared towards high technological areas and more intensive capital project such as;

- Iron and Steel Complex

- Car assembly Plant
- Nitrogenous Fertilizer Plants
- Petrochemical Complex
- Pulp and Paper Mill at Jebba
- Salt Refinery at Sapele and Otta

4.4 The Third National Development Plan 1975 – 1980 witnessed the oil boom era. During this period Nigeria had huge foreign exchange earnings from oil exports. During this period, Nigeria had her best opportunity to pay for import technology and other industrial projects. But unfortunately government neglected the desire for technological development. This led to continuous dependency on foreign technology.

4.5 The Fourth National Development Plan 1979 – 1983 witnessed high degree of mismanagement in the economy. It was a period when the civilians came back to power after long period of military rule. This period was characterized by heavy importation of foods, cars and other personal items. The national per capita income was reduced during this period and had never witnessed any new project except the commissioning of those from the third national development plan. This period offered no hope for any growth in the national economy.

However, the desire by the military government to repair the economy led to emergence of the popular programme called Structural Adjustment programme (SAP) aimed at

- Removing inefficiency in resources management
- Maintaining realistic exchange for the naira
- Reduce the inflation aspects of commodity prices
- Reduce government deficit and balance of payment deficit
- Improving the investment climate as means for achieving the objectives
- Trade liberalization
- Commercialization and privatization
- To stimulate some technological innovations
- Domiciliary account to minimize capital flight

4.6.Summary of Unit 4

In study session 4, you have learnt that:

1) The origin of Nigerian technological policies; can be traced to the national development plans, establishment of technological institutions and other viable economic policies.

2) The first National Development Plan 1962 – 1968 was aimed at developing the industrial sector of the economy to;

- Stimulate the establishment and growth of industries
- Enable Nigerians to participate in the ownership and management Nigerian industries and trade.
- Broaden the base of the economy and minimize the risk of over dependent on foreign trade
- Secure full employment for her citizens and make the highest use of available resources.

3) The Second National Development Plan 1969 – 1974 was aimed at developing Nigerian economy through massive industrial expansion. The emphasis was geared towards high technological areas and more intensive capital project.

4) The Third National Development Plan 1975 – 1980 witnessed the oil boom era. During this period Nigeria had huge foreign exchange earnings from oil exports. But unfortunately government neglected the desire for technological development. This led to continuous dependency on foreign technology.

5) The Fourth National Development Plan 1979 – 1983 witnessed high degree of mismanagement in the economy. The national per capita income was reduced during this period and had never witnessed any new project except the commissioning of those from the third national development plan.

4.7. Conclusion

Science and technology are interrelated and integrated concepts applied to ameliorate human conditions. Science and technology can contribute greatly toward the development of a new society

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UNIT 5: Man and the Management of Renewable and Non-Renewable Resources

5. Introduction

One of the topical issues today is the preservation and conservation of man's natural habitat. There is an outcry from scientists that the earth is losing its biodiversity at a faster rate than it used to be decades back. However, renewable and non-renewable resources, specifically agricultural resources, scientists had observed that, the world has probably a quarter million flowering plants , which potentially useful as human food; and so far less than 1500 species have been brought into formal agriculture. It is also observed that only 30 species produce approximately 95% of global food requirements, with 75% of the diet provided by only 8 crops (Odhiambo, 1986, cited in African Forum on *Sustainable Development, Governance, Globalization, African Perspective,* Nairobi: Heinrich Boll Foundation, 2002, pp.93). This suggests that the threat to food security and human survival can be averted if appropriate initiatives are taken to rationally use and improve the natural and human resources.

5.1 MAN

Man is at the centre of natural resources. There is indeed for a close relationship between man and the management of both renewable and non-renewable resources. Man is extremely complex at all levels, physical and psychological, and he is, so far, the most successful creature on earth. Man is above all else a worker or labourer. Work is the primary condition of his existence. If he does not work, he ceases to exist. What man needs to survive exists in nature. However natural resources rarely exist in a form directly suitable to his needs. Over time and space, man has observed, analyzed and, by his labour ,conquered nature to live a relatively safe life, tamed wild plants and animals, landed on the moon, gauged the deep oceans and seems to have become the "master" of his destiny and all other living things.

5.2 Resource; refers sources of human satisfaction, wealth or strength. Labour, entrepreneurial skills, investment funds, fixed capital assets, technology, knowledge, social stability and cultural and physical attributes may be referred to as the resources of a country. Resources may be used for both desirable and undesirable means such as war. (Johnston et al, 2000).

In the context of **resource management,** the term is restricted to 'natural resources', which are

substances, organisms and properties of the physical environment that are valued for their perceived ability to satisfy human needs and wants. People acting through culture evaluate nature and decide that certain of its elements are resources, while others may be either disregarded or perceived as a pest, weed or danger. This perceived resource set alters markedly over time and space to reflect variations in knowledge, technology, social structures, economic conditions and political systems.

Therefore, something becomes a resource when Man is able to use it for some form of support, which means it can be regarded as the usefulness of a feature to Man with the amount of support it affords him.

5.3 Classification of Resources

5.3.1 Natural Resources; natural resource is any naturally occurring substance or physical property of a place, which is used in several forms to satisfy human needs. Similarly, Faniran and Ojo (1980) viewed a natural resource as anything in the natural environment that can be used by Man.

Natural resources could further be categorized into two:

i. Biological resources; biological resources comprise all forms of life used by Man to satisfy his basic domestic, agricultural, commercial and industrial needs such as flora, fauna and microorganisms, among others.

ii. Physical Resources; the Physical resources on the other hand include soil, water, sunshine, air, vegetation, wildlife and mineral deposits among others (Ibrahim, 2002).

5.2.2 Human Resources; Under the human perspective, a resource could be viewed as somebody or something that can be used as a source of strength; or it could be a backup supply, that is a reserve supply of something such as money, personnel or equipment; it could also be viewed as a nations economic, political or military asset, such as labour, capital or military personnel. Resource could also be viewed as a source drawn on by a company for making profit, for example, personnel, capital, machinery, or stock (Encarta Dictionary, 2005).

Explain

i. Natural resources?

ii. Human resources?

5.5 Classification of Natural Resources

5.5.1 Renewable Resources; A renewable resource is one that may be replaced overtime by natural processes. As the name implies, it could also be referred to as non-exhaustible resource, such as soil and biotic resources. It also includes flow resources such as water, ocean tides, wind and solar energy. These types of resources are capable of yielding output indefinitely without inferring productivity. Odihi (1992) observed that, renewable resources are sustainable only under the right mix of utilization and management.

5.5.2 Non-Renewable Resources; are referred to as exhaustible resources. They cannot be efficiently replaced once they have been used, except in terms of geographical time scale. Exhaustible resources, as the name implies, are fixed in amount and usually formed very slowly. They are not necessarily destroyed by production or exploitation. For example, a fertile soil is an exhaustible resource if it is over cropped; mining can deplete iron-ore, but this does not mean excessive shortages of steel. The steel from used and discarded machines and scraps can be recycled. The recycling possibilities therefore set the limits on the sustainable use of exhaustible resources. Therefore, it is clear that a resource is exhaustible if the pattern of use makes its supply dwindle to zero. The misuse of resources can be described in terms of the concept of 'tragedy of the commons'.

5.6 Tragedy of the Commons; the concept focuses on the way public resources are misused by man each of day due to our unwillingness to use a minimum share of a resource. Johnston et al gave the example of fishermen who are likely to take as many game fish as possible out of a lake where there is no rule to stop them. This is because they feel that if they do not catch them, others will. The same principle applies to the misuse or over exploitation of any renewable or non-renewable resource.

5.7. Resource Management; is a process of decision-making whereby resources are allocated over space and time according to the needs, aspirations and desire of Man within the framework of his technological inventiveness, political and social institutions, and legal and administrative framework.

Therefore, the study of resource management is concerned with allocation of resources and the biophysical and socioeconomic milieu in which the resources are or ought to be developed. In terms of practical application, resource management can be described as an essential national undertaking since all sectors of the national economy depend on it. However, Ibrahim,(2002) identified four approaches. These include: - ecological; economic; technical and ethnological approaches.

5.8. Ecological Approach; the ecological approach pays attention to the allocation and management of resources in line with the physical and biological environment, which entails that resource allocation and development should always be in harmony with the biophysical environment.

5.9. ***Economic Approach; t***he economic approach is based on the principle that resources are scarce and as such users have to make a rational choice for better or optimum use. The strategy used in economic approach is the cost-benefit analysis, this approach focused on conservation, maintenance, appropriate use and reuse of natural resources in order to preserve the quality of life from excessive waste.

5.10. Technological Approach; The technological approach tries to enhance the efficiency and effective application of the economic approach with the aid of technological development. Its broad aim is centred on reducing the fear of resource depletion and the urgent need to cut down economic growth and consumption (Omara-Ojungu 1992 in Ibrahim, 2002).

5.11. Ethnological Approach; the ethnological approach involves the incorporation of public consent in resource allocation and management anywhere. This emerges due to the fact that in many instances, cultural dichotomy influences the perception and the use of the available resources. It involves a judgment of the degree of conflict or conformity with politics, law, tradition or expected modes of behaviour and the nature of institutional arrangements. The strategies used under this approach are quite many, but the most common aspect about them is that they attempt to assess the direction and magnitude of public attitudes and preferences on issues in resource usage.

5.12. Conclusion

From the discussions above, it is clear that the issue of resource management is of great concern

and many Nigerians and indeed other developing countries are little informed about resources management and appear unconcerned about their ignorance; they also seem to be very liberal about resource utilization modes and purposes; and their orientation is towards short term. The consequences will be felt most by the future generations since it takes many years for some of these resources to regenerate.

5.13.Summary of Unit 5

In Unit 5, you have learnt that:

1). Relationship between man and management of resources. Natural resources rarely exist in a form directly suitable to his needs. Over time and space, man has observed, analyzed and, by his labour ,conquered nature to live a relatively safe life, tamed wild plants and animals, landed on the moon, gauged the deep oceans and seems to have become the "master" of his destiny and all other living things.

2) Resource; refers sources of human satisfaction, wealth or strength. Labour, entrepreneurial skills, investment funds, fixed capital assets, technology, knowledge, social stability and cultural and physical attributes may be referred to as the resources of a country.

3) **Natural Resources;** natural resource is any naturally occurring substance or physical property of a place, which is used in several forms to satisfy human needs. Natural resources could further be categorized into two: **i.** Biological resources; biological resources comprise all forms of life used by Man to satisfy his basic domestic, agricultural, commercial and industrial needs. **ii**. Physical Resources; include soil, water, sunshine, air, vegetation, wildlife and mineral deposits among others.

4) 1 **Natural Resources;** is also classified into Renewable Resources and non-renewable resources; A renewable resource is one that may be replaced overtime by natural processes. It is also called non-exhaustible resource. While Non-Renewable Resources cannot be efficiently replaced once they have been used, except in terms of geographical time scale they are also referred to as exhaustible resources.

5) **Tragedy of the Commons; t**he concept focuses on the way public resources are misused by

man each of day due to our unwillingness to use a minimum share of a resource.

6) **Resource Management;** is a process of decision-making whereby resources are allocated over space and time according to the needs, aspirations and desire of Man within the framework of his technological inventiveness, political and social institutions, and legal and administrative framework.

7) ***The*** ecological approach pays attention to the allocation and management of resources in line with the physical and biological environment, which entails that resource allocation and development should not have negative effects on the environment.

8) ***Economic Approach; t***he economic approach is based on the principle that resources are scarce and as such users have to make a rational choice for better or optimum use.

9) **The technological approach** tries to enhance the efficiency and effective application of the economic approach with the aid of technological development.

10) ***Ethnological Approach; t***he ethnological approach involves the incorporation of public consent in resource allocation and management anywhere. This emerges due to the fact that in many instances, cultural dichotomy influences the perception and the use of the available resources.

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UNIT 6: Science and Technology in Society and Service to Man

6. Introduction

Science is the foundation upon which the vast majority of present day technological breakthrough is built. Through the application of science, man ensures the longevity of his existence. Also, the prestige and political power of any nation resides in its level of scientific activities. It is thus of importance that as part of the strategies of popularizing science among pupils, science teachers should seize every opportunity to make pupils appreciate the fact of science being a means of achieving technological development and economic survival.

Science is the knowledge about the *structure* and *behavior* of the *natural and physical world*, based on facts that you can proof. It is the means of achieving technological development and economic survival. Scientists draw from more than one discipline in their application principles to creating wonders. The basic or conceptual science subjects are Physics, Chemistry, Biology and Mathematics.

Applied or Technological science is concerned with finding solutions to practical problems. It is concerned with application of data, principles and theories of one or more fields of sciences for obtaining solutions to human practical problems. Therefore, important disciplines or the so-called professional courses such as Engineering, Medicine, Pharmacy, Agricultural Science, Building technology, Architecture, Veterinary medicine, etc. are technologies. However certain disciplines might be considered as *Hybrid* Sciences, they include Biochemistry, Biophysics, Molecular Biology, and Geology etc.

6.1.1 Importance of Physics to Man

Physics is inevitably instrumental to social growth. The knowledge of physics contributes to the discovery and rise hydroelectric power which has made life in the urban and rural areas more comfortable. The invention and discovery of telephone by Alexander Graham Bell in 1876 also made communication between individuals much easier and efficient. Basic principles of physics are also employed in the construction of land, sea and air vehicles together with modern rockets to bombs that are used in warfare. In technology, ranging from modern transistorized computers to radiation techniques in medicine [X- ray, Ultra Scan etc] had their roots in physics.

Almost all electronic devices depend on physics. We can run on endless list of contributions of physics towards making the world worth living, the prestige of several nations.

6.1.2 Importance of Chemistry to Man

We live in a country which is dependent on oil. The exploration and processing of oil and other related products depend a lot on the science of chemistry. Chemical products such as fertilizers are needed to boost our agricultural products. The impact of chemistry is also being felt in several communities. For instance, the production of salt at Okposi and Uburn in Imo state is an example of a traditional way of making salt based on principles of chemistry. The Jebba paper mill in Kwara state which manufactures paper from wood uses the knowledge of chemistry.

Chemistry can be actively seen in oil refineries and in chemical industries where cosmetics, soaps, perfumes plastic, nylon, glass, drugs, pesticides and dyes are made. Chemistry stands in a central position with physics and biology in solving many scientific problems.

6.1.3 Importance of Biology to Man

The study of Biology helps in a better understanding of animals and their habits, reproduction, physical growth, feeding and disease control. One of the deadly diseases in this country is Malaria. This and other diseases can be controlled through the knowledge of the life cycle of the organisms that causes them. Biological principle shave been used to control pests that constitute economic menace to some of our cash crops. Together with physics and chemistry, several techniques in Medicine, Agriculture and Engineering are made possible e.g. Pathogenic Bacteria, Herbicides used in warfare.

Biology is important in the study of genes and how they are transmitted. Genes are units of inheritance that dictates the characters of the organism. In humans, when the gene responsible for the production of the amino acid Tyrosine is lacking during pregnancy, the pigmentation of the child will be affected and an albino is produced

6.1.4 Importance of Mathematics to Man

Mathematics is the basic tool/language of science. Although mathematics and science are taught as separate subjects in school, from instructional point of view, science activity in the classroom has mathematical implications. Mathematics is used in a variety of ways in sciences.

For example, mathematics is used to show relationships between variables such as Volume, Temperature and Pressure. Mathematics is also used to extrapolate and interpolate data and to solve scientific problems. Mathematical notations are also employed in presenting scientific laws and theories economically, in developing originality, accuracy and simplicity of ideas as well as in logical reasoning.

6.2 Importance of Science and Technology to Man

The pursuance of science has had influence in social, political and economic status of a country. The so-called developed nations acquired their prosperity through scientific advancement. For example, Japan, China are the leading industrial nations because their scientists posses a greater amount of scientific know-how and practice than the rest of other countries. Application of science has provided essentials such as drugs, clothing, fuel and food. Scientific principles also provide the basis for such inventions such as Televisions, Telephones, Radios, Refrigerators, Vehicles, Planes, Ships, etc.

6.3.Summary of Unit 6: In this Unit, you have learnt:

a. The basic science and technological science subject
b. The importance of the conceptual science subjects to man
c. Importance of technology to man

6.7.Conclusion

If you look around, you will see a host of things like trees, lizards, insects, other people, soil, sky, and so on. Humans have always been curious about things they see and find in their surroundings. They ask themselves questions about what they see and try to work out answers by testing their ideas. This is the basis of all science while technology is the transformation of science into practical- that is, the application of science will lead you to technology.

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Unit 7: Man and His Cosmic Environment

7. Introduction

Cosmos refers to the universe as an integrated whole. Cosmology is the study of the universe as a whole, its theories, origin, evolutions, structures and features. Universe is the whole system, the matter and energy of which the earth is part of. Universe contains many astronomical bodies ranging in sizes from dust particles to planets, stars and sun.

7.1. Origin of the Universe

The universe appeared as a body in single point between 12-20 billion years and a violent explosion of some primordial mass gave rise to it through the BIG BANG theory. Products of big bang theory were hydrogen and Helium which later condensed to form stars and galaxies. Galaxy is an ensemble of hundreds or thousands of millions of stars, interacting by gravitational force and orbiting about a common center. Stars visible our eyes belong to our galaxy, the Milky Way. The visible part of our galaxy is roughly about 100,000 light years and 1 light year is about 10 billion km.

7.2. Components of the Universe

The universe is made up of a wide range of astronomical bodies. It includes the stars, sun, planets, meteors and meteorites, asteroids, comets, planetoids and moons. These objects all have different physical, chemical and biological attributes. However, only earth is known to have living creatures.

7.3. The Solar System

The solar system consists of astronomical bodies [planets, moon, comets, and meteors] in a portion of universe revolving around a particular star. These bodies orbit round the star due to gravitational force of attraction by the star. The sun is a star which the earth and other astronomical bodies orbit round it. There are 10 planets, 32 moons, more than 40,000 asteroids and countless number of meteors, meteorites and comets revolving round the sun.

7.3.1 The Sun

The sun is really a star, ball of gas and 1,392 km in diameter at its equator. It is nearly 333,000 times more invasive than the earth. There is continuous nuclear fusion reactions in its

core that produce large amounts of energy. Temperature in the core of the sun is about 15.7 million ^{0}C. The sun is about 150 million km from the earth and rays take only eight (8) minutes to reach the earth.

Energy from sun is the ultimate source of power for all life in earth. Through photosynthesis, plants convert solar energy into hydrocarbons (sugars and starches). Animals and people rely on foods produced by plants. Solar energy captured by living things millions of years ago is stored beneath the earth in the form of coal, gas, petroleum, etc. this energy fuels transport, industrial production and most power plants.

7.3.2 The Moon

The brightest object in our night sky and is the natural satellite of the earth. The moon is made up of solid rock materials like the earth; it shines by the reflection of light beamed from sun. The moon orbits the earth at an average distance of 384,400 km, just over 30 times the diameter of earth. It has a diameter of 3,480 km and its mass is about 1.2% of earths. The moon has no atmosphere and no liquid water. Average surface temperatures range from -153 ^{0}C at night to 107 ^{0}C during the day. The moon's main features are its crater-marked terra, or highlands, and darker maria, relatively flat basins that is filled with lava during an ancient period of volcanic activity.

The moon takes about 29 days to complete an orbit round the earth. It rotates on its axis in exactly the same time that it takes to revolve round the earth. Thus, the same side of the moon (its near side) always faces the earth. When the moon is positioned between the earth and the sun, the near side receives no sunlight and is invincible from earth- except when it blocks the sun to create a solar eclipse. We call this phase the new moon. As the moon revolves around the earth, its near side rotates to face the sun and it "waxes." When the moon revolves to a point on the other side of the earth opposite the sun, the entire near side faces the sun, and we see a full moon in our night sky. As the moon returns to a point between earth and the sun, it "wanes" in our night sky as the near side turns away from the sun.

7.4 Planets

Planets are planetary bodies that orbit around the sun on a definite path. There are nine known planets, but one was recently discovered. Some of the planets are made up of solid rock

materials like the earth while some are in gaseous form. On cloudless night, it is possible to see different planets during various times of the year. With the aid of telescope, it is possible to see more planets. Most planets have moon surrounding them. The earth has only one moon while Jupiter has 12 moons. All the planets revolve round the sun in time proportional to their distance away from the sun. The nine planets are:

1. **Mercury**

   Mercury is a small planet closest to the sun. It is slightly larger than the moon and is airless and has no atmosphere. Temperature ranges from -180 ^{0}C during long night to 430 ^{0}C in the hot days. It is 57 million km from the sun and takes only 88 days to make one revolution round the sun and has no moon. Mercury is sometimes visible just above the horizon before sunrise or immediately after sunset.

2. **Venus**

   Is the second planet from the sun and nearly the same size with earth. It consists of silicate rocks, Iron and Nickel. Clouds of sulphuric acid floats on atmosphere made up of carbon dioxide making the atmosphere poisonous and because of these substances, the surface temperature averages 460 ^{0}C.The distance of Venus from sun is 107 million km and takes 255 days to make one revolution round the sun and has no moon, it rotates in clockwise, or retrograde, direction. Venus shines brightly above the western horizon after sun set or above the eastern horizon after dawn.

3. **Earth**

   This is made of rocks and over 70% covered by oceans. The earth rotates on an axis that tilts about 23^0 from the plane of its orbit round the sun. It takes 24 hours to make one complete rotation and revolve round the sun orbit in 365 days. At any given time, about half of the earth surface faces the sun while the other half is in darkness. The earth atmosphere consist of 78% Nitrogen, 21% Oxygen with Argon, Carbon dioxide, Water vapour and other gases making up the remaining 1 %. It shields the earth surface from ultraviolet and other forms of radiation from the sun that may be harmful to life.

The earth's outer crust, extending 5 to 75 Km below the surface is made of rocks of containing Silicon, Iron and other minerals. The distance of the earth for sun in 150 million Km, it has a diameter of 12,600 Km and has one moon.

4. **Mars**

This is the 4th planet that is coated with iron oxide or rust and appears in our night sky as a reddish point of light. It has internal structure similar to earths and day length nearly similar to that of earth and goes through a yearly seasonal cycle like the earth. The planet contains both water and Carbon dioxide ice, which expand in winter and contract during summer. Surface temperatures average -63^{0}C [may fall to-140^{0}C at winter] to 20^{0}C. The distance of mars from the sun is 226.4 million km and it takes 687 days to revolve round the sun and have 2 moons. This planet is probably the most hospitable for life after earth, although people and animals could not breathe its thin cold atmosphere of carbon dioxide and water vapour.

5. **Jupiter**

Jupiter is one of brightest object in our night sky and is larger than all the other planets, moons in our solar system combined. Jupiter lacks a solid surface and its atmosphere consists of frozen ammonia and ammonium hydrosulphide, which is composed mainly of hydrogen and helium. Jupiter has 16 moons which are small and irregular in shape. Four of the moons are however, large solid bodies. Ganymede is the largest moon while others are Callisto and Europa, etc. The distance of Jupiter from sun is 773.3 million Km and it takes 11.9 years to complete one revolution.

6. **Saturn**

This is the 6th major planet from the sun and is the second largest planet in the solar system that is a bright point of light on our night sky. This planet has lower density that it can float on water. Just like Jupiter, Saturn has an atmosphere of hydrogen and helium. Saturn's most noted feature is the wide band of rings that extends out of the planet. These rings are actually thin, wide belts composed of icy particles. Saturn has 18 moons and the largest, *Titan*, is larger than mercury. The distance from the sun is 1.4 billion Km and takes 29.5 years for one revolution round the sun.

7. **Uranus**

This planet could only be seen from earth with telescope. It is green in colour due to methane clouds but the atmosphere is mainly Hydrogen. The distance from the sun is 2.9 billion Km and takes 84 years to complete one revolution and has 5 moons

8. **Neptune**

Neptune has about the same size and composition with Uranus. The distance from the sun is 4.5 billion Km, has 2 moons and takes 164.8 years to complete one revolution round the sun.

9. **Pluto**

This planet is the smallest, remote and least known in the solar system. Pluto and its largest moon, Charon, spin around each other like dance partners. Some astronomers consider Charon and Pluto a double planet while others consider Pluto too tiny to be qualified as a major planet, but should be considered as a minor planet, like an asteroid. The distance of Pluto from the sun is 5.9 billion Km, has no moon and takes 288.4 years to make one revolution around the sun.

7.5.1 Asteroids

Also known as minor planets or planetoids, asteroids orbit the sun. Scientists have counted more than 9,000 asteroids, but there are probably many thousands more of these mostly small, irregularly shaped chinks of metal and rock. Asteroids are mainly located between the orbit of Mars and Jupiter. The asteroids lack atmospheres or liquid water. The largest is Ceres, a sphere about 930 Km in diameter. Collisions between asteroids sometimes throw rock fragments, known as Meteoroids, into paths that cross the orbits of major planets, including Earth. Most meteoroids are so small that they burn up in the Earth's atmosphere, but occasionally one of these rocks falls to the Earth's surface as a Meteorite.

7.5.2 Comets

When observed from the Earth, a typical comet may show several different features. A star-like or fuzzy nucleus may be visible inside a surrounding coma, which is a bigger, hazy blob of light that might appear as large as the moon in the sky, but is usually smaller. Nucleus and coma together-or coma alone- is often called the head. The tail which, which may be narrow or wide, long or short, issues from the coma and usually is brightest nearest the head, gradually

dimming to invincibility along its length. The tail generally points away from the Sun and in rare cases may span a good fraction of the sky.

Comets have properties that set them apart from all other celestial bodies. They can appear anywhere in the sky—in sharp contrast to the sun, moon and planets, which are restricted to the rather narrow belt around the sky called the *Zodiac*. Comets can move at variable speeds with respect to the background stars.

7.5.3 Meteors

Meteors are objects in the universe almost of the same materials as comets. It is luminous due to its vapourization, and the heating of the air, caused by the friction resulting from its rapid motion appear like a bright light in the sky. Brilliant meteors, known as fire balls, occurring singly or in groups and generally consisting of a luminous head, followed by a comet-like train of light that may persist for several minutes. Some, called bodies, have been seen to explode, accompanied by a sound like thunder. Fainter meteors called shooting stars usually occur singly or sporadically. At intervals, however, hundreds or thousands of such meteors may occur over a period of hours or days and appear to emanate from a fixed point. These swarms are called meteor showers.

7.6 Eclipses

Eclipse is the obscuring of one of the celestial body by another, particularly that of the sun or a planetary satellite. Two kinds of eclipses involve the earth: the eclipse of the moon, or lunar eclipses; and those of the sun, or solar eclipses. A lunar eclipse occurs when the Earth is between the sun and the moon and its shadows darken the moon. A solar eclipse occurs when the moon is between the sun and the earth and its shadow moves across the face of the earth.

If the earth's orbit, the ecliptic, were in the same plane as the moon's orbit, two total eclipses would occur during each full moon and solar eclipse at the time of each new moon. The orbits however, are inclined, and as a result, eclipses occur only when the moon or the sun is within a few degrees of the two points, called the nodes, where the two orbits intersect.

Periodically, both the sun and the moon return to the same position relative to one of the nodes, with the result that eclipses recur at regular intervals. The time of the interval, called the *Saros* is a little more than 6,585.3 days or about 18 years and 9 – 11 days (depending on the

number of intervening leap years), and 8 hours. The maximum number of eclipses that can occur in a given year is 2, and the maximum 7, and the average 4.

7.7.Summary of Unit 7

In Unit 7, you have learnt about

a. The origin of the universe
b. The components of the universe
c. The solar system
d. Planets in the solar system
e. Eclipses and their causes

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Unit 8: Man, His Origin and Nature

8.Introduction

The main physical evidence of human biological and cultural evolution is deduced from a large number of fossil bones and teeth that have been found at various places throughout Africa, Europe and Asia. Tools of stone, bone and wood as well as hearths, campsites and burials have also been discovered and excavated. As a result of these discoveries in Archaeology and Anthropology, a picture of human evolution during the past 4 to 5 million years has emerged.

8.1 Human Origin

The fossil evidence for possible immediate ancestors of modern human beings is divided into the genera: *Ardipithecus, Australopithecus, Paranthropus* and *Homo,* and began about 4.4 million years ago. The nature of the hominine evolutionary tree before that is uncertain.

Between 20 million and 7 million years ago, primitive ape-like animals were widely on the African and, later, Eurasian continents. Although many fossil bones and teeth have been found, the way of life of these creatures and their evolutionary relationships to the living apes and human beings remain matters of active debate among scientists.

The fossil evidence of for human evolution may begin with a poorly known creature known as *Ardipithrcus ramidus* , known from a single Ethiopian site called Aramis. It is represented by teeth, jaw fragments and part of a skeleton, dating to about 4.4 million years ago.

Australopithecus is first known from sites in northern Kenya at about 4 million years ago and the genus became extinct about 2 million years ago. *Paranthropus* originated about 2.5 million years ago and persisted about 1 million years ago. *Homo* probably occurred between about 2.3 to 2.7 million years ago. A number of fossil skulls and jaws were seen in Ethiopia, Tanzania, Kenya and Malawi have been placed under the category *Homo habilis* (handy man) which has been associated with early stone tools.

Homo erectus occurred between1.8 to 1.9 million years ago from northern Kenya, were large brained and small toothed. They sophistication in tool making and there was evidence that fire was used. The brain sizes of early *Homo erectus* ranged from 750-900 cm^3 while the skulls that were seen later were in the range of 1,000-1250 cm^3.

By about 800,000 years ago, some *Homo erctus* had changed sufficiently to be recognized as a new species. *Homo heidelbergensis* was found near the town of Heidelberg in Germany. Members of this species had on average, a larger brain size, less projecting face, a more prominent nose and a more inflated brain case than *Homo erectus* fossils. After about 300,000 years, it apparently split into two: *Homo sapiens* (appeared in Africa) and *Homo neanderthalensis* (Neanderthal man) which appeared in Asia and Western Europe.

8.2 Physical Traits of Modern Humans

Human beings have physical traits that make them different from other mammals. The human body, brain, faces and teeth have evolved through various shapes and sizes

1. ***Bipedalism*** – two- legged walking, the most defining trait of the human *Spp* seems to be one of the earliest of the major hominine characteristics to have evolved. This form of locomotion led to a number of skeletal modifications in the neck, lower spinal column, pelvis and legs.

2. ***Human brain-*** the brain of the modern day man is large complex and sophisticated that allows him to use equipment's and tools well. Most modern human beings have a brain volume of between 1200 – 1500 cm^2. In the course of human evolution, the size of the brain has more than tripled.

3. ***Body size***: the earliest fossils show evidence of large differences in body size which may reflect a pattern of sexual dimorphism. The bones suggest that early females may have been 0.9 – 1.2 m in height and weigh 27 – 32 kg at maturity while men may have been somewhat more than 1.5 m tall and weigh about 68 kg.

4. ***Face and Teeth:*** Modern man has reduced size of face and teeth. Apes and ancient men had large, tusk-like canine teeth that project well beyond the level of the other teeth. Also, the chewing teeth, i.e., the molars and premolars size were decreased over time. Associated with these changes is the gradual decrease in size of face and jaws.

8.3 Human Races

Today, there are close to seven (7) billion people in the world. Different people live in different places, have different customs, beliefs, languages and even disease conditions. They are however grouped into different races. These are:

1. ***Caucasoid*** or Caucasians are people that originate from Europe, the Middle East and India. The colour of their skin varies from pale in cool, cloudy climates to olive brown in warm climates.
2. ***Mongoloid***: they make up about three quarters (¾) of the world's population. They include people who live in South East and Central Asia, the North American Indians and Inuits (people of Northern Canada, parts of Greenland, Alaska and Siberia). They have black and straight hair, have extra fold of skin in upper eyelid.
3. ***Negroid* :** This group is minority in terms of population. They have black or brown skins that help to protect them against the sun rays. They have tightly curled black hair. Negroid people originate from Africa

8.4 Distribution of Humans

The geographical areas occupied by human ancestors expanded during the course of human evolution. As far as is known, the earliest examples were the eastern and southern Africa, and they began to move into the tropical and sub tropical areas of Eurasia at least 1.5 million years ago, and into the temperate parts of these continents at least 500,000 years ago. Much later (about 60,000 years ago) human beings were able to cross the water barrier into Australia. Only long after the appearance of modern human beings did people move into the new world, probably less than 30,000 years ago. It is likely that the increase in human brain size took place as part of a complex interrelationship that included increasing social complexity and the elaboration of tool use and tool making, as well as other learned skills.

8.5.Summary of Unit 8

In Unit 8, you have learnt about:

a. The origin of modern man
b. The physical traits of modern man
c. The use of tools by the ancient man

8.6.Conclusion

Early human beings lived by hunting and gathering. They made tools and weapons by chipping hard stones together to make sharp jagged edges. They made fire by rubbing stones together and they wrap themselves in animal furs they killed to make them warm. At first, they lived in caves or a simple shelter made from branches and animal skins.

Present day humans learned to grow crops and keep animals. They had to settle in one place to build homes and towns. Man has evolved great civilizations during different times in history. Famous ancient civilizations include ancient Greek, Roman and Egypt.

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Unit 9: Solid Waste Generation and Management in Nigeria

9. Introduction

The World Health Organization (WHO, 1983) defines waste as something which the owner no longer wants at a given time and place and which has no current or perceived market value. Another definition is waste is what we do not want or what we fail to use for its proper purpose. It can also be defined as an unwanted by-product of a process.

The problem of solid waste is one of the most critical problems facing Nigerian urban centres. A feature of the urban scene in Nigeria in recent years is the gradual takeover of virtually every available open space by solid waste. Apart from physically obstructing legitimate human activities, the waste dumps have become fertile grounds for breeding mosquitoes, flies and other insects/pests which have in effect constituted the dumps into serious health hazards. Solid wastes disfigure the city image.

9.1 Waste generation in Nigeria

Based on the 1975 Industrial Directory published by the Federal Government of Nigeria, industrial wastes constitutes over 90% of the local waste generated in the country. Establishments/firms generating these wastes include: Mining and quarry industry, Wood and furniture factory, Paper and paper products, Rubber and plastic products [tyres, tubes etc.], Fabricated metal industries, Machinery industry and Electrical/communication equipment and repair services(for motor vehicle and motor cycle repairs).

9.2 Components of Waste

The typical waste in Nigeria consists of leaves and its components, paper and paper components, food left over, tin and metal waste, polythene, plastic materials and any other things that are thrown out of household, offices, etc. A study conducted in Maiduguri indicates that leaves accounted for 27% of waste generated in the metropolis followed by plastics and polythene bags [24%], papers (4%) and metals (13%).

9.3 Effects of Solid Wastes on the Environment

Improper disposal of solid waste has a lot of health hazards and other negative consequences on the people and the environment. Open waste dumps in most urban areas have become breeding grounds for mosquitoes, flies, rats and other disease vectors. This renders the populace exposed to various forms of diseases. Some of the major effects of solid waste include the following:

1. ***Environmental degradation***

Large heaps of wastes and the indiscriminate manner in which people dump them have become a serious concern to members of the public. It destroys the scenery of the environment and also a source of psychological disorder. Unclear waste lowers the aesthetic quality of the locality and property values in the affected neighbourhood. If tourism is an important revenue base to the economy, such environmental nuisance may reduce economic gains.

2. ***Insects***

The transmission route of filth induced diseases such as malaria, cough, cholera, diarrhea, dysentery, and a host of others are largely brought about by insect that use the waste dumps as their breeding grounds.

3. ***Odour:***

Wastes constitute a source of stench and offensive odour. This arises as a result of combination of food left over, vegetables, rotten items and other solid wastes that are indiscriminately discarded. When these combine with water, it causes offensive odour.

4. ***Rats/Rodents:***

Solid waste dumps have become the main source of food for rats and other rodents. In these dumps, they quickly proliferate and spread to neighbouring areas such as homes and farm lands. Health experts have observed that rats tend to be sources of diseases such as plaque, typhus; histoplasmosis, leptospirosis, Lassa fever, etc. when they find their way into houses, they destroy food items, furniture, etc.

5. ***Atmospheric Pollution***:

When waste is burnt in the open place, a thick and black smoke often covers the site and neighbouring land so that it pollutes the environment and cause human health hazards. Apart from the particular matter that constitutes smoke, gaseous discharges from incomplete oxides and various other noxious substances which are dangerous to human health are also associated with smoke from dumps.

9.4 Importance of Solid Wastes

1. Source of livelihood for some people.

2. Filling of gullies, depressions, old wells, pot holes etc.

3. Sources of manure for farm lands and gardens.

4. Old zincs, drums bowls are used in the repairs and reconstruction of buckets, basins, etc.

5. Ashes can be used for washing pots.

6. Papers can be recycled into tissue paper or used in igniting fire.

9.5 Methods of Waste Disposal

There are various methods of waste disposal which include:

1. ***Open dumping:***

This is the oldest and commonest method. In this method, waste sites are located in various points, of waste materials are allowed pile or leveled at times. Most urban centres in Nigeria are resorting to this method of disposal. However, the method has adverse effects on the environment, it causes nuisance and health hazards.

2. ***Sanitary land fillin****g* (Controlled tipping)

This is a method by which waste is deposited in a place and covered immediately after compaction with at least 15 centimeters of thick stable material. A typical sanitary land fill consists of alternate layers of compacted waste and soil. This method has the advantage of of a tight seal that prevents insects from multiplying fast, and rodents from invading the fill as well as minimizes the blowing and scattering of waste.

3. ***Incineration:***

This is a method of reducing combustible materials to inert or lifeless (ash or dust) residue at a very high temperature of about 760 ^{o}C (1400^{o}F). However, control devices are required to reduce the amount of dust and ash discharged from the incinerator stock. This method is not common in Nigeria due to high operation costs and maintenance skills.

4. ***Composting:***

This is the biological decomposition of organic materials to a human-like form by aerobic organisms under controlled condition for fertilizer making. A major disadvantage of this method is the inability to separate organic from inorganic wastes with a degree of reliability. This method is most common in Europe, Asia and the U.S.

5. ***Onsite disposal***

This is relatively recent and is mostly common in homes and institutions. Example is the swine feed method in which pigs are allowed to feed on garbage in urban areas, especially in the U.S.A. This however may lead to outbreak of diseases.

6. ***Recycling or Reuse****:*

In this method efficient recovery of wastes like glass, plastics, metals and cans can be achieved by the separation of the recyclables at source. Plastic wastes are turned into rubber mats. Broken glasses are important in the production of new glasses while tin and aluminum cans are usually recycled e.g. in the Ajaokuta steel mill.

9.6.Summary of Unit 9

In Unit 9, you have learnt

a. Waste generation industries in Nigeria
b. The components of waste
c. The negative effects of solid wastes on the environment
d. The importance of solid waste
e. Methods of solid waste disposal

9.7.Conclusion

The success of solid waste management in Nigeria largely depends on a high level of public awareness, education, reliable collecting service, an economic incentive, and considerable amount of resident involvement. This should be accompanied by a high level of investment in equipment and training for solid waste management.

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Unit 10: Environmental Effects of Chemical Industries

10. Introduction

Environment comprises of Air, Land and Water can and these can be affected by pollutants from Chemical and Petrochemical Industries. In its broadest sense, Pollution is any change in the normal quality of the environment brought about by Physical, Chemical and Biological Factors. In most cases, Pollution is mostly caused by human activities. However, natural phenomena like Flooding, Volcanic eruptions, Erosions could affect the state of the environment as well. Pollution has been studied from the point of view of human activities as it affects the Ecology of human surroundings.

The purpose of this paper is to explore the general environmental effects of some chemical and petrochemical industries such as Plastic, Paper, Fertilizer, Acids, Leather as well as Refineries. It has been reported that almost all processing industries have a dangerous effect on their immediate environment, which is referred to as pollution. Possible methods of preventing these environmental pollutants are suggested in this write up.

10.1. Components of Environment

The components of the environment are the Air, Water and Land/Soil and the effect of chemical/ petrochemical industries on any of these is pollution.

1. **Air Pollution**

Our environment may be divided into air, land surfaces and water. Of the, air is the most continuous, maintaining a connection between the land and the rivers, seas, lakes and oceans. There a number of ways the atmosphere may become polluted by chemical industries. One of these sources is emission from fires and furnaces. The atmospheric pollutants from this source may exit in the form of gas, suspended particles or droplets. They vary greatly in stability in air and reaction. These substances are sometimes more dangerous than the original compounds. For example, organic materials and oxides of Nitrogen that are release from the furnace exhausts interact under the influence of sunlight to form peroxyacetylnitrate and often toxic substances that are harmful to life.

2. Water Pollution

This largely arises from sewage disposal especially into the immediate water body from the processing plant. For example, the indiscriminate and unhygienic practices of disposing liquid waste from refineries, leather, acid plants, fertilizers and chemical industries contribute a lot in polluting the surface water. Water may also be polluted by substances dissolved in it or suspended on it.

3. Land or Soil Pollution

Soil accounts for a high proportion of the land surface. In contrast to their behavior in air and water, pollutants do not move readily once they are in soil. Hence, soil in the neighbourhood of factory chimneys become contaminated with particles of sooth and mineral matter

10.2 General Effects of Pollutants on the Environment

i. Air pollution

It has been shown that air pollution affects health of humans and animals, it damages vegetation, causes land degradation and deteriorates materials, affects climate, reduces visibility and solar radiation, impairs production processes, contributes to safety hazards and interferes with enjoyment of life and properties. Although some of these effects are specific and measurable, most are difficult to measure and as such, this has brought about disagreement over the quantitative effect of air pollution.

ii. Land pollution

Solid wastes on land seriously affect air quality. They also cause flooding due to blockage of drainages, result in land degradation and as such bring about difficulties in soil conservation.

iii. Water pollution

The effects of water pollution are not only devastating to people, but also to animals. Polluted water becomes unsuitable for drinking, recreational activities, agriculture and industry. It diminishes the aesthetic quality of water bodies. More seriously, contaminated water destroys aquatic lives or reduces their reproductive abilities.

10.3 Environmental Pollution Control

1. Air

The most effective means of dealing with air pollution is to prevent the formation of such pollutants or minimize their emission at the source. This can be effectively tackled at the early stage of the process design so as to select those methods that do not contribute much to air pollution potentials. These can be accomplished through:

i. Changes in raw material: this can be done by the use of biofuels (produce less air pollutants than fossil fuels) instead of fossil fuels.
ii. Changes in operational materials- this uses the best operational conditions (temperature, pressure, etc,) at which no or minimal level of air pollutants is achieved.
iii. Modification or replacement of process equipments- modification of the equipment designed so as to meet up with the operational condition or if the life time of the existing equipment is reached then, it should be replaced by new one.

2. Soil

For soil or land, pollution control could be achieved through the application of the following techniques:

i. Curative techniques: these include sanitary land filling, compaction, open dumping, incinerating, composting, shredding and bailing.
ii. Preventive techniques: these include waste reduction strategies, like recycling, recovery and reuse.

3. Water

Treatment before discharge is the best method, so that all waste waters can be recollected and treated for subsequent reuse.

10.4.Summary of Unit 10

In study session 10, you have learnt

a. The different chemical industries

b. The components of the environment and how they are polluted
c. The general effects of pollutants on the environment
d. Environmental pollution control

10.5.Conclusion

The planet earth and its atmosphere are like a giant 'green house' and as such, with the release of emission of such gases like carbon dioxide, the atmosphere may be accumulated. Consequently, the unabsorbed carbon dioxide rises to the upper atmosphere which may hinder the radiation from the sun, this results to an increase in global temperature generally referred to as "green house effect".

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