PRD 208:
MAN,ENERGY AND RESOURCES

NATIONAL OPEN UNIVERSITY OF NIGERIA

COURSE GUIDE

PRD 208
MAN, ENERGY AND RESOURCES

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CONTENT

INTRODUCTION

The course deals with energy utilization the indispensability of energy in the life of man. The course also touches on the history of origin of life and how man has evolved from his ancestors. You will also be exposed to a number of natural resources found around man in his environment.

In this course, you will be presented information in primary education in an organized way to make learning easier. All the units follow the same

pattern and so after the first few units, the rest will become easy to follow.

The primary school is the foundation of the Educational system in Nigeria, hence Primary Education Studies aims of equipping teachers with the relevant knowledge, skills, attitudes, methods and materials to enable them teach effectively all subjects in the primary school curriculum as contained in the National policy on Education.

As primary school teachers, you need to be exposed to a wide range of knowledge to enable you cope with the tremendous task of teaching wide range of subject matter at this level of education. With this background and a good professional training, you can then be acquainted with the necessary skills to achieve this goal of primary education. With this view in mind, we have packaged this course in such a way that you will learn about issues and concepts that will prepare you for the tasks which you may be asked to perform as primary educators.

The course consists of 15 units of teaching. They include materials which bother on the history of life on earth, origin of man, issues relating to energy and its utilization, conversion and conservation. It also discussed a wide range of natural and man-made resources available to man in his environment and the use to which they have been subjected. The course also includes a course guide which sheds light on what to do as you run through the content in such a way that you find the content interesting and enjoyable. There are regular tutorial classes that are linked to the course. You are advised to attend all the sessions.

WHAT YOU WILL LEARN IN THIS COURSE

The overall aim of the course "man, energy and resources" is to expose professional primary school teachers to materials which provide them with a wide range of knowledge about some basic concepts and ideas in science. Therefore, it is expected that, as you run through this course you will be exposed to some basic scientific concepts such as energy, its forms, conversion and conservation. You will also learn about how life originated on earth.

COURSE OBJECTIVES

To achieve the broad aims set, the course sets its overall objectives. There are specific objectives, stated at the beginning of each unit. These objectives are stated in specific terms. You will need to read these objectives before you start working through each of the units. It will be of great assistance to you if you make them your focus as you run

through each of the units. This will enable you check your progress. After going through the unit, try and read over the unit objectives. By doing this you will be sure that you are doing what is expected of you by the unit.

After you must have successfully completed the study of this course you should be able to:

a) Identify the major theories accounting for the origin of life on Earth.
b) Identify the role of Evolution in explaining how organisms especially man have acquired their present forms.
c) Explain the contributions of various interest groups towards the history of origin of man.
d) List the special features which place man ahead other creatures.
e) Convince a clergy man that evolution is real.
f) Define energy
g) Enumerate different kinds of energy
h) State the law of conservation of energy
i) Enumerate the various uses to which man has been able to put energy.
j) Explain the interconvertable nature of energy
k) State the laws of thermodynamics.
l) List and explain the recourses that are available to man in his natural environment.
m) List and explain the rationale behind the clarion call for conservation of natural resources.
n) List the uses of all the natural resources with which man is endowed

WORKING THROUGH THE COURSE

To complete this course, you are required to read the study units need set books and other materials provided by the National Open University of Nigeria (NOUN)

Each unit contains self assessment exercises and at some points in the course, you may be required to submit assignments for assessment purpose. The course should take you about 17 weeks to complete. You will find listed all the components of the course, what you have to do, and how you should allocate your time to each unit in order to enable you complete the course successfully on time.

COURSE MATERIAL

Major components of the course are

i) Course guide
ii) study unit
iii) references
iv) assignment files

ASSIGNMENT FILE

There are fifteen Tutor marked assignments in this course. The assignments will cover.

1. The history of the origin of life
2. The theories accounting for origin of life
3. The concept of Energy and man.
4. Energy conversion and utilization
5. Man and Resources.

PRESENTATION SCHEDULE

The presentation schedule included in your course materials gives you the important dates for this academic year. You must ensure that you complete your tutor-marked assignments and attend tutorials. Remember that you are required to turn in your assignments as and when due. You should guide against lagging behind in your work.

ASSESSMENT

There are three aspects to the assessment of the course. First are set assessment exercise; and second are the tutor-marked assignments and the third is a written examination. You are urged to be sincere in attempting the exercises. You are expected to apply information knowledge and skill that you have acquired during the course.

The assignment must be submitted to your tutor for formal assessment in accordance to the deadlines stated in the presentation schedule and the assessment file. The work you submit to your tutor for assessment will account for 40% of your total score in the course. At the end of the course, you will need to sit for a final examination which will also account for 60% of your total marks.

STUDY UNITS

The study units in the course are as follows:

Module 1 History of Life and Man
Unit 1 History of Life
Unit 2 The Theory of Evolution
Unit 3 The Nature of Earliest Organisms
Unit 4 Evidences for the theory of Evolution

Unit 5 Origin of Man
Module 2 Man and Energy
Unit 1 Energy and its forms
Unit 2 Man's Energy needs and sources
Unit 3 Energy and chemical systems
Unit 4 Energy Conversion
Unit 5 Conservation of Energy and Energy Utilization
Module 3 Man and Resources
Unit 1 Food Resources
Unit 2 Rubbers and Related products
Unit 3 Mineral Resources
Unit 4 Vegetation and Water Resources
Unit 5 Conservation of National Resources

The first five chapters discussed the history of the origin of life as well as the theories surrounding the origin of life and how organisms have acquired their present forms. The next five units focused on energy, its forms and the uses to which man has subjected energy. It also explained the indestructible and the indispensable nature of energy. In the last five units, we dealt with a number of natural resources with which man is endowed. We also explained the location and the threat which man's continuous exploitation of these resources could pose unless steps are taken to conserve them for posterity.

COURSE OVERVIEW

The table 2 below brings together the units, the number of weeks you should take to complete them and the assignment that follow them.

Table 2: Course Organizer

Unit	Titles of work	Weeks of activity	Assessment (of unit)
1.	History of life	1	1
2.	The theory of Evolution	1	1
3.	The nature of earliest organisms	1	1
4.	Evidences for the theory of evolution	1	1
5.	Origin of man	1	1
6.	Energy and its forms	2	1
7.	Man's energy needs and sources	2	1
8.	Energy and chemical systems	2	1
9.	Energy conversion	2	1
10.	Conservation of energy and	2	1

	energy utilization		
11.	Food Resources	1	1
12.	Rubbers and related products	1	1
13.	Mineral Resources	1	1
14.	Vegetation and water Resources	1	1
15.	Conservation of Natural Resources	1	1

HOW TO GET THE MOST FROM THIS COURSE

One major advantage of a distance learning programme is that, the study unit replaces the lecturer. By this, you have the opportunity of working through specially designed materials at your own pace, time and place that suit your interest. It also affords you the opportunity to read through the specially prepared lecture materials instead of listening to a lecturer.

TUTOR-MARKED ASSIGNMENT (TMA)

There are fifteen (15) tutor-marked assignments in this course. You are expected to attempt all the assignments, out of which the best five will be selected for you to give you your 40% continuous assessment score. Each assignment accounts for 8% of your total course work.

However, you are advised to read more widely using other reference materials. This will give you a broader knowledge and a better understanding of the course.

Whenever you have completed your assignment, send it together with a TMA (tutor-marked assignment) form to your tutor, make sure your assignment gets to your tutor on or before the deadline given on the presentation schedule and assessment file. If for any reason, you cannot complete your work on time, contact your tutor before the assignment is due, to discuss the possibility of an extension. Extension would not be granted after the deadline except on special grounds.

COURSE MARKING SCHEME

The following table lays out how the actual course marking is broken down.

Table 1: - Course Marking Scheme.

Assignment	**Marks**

Assignments 1-5	Five assignment, 8% each = 40% of the course mark
Final examination	60% of overall course mark.
Total	**100% of course marks.**

The study units provide exercises for you to check your progress at appropriate points just as a lecturer will give you an in-class exercise.

All the units in this course follow a common format. The first item is introduction of the subject matter of the unit. Next is a set of learning objectives. These objectives state in concrete terms what you should be able to do by the time you have read through the unit. You should let this objectives guide you in your study. On completing each unit, you should go back to check if you have achieved the stated objectives. If you cultivate this habit, you will significantly increase your chance of passing this course.

The main body of the unit serves as a guide to be able to run through the unit content materials. Self-assessment exercises are spread throughout the units. At the end of each unit, there is a tutor marked assessment. Working through the assessments will enable you achieve the objective(s) of the unit and get you prepared for the assignments and the examination. You should be conscientious while you go through the exercises and the tutor marked assignments. Make sure you plan your time on how you go through the course unit and ensure strict adherence to the time schedule. In case you might have difficulty with your schedule, try and let your tutor know about it before it gets out of hand.

After completing the last unit, review the course and get your self prepared for the final examination. Make sure, you have significantly achieved the unit objectives (listed at the beginning of every unit) and the course objectives (listed in this course guide).

TUTOR AND TUTORIALS

Since this is a 2 unit course, you are expected to attend tutorials for maximum period of hours in your study centre.

Your tutor will mark and comment on your assignment and monitor your progress in the course. He would also render useful assistance to you in case you have any difficulty comprehending any aspect of the course. In case of any difficult, do not hesitate to contact your tutor by phone, e-mail, or any other means of communication if you need help.

You should try as much as possible to attend tutorials. This is the only opportunity to have direct contact with your tutor and to answer all questions which may have been agitating your mind. You may also form tutorial group discussions where you can raise questions amongst yourselves. Try and join these discussion groups whenever they are organized. You will definitely learn a lot from participating actively when sincere group discussions are held. We wish you the very best in the course as you run through the content. No doubt, you will find it interesting and useful.

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MODULE 1

HISTORY OF LIFE AND MAN

UNIT 1 HISTORY OF LIFE

CONTENTS

1.0 INTRODUCTION

This unit and indeed, the next four units of this course are committed to discussing the many theories concerning the origin of life and the possible ways in which various species of organisms have originated. A brief outline of the main theories concerning the origin of life is presented such that students are aware that there is a range of opinions on the subject.

2.0 OBJECTIVES

At the end of this unit, students should be able to

- Be aware that there are divergent opinions about how life came in to being.

- Mention the major theories accounting for the origin of life on earth.
- Explain what each of the theories in (ii) above proposes

3.0 MAIN BODY

3.1 Background Information About The Origin Of Life

The issue surrounding how life originated has been a point of controversy among different categories of individuals who are interested in the subject. Traditionally, the study of history of life has been fraught with allegations of indoctrination. Indoctrination may be defined as a conscious attempt to inculcate unshakable commitment to a belief or doctrine. Such approaches are not only unscientific but also intellectually dishonest. Much of the evidences on which range of opinions on the subject are based is metaphysical. This implies that it is impossible to repeat the exact events of the origin of life in any demonstrable way. This is true of both scientific and religious accounts. However, evolution is the only theory concerning the origin of life that appears scientific. This is because it is made up of a collection of scientific hypotheses that are capable of being tested. Subsequently, we shall see some of these theories and evidences as presented by different individual scientists, who have contributed to the subject.

3.2 Theories of The Origin Of Life

Theories dealing with the origin of life on the Earth (on which man lives) and indeed the entire universe are diverse and uncertain. There have been divergent views about the origin of life. The argument had been between the scientists and theologians, Science, contrary to popular belief, can not contradict the divine origin of life. Nor theological view necessarily dismisses the scientific hypothesis, that during the origin of life, life acquired those characteristics which are explained by the laws of science.

The major theories that have been put forth accounting for the origin of life on Earth include;

v) *Special creation*: - (i.e. life was created by a natural being at a particular time)
vi) *Spontaneous generation*: - (i.e. life originated from non-living matter)
vii) *Steady state theory* (i.e. life has no origin)
viii) *Consmozoans theory* (i.e. life moved on to these planet, Earth, from elsewhere.
ix) *Biochemical evolution theory* (i.e. life arose according to chemical and physical laws.

Let us now look at each of these theories in much more detail, as given in each of the sections below.

3.3 Theory Of Special Creation

This theory is supported by most of the world's major religions (especially, Islam and Christianity) and civilizations. It attributes the origin of life and indeed man to a supernatural event at a particular time in the past. According to this, theory, God created man in his own image. In other words, the diversity of forms as seen among and within organisms are not as a result of either convergent or divergent gradual changes from an earlier structure or form; rather they were created spontaneously, just as we find them. For instance, archbishop Usher of Armagh in support of this theory, calculated in 1650 A. D. that God created the world in 4004 B. C, beginning on October 1 and finishing with Man at 9.00 a. m. on October, 23rd . He achieved this figure by adding up the ages of all the people in the biblical genealogies from Adam to Christ. Though the arithmetic is sound, he placed Adam to have lived at a time when Archaeological evidence suggests that there was already a well established civilization in the middle East.

The traditional Judaeo – Christian account of creation given in Genesis 1:1-26 has attracted and still continues to attract controversy. The view about special creation as presented in this theory to scientists lacks empirical basis because it can not be subjected to any form of testing.

Exercise 1.1

1. Differentiate clearly between the proposition by theory of special creation and scientific thought.

3.4 Theory Of Spontaneous Generation

This theory was prevalent in ancient Chinese, Babylonian and Egyptian thought as an alternative to special creation. Aristotle (684-322 B. C) believed that life arose spontaneously. His hypothesis of spontaneous generation assumed that certain particles of matter contained 'an active' principle' which could produce living organism under suitable condition. His active principle include the fertilized egg.

With the coming of Christianity, the spontaneous theory became less acceptable except those who believed in magic and devil worship, though it remained a basic idea for a long period afterwards. A number of people, through series of experimentation and observation, disproved the theory of spontaneous generation. Instead they based the origin of

life on biogenesis. This means that living organism was required to have another living organism to come to existence. Examples of those who belong to this school of thought are Redi, Lazzaro Spallanzan, (1965) and Louis Masteur (1860).

The validation of biogenesis raised another problem, where did the first living organism come from? The steady- state theory has an answer for this as would be seen in the next section.

Exercise 1.2:

1. What were the basic assumptions of the spontaneous generation theory?

3.5 Steady State Theory

This theory asserts that, the Earth had no origin, has always been able to support life, has changed a little and that species had no origin. The theory proposes that species, too never originated, the only alternatives are for its numbers to vary or for it to become extinct. The theory does not accept the palaeontological evidence that the presence or absence of a fossil indicates the origin of extinction of species. The paloeontological evidence presented in support of the steady state theory describes the fossils appearance in ecological terms. For example, the steady state theory believed that, fossilization is only favoured in an increased population or movement of the organism into an area that favoured fossilization.

3.6 Cosmozoan Theory

This theory does not offer a mechanism or account for the origin of life but favours the idea that, it could have had an extra terrestrial origin. It does not therefore constitute a theory of origin as such, but merely shifts the problem to elsewhere in the universe.

The theory states that life could have arisen once or several times in various parts of our Galaxy or the universe. Repeated sightings of café drawings, of rockets-like objects and specimen provide some evidence for this theory.

3.7 Biochemical Evolution

This theory has its root in the belief of astronomers, geologists and biologists that the Earth is about 4.5-5.0 thousand million years old. Many biologists believe that the original state of the Earth bore little resemblance to its present day form. and had the problem appearance. It was hot (about 4000-8000^{0}C) and as it cooled carbon and the less

volatile metal and formed the Earths core; the surface was probably barren and rugged as volcanic activity, constant earth movements and contraction on cooling folded and fractured the surface. The theory also described the atmosphere as being completely different from what it was in those days in terms of the component gases or elements. The theory proposed that pre-existing substances would have undergone series of chemical changes. This possible sequence of events would have produced a primitive self replicating heterotrophic organism feeding on an organic-rich materials.

4.0 CONCLUSION

In this unit a number of theories supporting the origin of life were looked at and discussed. Many of these 'theories' and the way they-explain the existing diversity of species cover similar ground but with varying emphases. Scientific theory may be imaginative on the one hand and skeptical on the other. Theological views may also fit into this framework depending upon one's religious belief. No matter what, one major area of controversy between scientists and theological views is history of origin of life.

5.0 SUMMARY

In this unit, you have learnt that,

- The issue surrounding how life originated on earth has been a major bone of contention especially between scientists and religionists.
- While science believe in imprericism and testing, theology favours indoctrination
- The only scientific basis for how life originated and have assumed the present form is evolution.
- Five major theories have been put forward accounting for the origin of life
- Many of the theories discussed cover the same ground but with varying emphases
- The controversy between scientists and theologists regarding the history of origin of life had been on for so long and still continues.

6.0 TUTOR-MARKED ASSIGNMENT (TMA)

Write short note on the history of origin of life.

7.0 REFERENCES/FURTHER READINGS

Connant, J. B. (1951), Science and Common Sense. New haren. Yale Unverdy press, 6.

Popper, U.K. (1969) The Logic of Scientific Discovery, London, hutchmson and co. 57-58.

Taylor, D. J. Green, N. D. O, Stout, G. W., Soper, R (1998) Biological Science 1 & 2. Cambridge, Cambridge University Press; 879-883.

UNIT 2 THE THEORY OF EVOLUTION

CONTENTS

1.0 INTRODUCTION

The term "evolution" has a special place in the study of the history of life. It has become a unifying concept which underlines the whole study of biological science. It refers to an overall gradual development which is both ordered and sequential. On a general note, it implies the development of differential organisms from pre-existing, less differentiated organisms over the course of time. In this unit you will be exposed to two major theories about the origin of life. These are Lamarck's and Darwin's theories of evolution.

2.0 OBJECTIVES

After reviewing this unit, you should be able to:

- The theory of evolution
- Discuss evolution theory based on Lamarckian evolution perspective
- Discuss evolution from the perspective of Darmin.

3.0 MAIN BODY

3.1 THE THEORY OF EVOLUTION.

The concept of evolution did not start with Darwin, when he published "the origin of species", rather it had been a point of discourse among several philosophers. The historical background of the theory of evolution reveals that the concept of continuity or gradual development of more complex species from preexisting simpler forms had occurred to

several philosophers and natural historians before the declaration of evolutionary hypotheses were put forward in the early 19th century. Let us now examine two of these theories as proposed by Lamarck and Darwin.

3.2 Lamarckian Evolution

Lamarck, a French biologist proposed a hypotheses to account for the mechanism of evolution based on two conditions. These are,

i. The use and disuse of parts and
ii. The inheritance of acquired characteristics.

According to him, changes in the environment may bring about changes in behaviours and this may lead to changed patterns of behaviour which can bring about use or disuse of certain organs or structures. Extensive use would lead to increase in size and/or efficiency, while disuse will lead to degeneracy and atrophy. These traits that are considered heritable can be transmitted to the next generation.

In order to explain this theory, Lamarck said the long neck and legs of the modern giraffe was due to the short necked and legged ancestors feeding on leaves of tall trees. The long neck and legs were then passed on to subsequent generations. He also explained the webbed toes of aquatic birds to constant use of the toes (legs) for swimming and extended the skin in between the digits. Similarly, the characteristics were passed on progressively to successive generations. Lamarck's theory provided basis for the acceptance of concept of evolution but his mechanism of change was not widely accepted.

Lamarck's emphasis on the role of environment in producing phenotypic changes in individuals, was correct. For instance, body building exercises will increase the size of muscles, but this trait cannot be transmitted to the next generation because it is not genetic. To show this, Weismann cut off the tail of mice over many successive generations. According to Lamarck, this would have led to the production of progeny (offspring) with smaller tails. These was not the case. Weismann then postulated that, body acquired characteristics (resulting in Phenotypic changes) did not directly affect gamete and cannot be termited to the next generation.

Exercise 2.1

1. Define evolution
2. What are the major points in Lamarck's theory of evolution?

3.3 Darwin and Wallace on the origin of species

Guided by the publication of reverend Thomas Malthus on principles of population (which highlighted the consequences of reproductive potential of humans), Darwin observed that under intensive competition, of numbers, in a population, any variation that favoured survival would increase that individuals ability to reproduce and lead to fertile offspring. Less favourable variation would lead to decreased number of such individuals in the population. This provided Darwin the framermk to formulate a theory of evolution by "natural selection".

Wallace another naturalist like Darwin working almost at the same time wrote on the same subject matter which was sent to Darwin, which led to their joint presentation in 1858. A year later, Darwin published his work on "origin of species by means of natural selection".

3.4 Natural Selection

Darwin and Wallace proposed that natural selection is the mechanism by which new species arise from pre-existing species. This theory of hypothesis is based on three main observations which may be summarized as follows:

i) Individuals within a population produce averagely more offsprings than are needed to replace themselves.
ii) The number of individuals in a population remain approximately constant. This means that many individuals fail to survive or reproduce. Hence, there is a "struggle for existence' within a population.
iii) Variation exists within all populations. This means that in the "struggle for existence" those individuals showing variations best adapted to their environment have a "reproductive advantage" and produce more offspring than less well- adapted organisms.
Struggle for existence or the hypothesis called natural selection provides the mechanism accounting for evolution.

According to Darwin favourable variations will be inherited by the next generation. Unfavorable variations are selected out 'or "selected against", the presence conferring a selective disadvantage on that organism. In this connection, natural selection leads to increased vigour within the species and ensures the survival of that species.

Exercises 2.2

1. What are the basic assumptions underlying Darwin and Wallace's theory about the origin of species?

3.5 Misconceptions about Darwin's theory of Evolution

Many misconceptions have grown up around the theory of evolution as outlined by Darwin; These misconceptions may be summarized as follows:

i) Darwin made no attempt to describe how life originated on the Earth. His major concern was on how new species might arise from pre-existing species.
ii) Natural selection is not simply a negative, destructive force but can be a positive means of change in a population. The struggle for existence was characterized by unhealthy terms like 'survival of the fittest' and elimination of the unfit" by the philosopher Herbert Spencer and the press of the day.
iii) The misconception that humans (man) evolved from the 'apes' by some linear progression was over sensationalized by the press and offended both the religious and secular communities. The former saw this as an insult on their belief that "man' was created in the "image of God" while the latter were unhappy by the apparent undermining, of the 'superior position' of humans (man) within the animal kingdom.
iv) The apparent contradiction between the Genesis six-day creation account and the progressive origin of species viz-a-viz the Darwin's conclusions in the origin of species. The claims and counterclaims between the theologists and scientists started long ago and still continues till date. The unfortunate controversy has continued as the Genesis versus Evolution debate which professor R. J. Berry summarized as: -

a) Those who are awed by scientific belief that the Bible has been disproved.
b) Those who cling to the inspiration of scripture and their interpretations of it and shut their eyes to the fact that God's work can be studied by scientific methods.

4.0 CONCLUSION

In this unit you have been exposed to the concept 'Evolution' as a special term in the study of the history of life. You have equally been exposed to two major theories in support of evolution. These are the role of environmental changes and theory of Natural selection on origin

of species (Man). Lastly, you were treated to the controversy which these theories generated among the religious and secular communities.

5.0 SUMMARY

In this unit you have been exposed to the following:

- ❖ Evolution is an important concept to be considered when discussing the history of life.
- ❖ Two important theories of evolution include those of Lamarck's and Darwin/Wallace.
- ❖ Lamarck based his assumption on the influence or role of the environmental change in modifying structures which are then transmitted to the next generation.
- ❖ Darwin/Wallace were concerned with the theory of natural selection (survival of the fittest through struggle for existence).
- ❖ That Darwin's theory despite his wide acceptability was faced with problems especially the religious world.
- ❖ That there were a number of misconceptions surrounding the theory of natural selection as proposed by Darwin's origin of species.

6.0 TUTOR-MARKED ASSIGNMENT (TMA)

1. What are the major deductions of the:

a) Lamarck's theory of evolution
b) Darwin's theory of evolution

2. Enumerate the major misconceptions about the theory of evolution by natural selection.

7.0 REFERENCES/FURTHER READINGS

Mapaderum. O. (1998), History and Philosophy of Science in Olaniran, O et al (eds) Citizenship and Computer Education, Oyo Andrian Publication series.

Taylor, D. I., Green N. P. O, Stout G. W, Sopper R. (1998) Biological Science 1& 2. Cambridge, Cambridge Universally press, 285-287.

UNIT 3 THE NATURE OF EARLIEST ORGANISMS

CONTENTS

1.0 Introduction

In the last two units, you were exposed to the theories supporting the origin of life. You were also treated to individuals' proposed theories concerning changes that have occurred in living things (organisms) and how they have acquired their present forms. In this unit we shall discuss about the nature of the earliest organisms and the modern views concerning how life has evolved on the Earth.

2.0 OBJECTIVES

At the end of this unit, students should be able to:

i) Be aware of the heterotrophic nature of the earliest organisms according to bio-chemical theory of evolution
ii) Identify the nature of the earliest organisms.
iii) Explain the modern views on evolution.

3.0 MAIN BODY

3.1 THE NATURE OF THE EARLIEST ORGANISMS.

Current evidence suggests that the first organisms as we discussed earlier in unit one, were heterotrophs. As they were the only set of organisms capable of using the external supplies of available energy locked up within the complex of organic molecules present in the soup. The chemical reactions involved in synthesizing food substance appear to have been too complex to have arisen within the earlier form of life

As more complex organic molecules arose through biochemical evolution, it is assumed that some of these were able to harness solar

radiation as an energy source, using this to synthesize new cellular materials. Absorption of these into preexisting cells without the need for them to abort organic molecules make them become autotrophs. The earliest photosynthetic organisms while utilizing solar radiation as their primary source of energy lack the pathway to produce oxygen. Later, it was believed that oxygen-evolving photosynthetic organisms develop, which result in the gradual build up of oxygen in the atmosphere. The increase in atmospheric oxygen and its ionization to form 'ozone layer' will reduce the amount of ultraviolet radiation (from the sun) reaching the surface of the Earth. Decreasing the rate of synthesis of new complex molecules, the decrease in radiation will bring about stability of successful form of life. A study of the present day organisms reveals a great variation in biochemical pathways associated with energy capture and release, which may show the nature of early experiments with living organisms.

In spite of this simple analysis, the problem of the origin(s) of life remains. All the above account is mere speculation and despite tremendous advances in biochemistry answers to the problem remains hypothetical. This brief account is a collection of present day hypotheses about the origin of life. However, more of the hypotheses have so for gained universal acceptance to become an all- embracing theory.

Exercise 3.1:

1. Give a brief account of the nature of the earliest organisms.

3.2 Modern Theories of Evolution

In unit two we discussed about how the theory of evolution as proposed by Darwin and Wallace, has been modified by modern evidence from genetics; molecular biology, paleontology, ecology and ethology. This is known as Neo-Dawinism. (*neo* means new). This may be defined as the theory of organic evolution by the natural selection of inherited characteristics.

Different types of evidence support different aspect of the theory. In order to accept neo-Darwinism evolutionary theory, it is necessary to

(i) Establish the fact that evolution (changes) has taken place in the past (past evolution)
(ii) Demonstrate a mechanism which results in evolution (natural selection of genes)
(iii) Observe evolution happening today (evolution in action)

Exercise 3.2

1 (a) What do you understand by Neo Darwninsm?
(b) What steps must we take in order to have a clear view of neo-Darwinism?

3.3 Evidence for past evolution

(a) There are evidence from many sources in support of past evolution. Such include geology, fossils, and stratigraphy (the study of the order and ages of rock formations).
(b) Evidence for a mechanism
This is found in the experimental and observational Data of the natural selection of characteristics that are inherited such as the selection of shell, colour of the hair in man and mechanism of inheritance as shown in the Medelian genetics.(example Mendel's cowpeas)
(c) Evidence for the action of these process occurring today is provided by studies of present populations such as in artificial selection, and genetic engineering as in the cultivation of wheat and the synthesis of genes.

It should be noted that there are no evolution laws, but well-supported hypotheses which join together to form a convincing theory. There is need to guard against accepting any modern view with dogma simply because they are reproducible under laboratory condition. This impedes intellectual growth and the search for the truth. The fact that the theories as proposed can be reproduced does not indicate that they did take place. The debate these days is not so much about whether evolution takes place but how it takes place.

4.0 CONCLUSION

In this unit, you have been exposed to the fact about the transition from complex non-living matter to simple living organism. However, the account of how these have come into being has remained illusive. While the propositions appear intellectually sound, the fact remains as to whether they did occur or not. Even if the events took place as proposed about how life originated, is a matter for further investigation.

5.0 SUMMARY

In this unit, you have learnt that:

- The earliest organisms were heterotrophs.

- ❖ They possess the ability to make use of external source of energy to make cellular materials.
- ❖ Neo-Darwinism gave a modern outlook concerning how life originated.
- ❖ Its acceptance was based on certain premises.
- ❖ All the accounts about the earliest organisms are speculative and hypothetical.
- ❖ The debate about the origin of life still continues as no universally accepted law has been proposed to achieve this end.
- ❖ Effort should be made not to accept the evidence provided by modern view of evolution with dogma as this stand may stifle intellectual growth and prevent further search for the truth about the origin of life.

6.0 TUTOR-MARKED ASSIGNMENT (TMA)

1. (a) Enumerate the features of the earliest organisms.
   (b) What are the evidences to support the neo-Demonism theory of evolution?

7.0 REFERENCES/FURTHER READINGS

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UNIT 4 EVIDENCES FOR THE THEORY OF EVOLUTION

CONTENTS

1.0 INTRODUCTION

In unit 2, it was emphasized that, evolution can not be overlooked in discussions that bother on how life originated. In this unit, our focus would be on the evidence in support of the theory of evolution.

2.0 OBJECTIVE(S)

At the end of this unit, students should be able to

- List and explain the various evidences that are available
- Explain the theory of evolution.
- Convince a sceptic that evolution is real.

3.0 MAIN BODY

3.1 EVIDENCE FOR THE THEORY OF EVOLUTION

A number of evidence abound to support the theory of Evolution, as the basis for origin of life on Earth. The main ones are listed hereunder.

- Paleontology
- Geographical location
- Classification
- Plant and animal breeding

- ❖ Comparative anatomy
- ❖ Adaptive radiation
- ❖ Comparative embryology
- ❖ Comparative biochemistry

All these evidence are discussed below in

3.2 Paleontology

This is the study of fossils. Fossils are any form of preserved remains thought to be derived from a living organism, Fossils may include, the entire organisms, hard skeletal structures, moulds and casts petrifications, impressions, imprints and fossilized faecal pellets. Fossisls were interpreted either as the remains of former creations or as artifacts inserted into the rocks by God.

Fossils evidence alone is insufficient to prove that evolution had occurred but it only shows progressive increase in complexity of organisms. One major criticism of using fossisl evidence in support of evolutionary theory is the lack of a continuous fossil records.
This incompleteness of the fossil record may be explained in terms of the following facts:

(i) Dead organism decompose rapidly
(ii) Dead organism are eaten by scavengers
(iii) Soft-bodied organism do not fossilized easily
(ii) Only a small fraction of living organism will have died in conditions favourable for fossilization.
(iii) Only a fraction of fossils have been discovered.

Alternatively, there is the possibility that new species appeared suddenly without an intermediate form along the sequence of evolution. Hence, evolution may not always follow a gradual process.

3.3 Geographical distribution

This evidence was based on the fact that all organisms are adapted to their environment. If the physical and biotic factors within an area favour a particular species in one geographical area, then one can assume that the same species of organism would be found in similar habitat (condition). This may not be the case always as organisms including humans (man) are dichotomously distributed throughout the world. The reasons for this discontinuous distribution are more than those of ecological factors. This accounts for why many related organisms are found in widely separated throughout the regions of the world, despite confinement of organisms to their natural environment.

3.4 Classification.

Classification of organisms on the basis of similarities and differences between organisms has implications for the origin of species and evolutionary theory. The similarities and differences may be explained as the result of progressive adaptation by organisms within each taxonomic group to particular environmental conditions over a period of time.

For example one of the earliest features of human civilization was the art of cultivation of plants and domestic animals from ancestral wild stocks. By selecting members of the species with favourable variations the desired characteristics were perpetuated (sustained). Other species with less favourable variations were selected out'. This selection uses naturally occurring genes variation in addition to imitations which occur from time to time. These have contributed to the presence of wide varety of species now on earth, including man.

3.5 Comparative anatomy

Comparative study of the anatomy of groups of animals or plants reveals great similarities in certain structural features. For example, the pentadactyl limb structures of all tetrapods (animals with limbs) from amphibians to mammals (to which man belong) has the same basic plan. This has been modified in different ways to suit different purposes in each of the species. These kind of organs from different species having a similar basic form or body position and embryonic development are said to be homologous. Certain homologous structures in some species with no apparent function are theory as vestigial organs (e.g. appendix in man) which has no connection with human digestion is homologous with the functional appendix of herbivorous animals. The vertebrate of the human coccyx are thought to represent vestigial structure the tail possessed by our ancestors and embryos. It will be very difficult to explain the occurrence of vestigial organs without reference to some process of evolution.

3.6 Adaptive radiation.

(a) Homologous structures and divergent evolution.

When a group of organisms share a homologous structure which is specialized to perform a variety of different functions, it shows what is known as adaptive radiation. The presence of a structure or physiological process in an ancestral organism which has become greatly modified or more specialized, in apparently related organisms, may be interpreted as indicating a process of descent by modification.

This is the basis of evolution theory as discussed in unit 2. the importance of a adaptive radiation is that it suggests the existence of divergent evolution based on modification of homologus structures.

(b) Analogous structures and convergent evolution.

Similar structures, philosophical process or modes of life organisms apparently bearing no close evolutionary links at showing adaptation to perform the same functions are described as analogous. Examples of analogous structures include eyes of vertebrates and cephalopods molluscs (snails, squides and octopuses) wings of insects and bats, jointed legs of insects and vertebrates etc. Analogous structures only bear superficial similarities. The existence of analogous structures suggests the occurrence of convergent evolution. This may be explained in terms of the environment, acting through the agency of natural selection, favouring those variations which confer increased survival and reproductive potential on those organisms possessing them. Generally, the process of convergent evolution shows an evolutionary mechanism.

3.7 Comparative Embryology

A study of the embryonic development of the vertebrate groups by Von Barer (1792-1867) revealed striking structural similarities occurring in all the groups especially during cleavage, gastrulation and the only stages of differentiation. Haeckel (1834-1919), suggested that this had an evolutionary significance. Similarity in embryonic development is a very indication of having originated from common ancestry. Study of the embryological development of major groups organisms reveals structural similarities in the embryonic stages which are not apparent in the adult stages. The implication of this is that an evolutionary process exists.

3.8 Comparative Biochemistry

With the advent of biochemical analysis, more light has been shed on evolution ideas. The occurrence of similar molecules in a complete range of organisms supports the existence of biochemical homology similar to the anatomical homology discussed in section 3.5. This evidence of evolutionary theory is supportive of other evidence. Most of the researches which have been carried out on comparative biochemistry has involved analysis of the primary structure of widely distributed molecules, such as protein and nuclei acid molecules.

Immunological research has also produced evidence of phylogenic links between organisms. One typical example of biochemical homology is

provided by the presence of similar or even identical hormone in vertebrates, where they carry out a range of different functions. For example a hormone similar to mammalian prolactin occurs in all vertebrate groups where it is produced by the pituitary gland.

4.0 CONCLUSION.

In this unit, you have been exposed a number of evidence in support of the theory of evolution as the basis of the origin of species; man inclusive. From our discussion, it is evident that though evolution appears to be widely accepted amongst scientists as the basis for origin of life; there is still much work to be done in refining the theory and its application to all circumstances. Generally, all scientific accounts, hypotheses and theories of the history of life are tentative and as long as scientists will remain objective in their search for the truth, they will continue to remain so.

5.0 SUMMARY

In this unit, you have learnt

- That evolution is widely accepted among scientists as a strong proof for the origin of life.
- That there are some theories or evidence which back up or tend to validate the linking of origin of life to evolution.
- That, as sound as evolutionary theory as the origin of life is, there is still much to be done by scientists in terms of refining the theory

6.0 TUTOR-MARKED ASSIGNMENT (TMA)

How can you convince a sceptic that evolution is real?

7.0 REFERENCES/FURTHER READINGS

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UNIT 5 ORIGIN OF MAN

CONTENTS

1.0 INTRODUCTION

The term "man" refers to all human beings of all races, and gender leaning. (both male and female). Man belongs to a group of higher animals called mammals and the order primate. In this unit you will be exposed to the origin of man and the features that make man a special creature above other creatures.

2.0 OBJECTIVES

At the end of this unit, students should be able to,

i) Describe the origin of man
ii) State the class and order to which man belongs.
iii) Distinguish man from other mammals /primates.
iv) Explain certain special features of man.

3.0 MAIN BODY

3.1 HUMAN PHYLOGENY

As stated earlier on in this unit, human being (man) belongs to an order of mammals called primate. Other primates include tarsiers, lorisers, lemurs, monkeys and apes (gorilla, Chimpanzee). Many of the features of this order are adaptations to life in a forest environment. Within this order primates are three groups of animals called anthropoids. These include the new world monkeys (marmosets and spider monkeys) the old world monkeys (baboons and prohoscis monkeys) and hominoids (apes and humans) humans and their ancestors are more closely related

to apes than other anthropoids. Man belongs to the family hominidae (the fossil forms and modern human). Recent evidence, based on comparative biochemistry has suggested that gorillas and chimpanzees may have diverged from human stock as recently as 5 million years ago.

Of particular significance in the evolution of man is the development of an upright posture and increase in brain size. Freedom of the hands from locomotion enabled them to be used for carrying objects and manipulating the environment all ritual activities. In addition an upright posture which gave the hominids increased height and range of vision have some advantages for the primates In addition to their ability to stand erect on two legs, they enjoy the advantage of increasing brain size. This enables control and coordination to be exercised as in special abicularities, such as hunting, tool-making and speech.

The course of human evolution is remarkeable in that gradual transmissions in physical features (skeleton development, out) were supported by an accelerating development in social behaviour. This process of becoming human is called hominisation which is believed to be influenced by:

i. The development of manipulative skill and speech.
ii. Changes in sexual behaviour allowing pair bonding and increased parental supervision of children.
iii. The establishment of communal organization and social responsibility, arising from the principle of food sharing.

Exercise 5.1

What makes the evolution of human being remarkable?

3.2 Characteristics of the order primates

Below are the features of the members of primate,

i. Possession of opposable thumb with grip for power and precision.
ii. Ability to rotate hand (fore limp) through 180^0
iii. Eyes close together on face with parallel optical axis. (i.e. eyes are located in the front part of the head).
iv. Possession of increased number of rods/ cones with own nerve cells.
v Possession of reduced snout allowing flatter face.
vi Possession of expanded area for cerebrum, ventral foramen magnum (i.e. enlarged skull).
vii Possession of increased sensory/motor areas, deeply fission.

vii Undergo long gestation period (period of conception) and parental care (care for their young ones).
x Used to embark on corporate activities and group cohesion.

3.3 Origin of man

The issue of the origin of man in line with the origin of life still remains a controversial issue among different groups of people. This is because there are a number of rival propositions and counterclaims on how man actually originated. For instance the Yoruba in Nigeria believe that God is the original creator of heavens and the earth with all that dwell in them. It is on the basis of this belief that the whole superstructure of the Yoruba believes rests. According to the Yoruba tradition, as documented by Idiom (1962), some creatures that form the nucleus of the human occupation of the earth had been in existence even earlier than the earth. Traditionally, Yoruba also believe in "Olodumare", "Orisanla" "Orunmila" e.t.c. Orisa-nla was regarded as the minister in charge of creation of the earth and later created humans from the clay or dust of the earth. The duty of Orisa-nla was to create a life-less human, while God will breathe in to the creative and thus, complete the creation of human being. The office of the creator gave the Orisa-nla the freedom of creating at will, human figures, perfect or defective, or whatever colour he wants them to be. Thus, the hunch-back, the cripple, the albino, all are special works of his prerogative or more often than not displeasure. Thus, to Yoruba, variation among human beings was due to the pleasure or displeasure of Orisa-nla.

Other people from different parts of the world have their own way of looking at the origin of man. The Memphis in Egypt, the shilluck of the upper Nile, the people of Rwanda kingdom in Central Africa, from the republic of Benin believe in God (whom they call different names) mould clay into human beings. Abaluyia of karimido in the world in stages. According to them, the creation took six days, God rested on the seventh day. Chinese legends gave the name of the first man created by God as Panku. He was as big as four ordinary men put together. It was this creature who separated the heaven from the earth with stone. He carved out spaces for the moon, sun, stars. He dug valleys and made mountains on earth. When he died, his remains formed five mountains in China. His breath became wind, his voice became thunder, his bone became metal. Lastly, insects which stuck to his body became human beings.

The theory of the special creation approached the origin of man from the religious points of view. The holy Qur'an and the holy Bible share the same view about the origin of man. The main point of the two religions has to do with spontaneous creation by God as we see them.

Exercise 5.2: Give a brief summary of the traditional view on the origin of man.

3.4 Controversy Surrounding the theory of Human Evolution

The theory of organic evolution as discussed in the previous units opposes the theory of special creation which was proposed by spontaneous creation. With all the evidences discussed in favour of theory of organic evolution, the proposition of the special creation may not hold water. For example if man were created in God's image what is God's image. Is God black or a white or mulatto? Is he a cripple man or hunch-back? Is he tall or short? The controversy about the theory of Evolution as it relates to origin of man had been on for a long time. For example it was Charle's Darwin's work on the origin of species that sparked off the controversy in the year 1859. The issue had been that of belief versus hypotheses. For example, white (1960) in assessing the reason for religion/science conflict over Darwin's work noted that:

i) Darwin's theory casts serious aspersion upon the creation story in the book of genesis.
ii) Its logical consequences threatened the belief that man was made in God's image.
iii) Its acceptance rendered the doctrine of the fall of man unacceptable.

Edward (1979), however observed that while there is no genuine evidence to back the theory of special creation, it is also very difficult to disprove. According to him, acceptance and adherence to an evolutionary theory in preference to a special creation, simply on the plausibility of the interpretation provided by the evolutionary theory rather than definitive disproof of special creation.

3.5 Special features of man

Human beings enjoy some of the following advantages over and above other primates.

(i) Humans alone have developed spoken and written languages which are used to communicate information not just about the physical world but to formulate abstract concepts of arts, science, philosophy and religion.
(ii) Development of social behaviour to a greater extent than any other species. This was intimately linked with the development of culture categorized by

a) Establishment of the family (one partner or many wives)
b) Prolonged childhood during which time children could acquire the prevailing culture.
c) Increased use of speech for communication.
d) Development of the concepts of a home base and food sharing.
e) Increased cooperation in food-gathering enterprises
f) Division of labour by age and sex with older males hunting in bands to increase efficiency of hunting and women staying together to 'educate' children and gain protection from danger
g) Stabilization of a broader social structure where the dominance hierarchy was placed by kinship and prohibition incest.
h) Use of simple tools and eventually the manufacture of complex tools.
i) Use of fire for cracking rocks, hardening wood, cooking food, and defence against animals.
j) Development of folk wisdom, art, religion, philosophy, science and technology.

iii) While humans share many aspects of behaviour with other primates and non-primates, they are very unique in terms of art, religion and free-will Humans are known for carving of wood, ivory, painting. Religiously, it is only humans that have religion and free-will to do things accordingly.

4.0 CONCLUSION

In this unit, you have been exposed to the history of the origin of man. You have also learnt that man is a mammal of the order primate and family hominidae. Man happens to be the most advanced of all the mammals, in fact of all creatures; this is because of certain special features which they possess that place them above/ahead all other creatures.

5.0 SUMMARY

In this unit, you have learnt that

- Man is a special creation that has many special features than other creation.
- Man belongs to the order primate and family hominidae.
- Human beings are more related to the apes than any other group of animals.
- Some of the special features of human beings include, development of spoken and writing skills, social and cultural behaviours, religion and arts etc.

- Different people have different feelings about how man originated.
- There had been a lot of controversy which bothers on religion or belief or science.

6.0 TUTOR-MARKED ASSIGNMENT (TMA)

1. Discuss in details the special features of human that differentiate them from other primates
2. Enumerate the features of all primates

7.0 REFERENCES/FURTHER READINGS

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MODULE 2

MAN AND ENERGY

UNIT 1 ENERGY AND ITS FORMS

CONTENTS

2.0 INTRODUCTION

Matter is something we can at least in principle touch or see. Energy, however is quite different. It is not a material thing so by its nature it is abstract. Energy is a concept used so often in everyday language which seems quite familiar. Energy manifests itself in man's day-to-day activities. For instance, a young child jumping up and down has energy. Motion is certainly associated with energy. Energy comes in other forms too. Heat and light are forms of energy. Energy not only moves society but also other societies. Computers, planes find cars, bicycles and trains all moved by energy. In this unit we shall define energy and explore some forms its takes.

2.0 OBJECTIVES

At the end of this unit students should be able to:

- Define energy
- List different forms of energy
- Define and explain kinetic and potential energy.

- Solve simple problems on kinetic energy and potential energy

3.0 MAIN BODY

3.1 THE CONCEPT ENERGY

Energy is defined as the ability or capacity to do work. We can also define energy as the potential or capacity to move matter. To a scientist, this definition means that the energy of anything is related to its ability to move an object some distance. All forms of energy are capable of doing work (that is of exerting a force over a distance). Energy is divided into potential i.e. energy due to position, and kinetic (energy produced by a moving object). The most obvious form of energy is kinetic energy (or energy of matter in motions). There are other forms of energy, though, where there is no obvious motion, but where there is a potential for motion.

3.2 Forms of energy

As stated earlier on, energy exists in different forms. The two main forms of energy are potential energy and kinetic energy. Energy may also be electric, chemical, radiant, nuclear or other forms.
A battery is essentially a store of energy because it has chemical substances with the potential to move matter. Imagine an electric car which has a battery pack that drives the car. The battery in the pack contains chemical substances that can react to produce electric current, which goes into the electric motor. The electric motor moves the car. A car in motion has energy as a result of that, motion. A battery is said to contain 'chemical energy' because the chemical substances in it has the potential to move matter, irrespective of their being used for this purpose or not.

Heat is another form of energy. When heat passes into a substance such as air, bits of matter (air molecules) begin to move faster. The motion is not that of ordinary-size pieces of matter, rather that of extremely small bits of matter or molecules. Heat is the kinetic energy of moving molecules. Light is another form of energy. When a material absorbs light, it becomes hotter. The hotness is due to extremely small bits of matter (molecules of the material) moving faster than they were before the material absorbed the light. Light then has the potential to move matter and is a form of energy. This indicates that all forms of energy are associated with motion.

In summary, energy comes in various forms including chemical, heat and light. It is possible to change one form of energy into another.

Different forms of energy have been mentioned. Below are the explanations of different forms of energy:

i) ***Radiant energy*****:** - This comes from the sun (solar energy) and is earth's primary energy source. Solar energy heats the atmosphere and earth's surface; stimulates the growth of regulation through the process of photosynthesis, and influences global climate patterns.

ii) ***Thermal energy***: - This is the energy associated with the random motion of atoms and molecules. The more vigorous the motion of the atoms and molecules in a sample of matter, the hotter the sample the greater is its thermal energy. Generally, thermal energy can be calculated from temperature measurements.

iii) ***Chemical energy***: - This is stored within the structural units of chemical substances. Its quaintly is determined by the type and arrangement of atoms in the substance being considered. When substances participate in chemical reactions, chemical energy is released, stores or converted to other forms of energy.

iv) ***Energy is also available by virtue of an object's position*****:** - This form energy is called potential energy. For example by virtue of its altitude, a rock at the top of a hill has more potential energy and will make a bigger splash in the water below than a similar rock located pathway down. Hence, potential energy can also be expressed in terms of the energy possessed by an object in an elevated position. Chemical energy can be regarded as a form of potential energy because it is associated with the relative positions and arrangements of atoms within a substance.

3.3 Kinetic energy, potential energy and energy units.

The energy of an object as you already know, consists of kinetic energy and potential energy. The objects total energy is the sum of these two forms of energy. Thus, objects, total energy = kinetic energy of object + potential energy of object. Over time, the proportion of each kind of energy in the object can vary.
Kinetic energy is particularly easy to describe quantitatively. Let us look at this form of energy first, then we shall examine potential energy. We shall derive the unit of energy from the quantitative expression for kinetic energy. The same unit is used to measure other forms of energy.

An object that is moving has more energy than when it were not moving. Kinetic energy is the energy associated with an object by virtue of its motion. A car moving down the street has kinetic energy as does a

molecule moving across a vessel. The quantity of kinetic energy possessed by the car or the molecule depends on its speed, the faster the car or molecule the more the kinetic energy. Kinetic energy also depends on mass. The higher the mass the more the kinetic, mass and velocity for a given object is
Kinetic energy (K.E.) = ½ mass x (velocity) ^{2} = ½ mv ^{2}

The unit of mass in this expression is in kilograms, and the velocity is meters per second (ms^{-1}) giving KE unit of kgm^2s^{-2} is called the joule
1 joule = 1 kgm^2s^{-2}

The joule is popular among scientists primarily because it is defined in S.I units which makes calculation easier to do such calculation is illustrated in the next example.

Example 1.1: What is the kinetic energy of an object of an 80kg adult traveling at $10ms^{-1}$?

Solution :

K.E = ½ mv^2
=1/2 (80kg) $(10ms^{-1})^2$
=4.0 x10^3 kgm^2s^{-2} = 4.0 x 10^3J = 4.0 kJ
the answer is expressed in kilojoules:. 1kJ = 1 x 10^3 J

Exercise 1.2: Calculate the kinetic energy of an 80kg car moving at $20ms^{-1}$?

Potential energy is the energy an object has because of its position in a gravitational field, or similar environment that affects the object. The potential energy which an object has by virtue of its initial position is converted to kinetic energy as the object increases while the potential energy decreases.

The S.I. unit for measuring energy (i.e. Joule) was named after the British physicist, who first showed that the different forms of energy are basically the same. Potential energy and all other forms of energy can be measured in the same unit. However, the joule is an extremely small energy unit. For instance, consider a 40- Watt electric bulb, it uses 40J energy every second it is lit. Because there are 3600 seconds in an hour, a bulb that is lit for an hour uses 3600 x 40J or 144,000J of energy. The potential energy is dependent on the mass of an object. Another factor upon which the potential energy depends is the height or the elevated position where a falling object is located. The equation which relates potential energy of an object to the mass and height of the object falling under gravity is

Potential energy = mass x acceleration x height due to gravity
PE = mgh. Where m is mass in kilogram, g, is acceleration due to gravity measured in meter per second squared (ms^{-2}) and h is height measured in meter (m). the product gives the unit kgm^2s^{-2} = joule. g is a constant and its value is approximately $10ms^{-2}$.

Example 1.3

Calculate the potential energy possessed by a coconut fruit of mass 100 kg dropping from the top of the parent plant; 10 metres high.

Solution.

P. E = mgh.
= 100 kg x 10 ms^{-2} x 10m.
= 1000 kgm^2 5^{-2} = 1000J.
= 1 x 10^3J or 1KJ.

Exercise 1.4

Calculate the potential energy possessed by a rock sample of mass 50kg dropping from the top of a cliff 60 metres high.

Other units of energy are used in many different fields. A calorie (abbreviated cal) is another unit of energy. (but it is not an S.I unit). The calorie is an energy unit presently defined as 4.184 J, but originally defined as the quantity of energy needed to raise the temperature of 1g of water by 1^oC. The new definition is more precise than the older one.

To convert calorie to joules you need to use the relationship 1 cal = 4.184 J.

Example 1.5 :

It requires 2.4 x 10^3 cal of energy to heat 30.0g of water from 20^0c to 100^0c. Express 2.4 x 10^3 cal. in joules (not that 1 cal = 4.184 J).

Solution

Remember that:

1 cal = 4.184J.
2.4 x 10^3 cal convert to Joules
2.4 x 10^3 cal x 4.184J
1 cal = 1.0 x 104J

Exercise 1.6:

A sample of aluminum requires 48.6 J to heat it from 25^0c to 48^0c. how would you express the quantity 48.6 Joule in calories?

Engineers sometimes use BTUs (British Themal Units) to define energy. A BTU is 1/180 the heat required to raise the temperature of 1 pound of water from 0^0C (32^0F) to 100^0C (212^0f). One BTU is equal to 1055.8J. The BTU is often sued to describe the energy requirements of heating and air condition of equipment.

Kilowatt-hour: -is another energy unit. The power holding company (formerly NEPA) uses this unit to charge you for the electrical energy you use. The rate at which energy is produced or used is called power and the S.I. unit of power is the Watt. I watt (W) is defined as I joule per sound (Js^{-1})s kilowatt-hour then is 1000 watt-hours of energy use. This is equal to 3.6 x 10^6J.

Table 1.1 below shows the three other units of energy discussed in this unit apart from the joules.
Summary of Common Energy Units

Unit	Abbreviation	Equivalent in joules
Caloric	Cal	1 cal = 418J = 4.184 KJ
Colorie	Cal	I cal = 4.184 J
British Themal Union	BTU	I BTU = 1055.8 J = 1.0558 KJ

4.0 CONCLUSION

"Energy is a much used term, but it represents a rather abstract concept. For instance when we feel tired, we might say we have no energy. Unlike matter, energy is known and recognized by its effects, it can not be seen, touched, smelled or weighed. Despite its abstractness, its importance in man's daily activities is unquantifiable. Its roles in medicine, computer, engineering, commerce even in man's domestic life are so enormous.

5.0 SUMMARY

- In this unit we have looked at the definition of energy
- We have also looked at the various forms of energy
- You have also learnt about the basic unit for measuring energy.
- You have equally learnt, about the relationship between kinetic energy, potential energy mass, velocity and acceleration due to gravity.

- ❖ Energy is the capacity to do work
- ❖ There are many forms of energy and they are inter convertible.
- ❖ Kinetic energy is the energy possessed by a body in motion.
- ❖ Potential energy is the energy possessed by virtue of its position.
- ❖ The S. I. unit for measuring energy is Joule.
- ❖ Other units for measuring energy are calorie, ABTU and kilowatt-hour.

6.0 TUTOR-MARKED ASSIGNMENT (TMA)

1. Define the following terms (a) thermal energy (b) chemical energy (c) potential energy (d) kinetic energy.
2. What is heat? How does heat differ from thermal energy?
3. What are the units for energy commonly employed in science?

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UNIT 2 MAN'S ENERGY NEEDS AND SOURCES.

CONTENTS

1.0 INTRODUCTION

In the previous unit energy was defined as the capacity to do work. All living organisms including man, may be regarded as working machines which require a continuous supply of energy in order to keep working. Energy may come in various forms such as light, chemical, heat, electrical, mechanical and sound. All these forms of energy as we shall see in this unit are of great importance to man.

2.0 OBJECTIVES

At the end of this unit, students should be able to:

- State why man requires energy
- List and explain the various sources of energy
- Identify the various uses of energy to man
- Identify the basic sources of energy on earth.

3.0 MAIN BODY

3.1 MAN'S ENERGY NEEDS AND RESOURCES.

The ultimate source of energy on earth to man is the sun. (the solar energy). The sun is constantly radiating light on the earth surface. A portion of this light energy falls on earth, and some of it is used by plant to convert carbon dioxide and water into various energy storing compounds, via a process known as photosynthesis. During this process

water and carbondioxide (from air) combined using energy to producer glucose and oxygen..

When such plants are eaten, the chemical energy stored in them (glucose) is transferred into and used by man for his daily activities to produce energy thus reversing the above process of photosynthesis.

Carbondioxide + water + energy ⟶ glucose + oxygen (sunlight).

Glucose + oxygen ⟶ Carbondioxide + water + energy.

The chemical energy stored in the food eaten by man is converted into heat energy after being subjected to series of physiological processes in man's body. The energy is made available in its various forms depending on man's need at any given point in time. Much of the energy available on earth has been collected by plants during photosynthesis. Man and indeed all animals ultimately rely on plants for food energy. Ultimately, the plants and the sun provide man with the food energy we need.

Having examined man's basic source of energy the next question is why do man need energy? In the next section of this unit, you will learn about basic reasons for man's quest for energy.

Exercise 2.1

- Briefly discus the importance of sun as the ultimate source of energy to man.
- Write balanced equation for the biochemical reaction leading to production of energy?

3.2 Why do Man Need Energy?

Some common examples of the use of energy by man include

- ❖ Synthesis of materials for growth and repairs for instance protein synthesis.
- ❖ Active transport of materials in and out of cells against diffusion gradients, for example the sodium-potassium pump.
- ❖ Electrical transmission of nerve impulses
- ❖ Heat energy released from respiration is used to maintain constant body temperature in man.
- ❖ Mechanical contraction and relaxation of muscles.

However, human civilization consumes more than food energy.

We use energy to heat our homes, to power our cars, and to drive technology. Commerce, industries, computers are other vital area's where energy has been found very useful.

3.3 Energy on Earth

As stated earlier on in section 3.0, the sun provides the basic and ultimate source of energy to man. However the three largest sources of the energy consumed by man are petroleum, coal and natural gas. These are all "fossil fuels'. The fossil fuels were formed million years ago, when aquatic plants and animals were buried and compressed by layers of sediments at the bottom of swamps and seas. Here again we can trace the origin of energy back to plants, and therefore the sun.

Another large source of energy is hydroelectric to plant but can be traced back to the sun. Hydroelectric power is electric power generated by river water flowing through a turbine. This energy of the river comes from the sun. The sun's warmth evaporates water and this water vapour later condenses as rain which later flows to the rivers.

Nuclear energy another source of energy on earth does not originate from the sun. Uramium which is the source of nuclear energy has been present on earth since the solar system first formed about five million years ago.

Exercise 2.2

Discuss the relationship between the sun and the following sources of energy.

a) Fossil fuel (b) hydroelectric power (c) nuclear energy

3.4 Sources of Energy

There are a number of sources from which man obtains energy to provide heat, light, and power. These sources can be categorized as:

i) Basic or natural source
ii) Other sources/non-renewable sources.

Let us now look at these two sources of man's energy needs in more details.

3.5 Basic source of energy

Substantial amount of energy is obtained from such natural sources as wood, water, wind and tide. In this section, you will learn about how some of those natural products has provided man with useful means of obtaining energy.

i) **Wood**: - provides a major source of energy today in different parts of the world where other fuels are not available, or their prices are unaffordable. For instance, in Brazil, wood still provides a greater percentage of the nation's non-fuel energy. Nigeria, however is not an exception to this, especially nowadays that the prices of kerosene and other fuels are almost out-of-reach of common man. Wood is commonly used for cooking and other domestic purposes as a means of obtaining energy in Nigeria in both rural and urban cities in Nigeria.

ii) **Water:** - water is a good source of energy, though, attention is being directed at it presently, as it is estimated to provide less than five percent of the worlds energy requirements. Among the limitation placed on water power are; the fact that food from river valleys is more valuable than power obtained from damming the valley as a reservoir in arid lands. Water is essential for farming; examples are the lower Ogun irrigation scheme at Iseyin and a number of other river basin development authorities scattered all over Nigeria.

iii) **Wind**: - The wind contains tremendous amount of energy, but it is intermittent and diffuse. Wind mills are usually more expensive relative to the energy delivered. Interest in energy from water, wood and wind mill increases as fossil fuel costs rise and storage is improved. It is used in countries like France. This form of energy is yet to be developed in Nigeria.

iv) **Geothermal energy**: - This flows from the hot interior part of the earth to the surface where it is lost by radiation into space. Studies have been carried out on how this could be tapped as useful source of energy. This has been used very successfully in some parts of the world to generate energy and power. This form of energy is in use in places such as Netherlands, Empire and North America (for guiding grams in pumping water). In the west Indies it is used for grinding sugar cane. Other nations where this form energy has been successfully utilized include Italy, Iceland, California and so on.

v) **Tidal energy**: - There is a great amount of energy in the tides, but the oceans have been a difficult energy source to harness. This energy comes from the energy of rotation of the earth. Even though only a small fraction of the tidal power can be tapped, this source of energy is expected to be put in greater use in the near future.

All these energy sources are classified as recurring energy sources, because they are continuously being created from primary sources.

3.6 Other sources of energy

In industrialized society, man's sources of energy have been based on the substitution for animal energy of power from heat of combustion of carboniferous fuels. It seems likely that it will be based in the future largely on heat from the sun and heat which is generated by nuclear reactions. You will learn more about these two sources of energy in subsequent units in this course.

Major carboniferous fuels are coal, petroleum and natural gas-all fossil fuels formed in definite amounts many million years ago. Other important fossil fuels are oil shales and tar sands. A minor amount of energy is also produced from vegetation.

i) Petroleum and Natural gas

Petroleum and indeed natural gas occur together in nature and they are obtained from wells drilled by companies that produce and sell the fossil fuels. Petroleum is the same thing as crude oil. Oil and gas provide about 75 percent of the energy used in the world. Their production has increased tremendously in the world. Their production has increased tremendously after the development of the internal combustion engine in the 20th century. One thing stands out, and this is the fact that, nations would continue to consume more of these fossil fuels for the next few decades after which the supply will dwindle. Unless new sources are located, peak world petroleum production will occur in no distance time. Demand will still be rising when production begins its inevitable decline.

One major problem of the developed world is that, much of the petroleum and gas reserves are located in the developing countries, whose own energy requirement will be growing year-in-year-out. Another problem is that, it constitutes a serious pollutant of the environment, while shipping petroleum overseas, spills are recorded.

Petroleum is found in locations of the world e.g. Saudi Arabia, Nigeria and so on. In Nigeria, about 80% of the energy is derived from petroleum and petroleum products. It also accounts for more than 90% of our source of national income. In fact, it forms the bedrock of Nigeria's economy.

ii) **Coal**

Large quantity of coal is present in different parts of the world as great source of energy. Coal has been found very useful especially for moving locomotive engines, providing source of heating/heat energy. One problem with the use of coal is that coal constitutes a pollutant because coal bumping produces oxides of sulphur and solid waste particles, and the mines themselves empty wastes into the atmosphere.

iii) **Oil shale**

Oil shale and sand tar: - provide other useful sources from which man obtain energy. These materials are found in some areas, such as Ondo in Nigeria. Some deposits of oil shale and sand tar are found also in Albertia and Canada. If properly harnessed they would constitute about 2-4 percent of mains energy supply. The oil shale deposit are usually rich in bitumen materials called kerosene.

3.7 National Energy Policy

From our discussion of this unit, it is clear that life of man on earth depends very much on the availability of energy. No nation can develop without an abundant supply and judiciously managed energy sources. The conventional sources of energy such as wood, coal, petrol or natural water falls used for hydroelectric power are fast becoming inadequate. The erratic nature and "power shedding" system of electric power supply in Nigeria are indices to confirm that our energy demand is greater than the supply.

At present, the US, most European countries, Japan and a few developing nations generate substantial amounts of their electrical supplies from nuclear fuels. This should be the dream of any nation, for her desire to attain, social economic and technological advancement. More so, "he who has energy has power".

It is in this connection that, it is of utmost importance for a nation to have a clear-cut policy on adequate energy supply, production and management. For example, the forests are being depleted at a fast rate because it appears that is the only source of energy that the ordinary man can afford, and has access to. Industries produce at high cost

because they have to procure their own power generating plants due to the erratic nature of power supply in the country which in most cases are not always available.

The housewife is finding it extremely difficult meeting her domestic needs because of lack of energy sources such as cooking gas, kerosene to cook at home. All of these problems, in addition to the daily increase of petrol price are due largely to lack of standing energy policy to regulate and make affordable the various sources of energy that nature has provided us in Nigeria. Nigerians as a whole should start thinking about how nuclear reactions could be harnessed as a way of complementing that which is obtained from natural sources and fossil fuels. But certainly not much can be realized until a well-defined energy policy has been well articulated and put in place.

4.0 CONCLUSION

Man can not survive without constant provision and supply of energy either through the natural and recurring sources or taking the advantage provided by the energy from fossil fuels. All these and other sources of energy desire proper management through a clear-cut energy policy, and follow-up implementation of such energy policy.

5.0 SUMMARY

Below is a summary of all that you have learnt in this unit.

- The ultimate source of energy on earth is sun.
- Plants combine simple materials such as carbon dioxide and water in the presence of radiant energy from sun to produce glucose and oxygen is released as bye-products.
- Man requires energy for a number of physiological reasons.
- Man's energy come from many sources. The three largest sources of energy consumed by man are petroleum, natural gas and coal.
- Man's energy sources can be grouped into two: the natural and recurring sources and the fossil fuels; which are finite and non-renewable.
- There is serious need for clear-cut energy policy in Nigeria in view of all problems associated with production, supply and utilization of energy.

6.0 TUTOR-MARKED ASSIGNMENT (TMA)

1. What is fossil fuel? Name three examples.
2. Name three kinds of non-fuel sources of energy.
3. Comment briefly on the need for a clear-cut national energy policy in Nigeria
4. Outline the uses of energy to man.

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UNIT 3 ENERGY AND CHEMICAL SYSTEMS.

CONTENTS

1.0 INTRODUCTION

The energy changes that take place during chemical reactions are of much practical interest. For instance, the combustion reactions involving fuels such as natural gas and diesel oil are carried out in daily life especially for the thermal energy they release. Almost all these chemical reactions absorb or produce (release) energy in the form of heat. Basically heat refers to the transfer of thermal energy between two bodies at different temperatures. The aspect of chemical science that studies the process of change in chemical reactions is called Thermo chemistry. In this unit you will learn about how heat is converted to other forms of energy especially as it relates to chemical systems. You will also learn about those laws that are related to energy.

2.0 OBJECTIVES

At the end of this unit, students should be able to:

- Define the term 'Heat'
- Differentiate between heat and thermal energy
- Mention three kinds of chemical systems.
- State and explain the first law of thermodynamics
- State and explain the second law of thermodynamics
- Define the concept 'free energy'
- Explain the importance of entropy in chemical systems.

3.0 MAIN BODY

3.1 Types Of Chemical System

In order for us to analyze energy changes associated with chemical reactions, there is need to first define "the system; or specific part of the universe that is of interest to us. For chemists, systems usually include substances involved in chemical and physical changes. For instance in a neutralization reaction involving dilute hydrochloric acid and sodium hydroxide solution in a beaker, the system may be the beaker containing the compounds while the rest of the universe outside the system constitute the surroundings.

Basically, there are three types of systems. These include an open system, a closed system and an isolated system. An open system can exchange mass and energy (usually in the form of heat) with its surroundings e.g. water in an open container. A closed system allows for transfer of energy but not mass. Thus, if the container above is closed such that no water vapour can escape, a closed system is created. If the container is put in a totally insulated condition, an isolated system is created. This does not allow ether mass or energy transfer.

Exercise 3.1

i. What do you mean by the term "Heat'?
ii. Define (i) a closed (ii) an open and (iii) an isolated system

Evolution and absorption of heat Energy during in chemical reactions.

Energy changes during a process can be explained in terns of absorption or release of energy, since energy can not be created or destroyed, any energy lost by a system must be gained by the surroundings. Thus, the heat generated by the combustion of say acetylene to produce heat energy is transferred from the system to its surroundings Any process that transfers thermal energy to the surroundings (i.e. gives off heat) is called an exothermic reaction.

In other systems such as decomposition of mercury (II) oxide at high temperatures requires supply of energy for the reaction to take place. This is an example of endothermic reaction process, in which heat has to be supplied to the system by the surrounding.

In an exothermic reaction, the energy of the product is less than that of the reactants. This is the energy that is given off from the system to the surrounding. (that is the difference). In the same vein, the energy of the

product is higher than that of the reactants in an endothermic system. The difference is due to the energy supplied to the system from the surroundings.

Energy associated with breaking or forming of a bond

Energy changes in chemical reactions are due to the forming and breaking of bonds. The strength of a bond is determined by the amount of energy required to separate the atoms or ions held by the bond. This energy requirement is known as BOND ENERGY. It is defined as "the average amount to energy required in making or breaking a mole of a particular bond in its gaseous state.

Exercise 3.2

1. Define the following terms
   a. Bond energy
   b. Exothermic reaction
   c. Endothermic reaction.
2. What constitutes the source of initial and final energy in each of the processes in 1 (a) and (b) above?

3.2 Introduction to Thermodynamics.

Thermodynamics is an aspect of (chemistry) that deals with the study of interconversion of heat and other kinds of energy. It expresses the relationships between heat and other forms of energy. In thermodynamics, we study changes in the state of a system; which is defined by the values of all relevant macroscopic properties e.g. composition, energy, temperature, pressure and volume. Energy, pressure, volume and temperature are send to be stated functions. (- properties that are determined by the state of the system, regardless of how that condition was achieved). In thermodynamics other forms of energy are referred to as work and are represented by, w, while heat is represented by symbol, q, the relationships between heat and work is expressed in the laws of thermodynamics. In the next section, we shall look at this relationship in the first and second laws of thermodynamics.

3.3 The First Law of Thermodynamics

The first law of thermodynamics: - is based on the law of conservation of energy. It states that energy can be converted from one form to another but cannot be created or destroyed. The validity of the first law of thermodynamics can be determined by considering the change in internal energy of a system between its initial and final states. This is given by.

$$\Delta E = E_f - E_i$$

Where E_f and E_i are the internal energies of the system in the final and initial states respectively when the conditions of the system change, the internal energy of the system also changes. The relationship between the internal energy of a system and work is given by.

$$\Delta E = q + w$$

This equation simple means that, the change in the internal energy, ΔE of a system is the sum of the heat exchange q, between the system is the surroundings and the work done, w on (or by) the system.

By convention, q is positive for an endothermic process and negative for exothermic process. The sign convention for work done on the system by the surroundings, w is positive. For work done by the system on the surroundings, w is negative.

If a system loses heat to the surroundings of does work on the surroundings, the internal energy decreased since both are energy-depleting processes. Conversely, if heat is added to the system, or if work is done on the system, the internal energy of the system, would increase.

Exercise 3.3:

1. Write down an expression for
   a) The relationship between internal energy of a system and work.
   b) Change in internal energy of a system.
2. Comment briefly on the relationships between work and internal energy of a system.

3.4 The Second Law of Thermodynamics.

Most exothermic processes occur spontaneously, such processes result in a decrease in the overall enthalpy or (heat) of the system. Some endothermic processes also take place spontaneously. Enthalpy (Heat content) alone is not the only factor which determines whether or not a reaction would occur spontaneously. Other conditions are.

i) the entropy
ii) the free energy.

of the system undergoing a change. Let us now examine these two concepts in more details in order to bring out their meanings. For the

purpose of this course a very simple treatment of the concepts would be embarked upon for the purpose of clarity and understanding.

Entropy

Is a property of a substance measured in JK^{-1} and mol^{-1}. In simplest sense, entropy means "a measure of the degree of disorderliness or randomness of a substance. Solid crystals with orderly array of molecules has low entropy, a liquid has a higher entropy while gases with random motion has very large entropy.

Generally, for any given substance, as temperature increases, the degree of disorder or entropy increases. The influence of entropy on a process is given by the second law of thermodynamics, which states that. "a spontaneous process occurs only if there is an increase in the entropy of a system and its surroundings." For a reversible process the entropy change, symbol Δ S, at constant temperature is given by

$$\frac{\Delta S}{S} = \frac{\Delta H}{T}$$

Where Δ H is the heat evolved or absorbed, and T is the temperature (absolute) at which the process occurs. If heat is absorbed Δ S is positive and there is an increase in entropy. If heat is evolved, Δ S is negative and there is a decrease in entropy.

Free energy

The free energy of a chemical system, denoted by, G is the energy which is available for doing work. This is the force that brings about a chemical change. In order to determine the free energy of a chemical system, the following expression is used.

$$\Delta G = \Delta H - T\Delta S$$

The (TΔ S) is the free energy change, DG. For a chemical change to occur spontaneously, Δ S must be positive as the total entropy must increase and Δ G must be negative.

4.0 CONCLUSION

Any chemical process in nature involves energy changes in terms absorption or release of energy. Hence, all chemical processes are associated with interconversion of energy from heat to other forms of energy. The relationships between heat energy and other forms of energy is studied in thermodynamics. All these were briefly treated in

this unit considering the scope of the course under consideration. A more detailed analysis of thermodynamic processes shall be considered in appropriate course (s) in your programme.

5.0 SUMMARY

In this unit you have been exposed to the following

- ❖ All chemical changes in nature involve energy changes.
- ❖ The energy changes are in the form of heat.
- ❖ The chemical changes usually take place in chemical systems.
- ❖ There are three main types of chemical systems. These include open, closed and isolated systems.
- ❖ All chemical processes are associated with formation of breaking of bonds. The amount of energy required to break the atoms and ion in substance (bond energy) determine the strength of the bond.
- ❖ Any chemical process where energy is supplied into the system is said to be endothermic
- ❖ Any chemical process that releases energy to the surroundings is called an exothermic process.
- ❖ Chemical process may occur spontaneously or otherwise.
- ❖ Two main factors determine the spontaneity of a chemical process. These are free energy and entropy of the system
- ❖ The study of interconversion of heat energy to other forms of energy is known as thermodynamics.
- ❖ Entropy means degree of disorderliness or randomness of a system.
- ❖ Free energy is the energy available to do work..

6.0 TUTOR-MARKED ASSIGNMENT (TMA)

1. Define the following terms.
   Systems, surroundings, open system, closed system, isolated system thermal energy, chemical energy, law of conservation of energy.
2. a) On what law is the first law of thermodynamics based? Explain the sign conventions in the equation, $\Delta E = q + w$
   b) State the second law of thermodynamics.

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UNIT 4 ENERGY CONVERSION

CONTENTS

1.0 INTRODUCTION

Although energy can assume many different forms that are interconvertible, scientists have concluded that energy can neither be destroyed nor created. When one form of energy disappears, some other forms of energy (of equal magnitude) must appear and vice versa. In this unit you would learn about interconvertibility of energy from one form to another.

2.0 OBJECTIVES

At the end of this chapter, students should be able to:

- Explain the principle of inerconvertibility of energy.
- Give examples of ways by which energy is converted from one form to another.
- Relate the intervonvertible nature of energy to man's day-to-day activities.

3.0 MAIN BODY

3.1 ENERGY CONVERSION

Energy conversion involves the process of changing energy from one form to another. There are many conversion processes that appear as routine phenonena in nature, such as evaporation of water by solar

energy in fossil fuels. In the world of technology, the term is more generally applied to man-made operations in which energy is made more usable. For instance, burning of coal in power plants to convert chemical energy into electricity. Burning of gasoline in automobile engines to convert chemical energy into propulsive energy of moving vehicle or a propellant for ion rockets and plasma jets.

Objective(s) of energy conversion

The predominant objective of energy conversion system is to take raw energy from sources such as fossil fuels, nuclear fuels, solar energy, wind, waves, tides and terrestrial heat and convert it into electric and/or more usable forms of energy for the benefit of mankind.

3.2 Conditions and Limits for energy conversion

There are well-established principles in science which define the conditions and limits under which energy conversion can be brought about; such conditions include, the "law of conservation of energy, the second law of thermodynamics, discussed in the preceding chapter of this course, the Bernoulli principle and the Gibb's free-energy relation. Recognizable forms of energy which allow varying degrees of conversion include chemical, atomic, electrical, mechanical, light, potential, pressure, kinetic and heat energy. In some conversion operations the transformation of energy from one form to another and more desirable form may approach 100 percent efficiency, whereas with others, even a 'perfect' device or system may have theoretical limiting efficiency far below 100 percent.

Exercise 4.1:

i. What do you mean by energy conversion?
ii. Outline the main objectives of energy conversion.

3.3 Energy Conversion and Efficiency

As stated earlier, it is possible to convert one form of energy into another useful form of energy. For instance, the conventional electric generator, where solid metallic inductors are rotated in a magnetic field, usually converts 95-99% of mechanical energy input to the rotor shaft into electric energy at the generator terminals. On the other hand, an automobile engine might operate at its best point with only 20 percent efficiency, and even if it could be made perfect it might not exceed 60 percent for the ideal thermal cycle.

3.4 Example of Energy Conversion Processes.

i) This section of our discussion is concerned with giving example of some processes involving energy conversion. For instance, let us examine the method involved in producing electric energy in steam power plants. In this case, there are many energy-conversion steps between the raw energy of fuel and the electricity delivered from the plant, for example, chemical energy of fuel to heat energy of steam jets, jet energy to kinetic energy of rotor, and mechanical energy of rotor at generator terminals. This is a typical, elaborate and burdensome series of conversion processes. Many efforts have been made over the years to eliminate some or many of these steps for such objectives as improved efficiency, reduced weight, less bulk, lower maintenance, greater reliability, longer life and lower costs. The main emphasis here is on reducing weight, space and atmospheric contamination on improving efficiency and lowering costs.

3.5 Improving Efficiency of the Steam Power Plant

The scientific steps which are recognized within the specification, are electromagnetism, electrochemistry, (fuel cells) Thermoelectricity, thernionics, megnetohydrodynamics, photoelectricity, magnetostriction, femoelectricity, atmospheric electricity, terrestrial currents and contact potential. Nowadays, the electromagnetism principle dominates the field. Electric batteries are an accepted form of electro chemical device of small capacity. For instance 1 km in automobile service, further efforts and funds are being given to some fields with attractive prospects of practical adaptation.

ii) Conversion of chemical energy to mechanical energy in an automobile

The combustion engine in automobiles gives a typical example of the process of converting chemical energy to mechanical energy. The energy expended in running the automobile is derived from the large amount of heat energy produced by the combustion of petrol or diesel oil in the engine. The chemical energy contained in the fuel is converted to heat energy when the fuel bums in the combustion engine. The heat energy is in turn converted to mechanical energy which is used to turn the wheel. The heat energy is also converted to electrical energy to operate the various gadgets (radio, radio cassette, air conditioners etc) in the automobile. It is also converted into light energy in the lamps, and sound energy from the horns or radio.

iii) Energy conversion in a thermal-electricity plants

Many nations are not blessed with water falls through which they can generate electricity via hydroelectricity. Even in countries where they exist, the supply can not meet the demand of the teeming population. Fuel may be used to generate heat energy which is converted to mechanical energy used in turning the coil, which eventually produces electricity (electrical energy). This is often called thermal electricity, example of which we have at Egbin power station near Lagos. Here natural gas is produced and sent to the power station directly from the oil field.

iv) Energy conversion through solar energy
The nuclear processes of the sun produces a large quantity of energy which is transmitted in the form of light and heat waves; through space. The energy is known as radiant or solar energy. This energy had been used to prepare solar cells, a device which converts solar energy to electrical energy. A number of such cells can be combined to form solar batteries to generate a large amount of electrical energy for industrial and domestic needs.

Exercise 4.2:

1. Mention any five recognizable processes to improve efficiency of a steam power engine.
2. Why is it difficult to attain 100 percent efficiency in the efficiency of thermal engine involving thermal energy?

v) Energy Conversion using Electric Iron.
The use of electric pressing iron at home involves a series of energy conversion processes. For instance, the pressing iron while not in use possesses a potential energy which is converted to electrical energy when the pressing iron is connected to the electrical mains. The electrical current flowing through the cord gets the coil in the pressing iron heated up, hence the electrical energy is converted to heat energy. The heat energy is what is needed by the dry-cleaner to stretch the squeezed dress or to get it smoothened. The process of ironing the dress involves moving the iron to - and - fro on the dress (kinetic) and the process of handling the pressing iron by the user is mechanical. Hence, the initial potential energy in the iron has been subjected to a series of energy conversion procedure. However, when the pressing iron is disconnected from the electrical mains, the iron returns back to its original potential energy status.

3.6 Energy and Life

All forms of energy used in biological processes on the earth come from the thermonuclear reactions which take place in the sun (see 9.5 (iv). A fraction of the radiant energy which is falling on the earth's surface is absorbed by green plants, green algae as well as photosynthetic bacteria. The energy is trapped by the chlorophyll in a complex series of bio-chemical reactions leading to the formation of glucose, releasing oxygen as bye-product. The glucose formed is converted to starch and cellulose and stored in the body of plants. Other forms in which locked-up energy is stored include proteins, fats and carbohydrates.

The potential energy stored in these food materials must be converted into useful forms which are employed to affect the energy processes of man. First the large molecules in these food items are broken down into the unit components i.e. amino acids, fatty acids and simple sugars. When they undergo series of chemical changes, energy in stepwise manner which is somewhat complex in nature, the energy in these food materials are made available as ATP (Adenosine triphosphate), which is the final chemical compound in which most cellular energy is packaged before use. The energy is usually made available as heat energy measured in calories or joules (see unit 6), which may be converted into various other forms to perform useful work. Basically, man body cells require energy for (i) activity and (ii) growth.

3.7 Energy Storage

Most energy systems desire a provision for storing to be able to meet power demands or emergencies or to drive systems that operate entirely stored energy. Most machines have provisions for storing either potential or kinetic energy. Elevated reservoir stores energy, capacitors in the circuits store small amounts of electricity, batteries store large amount of energy and for long periods. Thermal energy can be stored as chemical energy by combustion with natural oxygen in the atmosphere or with liquid oxygen. The performance of many products is limited by their energy storage capacity.

4.0 CONCLUSION

Large amount of energy is at man's disposal. This energy exists in their various forms and can be converted from one form to another. The conversion of energy is noted in man's desire to optimally utilize the abundantly available energy to be able to survive in his environment. For instance, useful mechanical energy can be produced by fuel-burning heat engines. All man's activities domestically and industrially involve series of energy conversion.

5.0 SUMMARY

In this unit, you have learnt the following

- ❖ Though energy exists in various forms, they can be converted from one form to another.
- ❖ Energy conversion is a process of changing energy from one form to another.
- ❖ Technologically, energy conversion is a man-made process or operations in which energy is made more usable
- ❖ The main objective of energy conversion system is to make energy available to man in more usable forms.
- ❖ Certain conditions or factors inhibit the attainment of 100 percent efficiency in energy conversion.
- ❖ The functioning of some appliances e.g. electric pressing iron involves a series of energy conversion (ranging from potential to electrical to heat to mechanical/kinetic and back to potential).
- ❖ Other examples given in this unit include energy conversion in automobile engines (chemical-heat-mechanical) etc.
- ❖ All biological processes on the Earth come from the thermonuclear, reactions which take place in the sun.
- ❖ Energy in food is made available as ATP (Adenosine Triphosphate) and is usually in the form of heat.
- ❖ Heat energy released from foods are converted into other forms of energy when man engages in series of activities.
- ❖ Basically man requires energy for body maintenance, activity and growth.
- ❖ No matter the energy conversion process (es), all return to the initial potential energy status. After all "whatever goes up must come down".
- ❖ Most energy systems desire a provision for storing energy.
- ❖ Energy could be stored in different various devices for example, reservoir, capacitors, fossil fuels, batteries etc.

6.0 TUTOR-MARKED ASSIGNMENT (TMA)

6. Write short notes on
   a) Energy conversion in an electric pressing iron.
   b) Energy conversion in internal combustion engines.
   c) Energy conversion in thermal electricity plants.
7. State two reasons that make it essential for man to store energy.

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UNIT 5 CONSERVATION OF ENERGY AND ENERGY UTILIZATION

CONTENTS

1.0 INTRODUCTION

In line with our discussion in unit 9 of this course, man has learnt to convert the various sources and forms of energy at his disposal into his own uses. At the beginning man has the knowledge of only one basic source-the food, needed for him to survive. He then learned to make weapons and tools to aid him in his search for game and other food materials. From the hides of animals he fashioned clothing that enable him conserve energy in the form of heat in the same way, he learned how to use fire the energy of rapid combustion, for his domestic cooking. In this unit you will learn about how man in his day to day interaction with his environment has been able to utilize the various forms of energy available to him.

2.0 OBJECTIVE

At the end of this unit, students should be able to

- State the law of conservation of energy.
- Explain how conservation of energy principle forms the basis of energy utilization.
- Define the uses of some forms of energy such as solar energy, waves, sound and optics etc.
- Define and explain nuclear energy
- Define and explain nuclear energy

- State the uses of nuclear energy

3.0 MAIN BODY

3.1 CONSERVATION OF ENERGY PRINCIPLE.

Law of conservation of energy states that, "the total energy of a system is unchanged in any series of processes: energy is rather converted from one form to another. The law explains the indestructible nature of energy and emphasizes the interconvertible nature of energy from one form to another.

For example when a body is at a height, it has a P. E. (mgh). If it falls to the ground, it K. E. ($\frac{1}{2}mv^2$) just before landing will be exactly equal to the P. E. at the top. This implies that energy can be converted from one form to another and that during the conversion, the total amount of the energy remains constant. This is true of all forms of energy and it is referred to as "conservation of energy principle. This principle forms the basis of energy utilization. Having established the basis for energy utilization, we can now explore the extent to which man has been able to harness different forms of energy at his disposal for his own benefits.

Exercise 5.1 :

State and explain the law of conservation of energy, making reference to a specific example.

3.2 Hydroelectric Power Generation

This is one particular invention through which man has harnessed the cost-free potential energy of water falling from a hill or mountain to generate electricity. The falling water is detected through pipes and its energy now in kinetic form is used to turn turbines. The turbines on rotation in a magnetic field convert mechanical energy into electrical energy. The Kainji power station in Nigeria provides a typical example of a hydro- electric power station. Other power stations in Nigeria source their energy inputs from other forms of energy, usually heat.

3.3 Heat energy

As stated in unit 2 of this module, heat is a form of energy and it flows between two points whenever there is a temperature difference between a region of high temperature to a region of low temperature. As of a body which determines the direction of heat flow between it and another body with which it makes a thermal contact.

When heat flows to a body the kinetic energy of its molecules increases and consequently its temperature rises. The only exception to this is at the point of transition. In the next section we shall discuss more on the importance of heat energy as far as man is concerned.

3.4 The refrigeration.

The refrigeration is a modern fashion of the clay pot. It contains a volatile liquid, usually ammonia which is allowed to vaporize in the freezer compartment, therefore extracting heat of vaporization from the freezer. The main function of the refrigeration is to extract heat from the freezer and send it to the surrounding. The freezer compartment gets colder and the surrounding gets warmer. Man has found the refrigerator very useful in the storage and conservation of vegetate food items e.t.c.

3.5 Demand for Heat Energy by Man

Right from the beginning man has made endless and frantic efforts in search for richer and cheaper means of obtaining heat energy which can be readily converted to other forms of energy. From the stone age to date heat energy and generation has remained the starting point of most energy conversion processes. Hence the search for fuel like petrol, wood, coal, and of recent nuclear materials has been on the increase. Below are some examples of how man has put heat energy in use.

i. Automobile

The energy used in running the automobile is obtained from the large amount of heat produced during the combustion of petrol or diesel oil in the automobile engine. 70% and above of the heat, depending on the efficiency of the engine which is converted to mechanical energy to turn the wheels, electrical energy to operate the various gadgets and devices in the automobile, light energy in the lamps and sound energy from the horns of radio.

ii. Thermal electricity plants

As a result of the growing need for electricity supplies, energy generated through hydroelectric turbines can no longer cater for the need of the teeming population in nations where such facilities exist; like Nigeria. As a result, other means of supplementing the power generated through hydroelectric turbines have to be worked out. As stated earlier on, when a coil rotates in a magnetic field, electricity is generated. The problem of generation is usually how to obtain the initial mechanical energy to turn the coil. If this energy is obtained from the heat produced by burning a

fuel, the electricity generated there of is called thermal electricity. The giant Egbin power station, near Lagos uses fuel, natural gas, piped all the way from the oil field. As we shall see later in this unit, nuclear energy is also a source of large supply of electricity most crucial to the economy of any nation. Thus, the fuels (i.e. petrol and nuclear) are of immense importance in energy utilization by man as they often determine the trend in national and international politics.

3.6 Solar energy

A large quantity of energy is generated through nuclear processes in the sun. This is transmitted in the form of light, and heat waves through space in all directions. The amount that gets to the earths surface warms and keeps life going on earth. The energy is known as solar energy and its value known as solar constant; is about 1,400 J/s. Man for quite sometime have been tapping this energy for many purpose. The latest is the invention of solar cell. The solar cell is a device that converts solar energy to electrical energy. A number of cell units can be combined to form solar battery producing a large amount of electrical energy which is used in homes and industries.

3.7 Waves, sound and optics

A wave is a propagation of energy through a medium of space without the particles of the medium being displaced. The ripples generated when a pool of water is disturbed at a point and which then spread to another part is a form of wave. The wave could be mechanical or electrical and magnetic.

In an electromagnetic wave, it is the electric and magnetic field that oscillate. No material medium is required. Sound is a mechanical wave and hence it requires a medium to propagate. The range of frequency of a sound which can stimulate the human organ of hearing is called the audible range and it has between 20Hz and 20,000Hz. Below this range is called the infrasonic wave such as that produced in an earth quake. Above the audible range is the ultrasonic such as that produced by certain crystals in the ultrasound machine.

Ultrasound machine has found a number of fields of application in machine, especially in the area of surgery, therapy and diagnosis.

3.8 Electricity and magnetism.

When a charge is in motion, a magnetic field is produced around it in addition to electric field. Thus, an electromagnetic field is said to exist around a moving charge. A moving charge in a magnetic field will experience a magnetic force. A magnet is a piece metal which when in a magnetized state is capable of establishing magnetic field around itself. Examples include cobalt, and iron and their alloys. They have the ability to attract pieces of the same set of metals. Magnetic force of this kind has found application in the electric bell, the telephone receiver, fans and motors. Electromagnetism has also found tremendous uses in a compass which is used in air and sea navigations. When a coil rotates, in a magnetic field, electric current is established in the coil indicating a conversion of mechanical energy to electrical energy. This electromagnetic induction, accounts for more than 90% of the worlds electrical energy generation. Chemical cells and solar cells etc. account for the remaining 10%.

3.9 Nuclear Energy

When chemical reactions occur, they are accompanied by changes is energy. Nuclear reactions involve also energy changes, and these changes are enormous in comparison to the energy involved with ordinary chemical reactions. There are two ways to obtain this energy. These include, nuclear fission and nuclear fusion.

Nuclear fission involves a process in which the heavy nucleus splits into two lighter and more stable nuclei. During nuclear fission, large amount of energy is released in addition to radiation. For instance, energy released by the fissioning of 28g of uranium- 235 is equal to the energy provided by 388.4 barrels of oil. The only set back of this form of energy is that, it is only uranium that is efficient in producing energy. Efforts are being made nowadays to ensure that all ores of uranium and even thorium can be used to generate energy. Example of nation where fission is being used is the United Sates of America. It is less developed in Africa.

Nuclear fusion on the other hand involved a process in which light nuclear combine to give heavier, more stable nuclei with an accompanying release of energy and radiation. Nuclear fission and fusion have been found to be of immense importance, for instance, nuclear fission is useful in the production of atomic pile and atomic bomb. The amount of energy produced during nuclear fusion is far greater than that liberated by nuclear fission per unit mass of nuclear fuel, nuclear fusion has been found useful in the production of hydrogen bomb which lethal power. It could also provide possible source of cheap power at a very economic price.

4.0 CONCLUSION

From our discussion in this unit it is evidenced that man requires abundant supply of energy. In addition, an number of energy sources are at man's disposal which he has been able to harness to be able to survive in his natural environment. From time to time man is in continuous search for other plausible ways of generating more energy to support is ever growing population.

5.0 SUMMARY

In this unit, you have been exposed to the following.

- ❖ Energy can not be created nor destroyed; rather it can be converted from one form to another.
- ❖ Man more than any other organisms has been able to generate energy through his endless efforts.
- ❖ Man's utilization of energy cuts across almost all facets of man's life e.g. refrigerator, automobiles, hydroectricity, thermal-electricity plant etc.
- ❖ The latest source of energy nowadays is the nuclear energy.
- ❖ Nuclear energy is obtained through nuclear fission and fusion.
- ❖ Nuclear reactions are useful in the production of hydrogen bomb, atomic pile and atomic bomb and economic quantity of energy.
- ❖ Even greater amount of energy is available from nuclear fusion, which is the process that fuels the sun.

6.0 TUTOR -MARKED ASSIGNMENT (TMA)

1. (a) Give two major differences between ordinary chemical reactions and nuclear reactions.
   (b) What is a source of the earth's internal heat.
2. Distinguish between mechanical and electromagnetic waves and give two examples of each.
3. Write a brief but concise note on nuclear energy

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MODULE 3

MAN AND RESOURCES

UNIT 1 FOOD RESOURCES.

CONTENTS

1.0 INTRODUCTION

Man's physical environment is endowed with a lot of materials and resources with which he is able to sustain life and maintain superiority over and above all other creatures. These resources are natural things (both living and non living) which are available to man and are used as wealth for his well being. These material resources form the focal point of our discussion in the next few units in this course. Specifically, this unit is aimed at discussing the natural food resources such as carbohydrates, proteins and fats/oils. The unit shall delve into the physical and chemical nature of these food resources and their uses will be highlighted.

2.0 OBJECTIVE

At the end of this chapter, students should be able to:

- Identify all the classes of food resources available to man.
- State the chemical composition/constituents of each kind of food items.
- State the importance of the various food resources to mankind.
- Define some basic concepts that are related to resources.

3.0 MAIN BODY

3.1 DEFINITION OF SOME TERMS- ENVIRONMENTAL RESOURCES

In order to have a firm grip of all that we are going to discuss under environmental resources, it is desirous that we define some terms that are related to the topic of discourse. This would facilitate easy understanding of the topic on hand. Some of these terms are defined below.

i) **Environment:** Within the context of our discussion, environment refers to all natural features and/or the attributes of nature that surround man. These include vegetation (forest), rivers, soil, mountains, animals, sun, air, crude oil, food etc.

ii) **Resources:** These are natural attributes that are found useful in a particular place at a particular point in time. Examples include, oil, iron ore, coal, plant (trees), animals etc.

iii) **Reserve:** This refers to the portion of the resources that can be kept and obtained for Man's use. This is the part that Man can convert to wealth.

iv) **Renewable Resources:** These are resources whose stock are in continuous supply, Examples of renewable resources include solar or radiant energy, water, air etc.

v) **Non-renewable Resources:** These are resources whose stock can be exhausted. Examples include crude oil, coal, tree etc.

vi) **Sustainability :** This has to do with the use of resource in such a way that it continues to be available.

Exercise 1.1

(1) Define the following terms
(i) Environment, (ii) Resources (iii) Reserve (iv) Renewable (v) Non-renewable resources (vi) Sustainability of Resource.

3.2 Food Resources

Food products are a group of naturally occurring materials found in the physical surroundings of man. Such products include carbohydrates, proteins, fats and oils. There are other non-food resources, which are also naturally occurring. These include, crude oil, petrochemicals etc. In this unit, only food products shall be dealt with. In subsequent units attention will be directed at discussing other naturally occurring products/resources.

3.3 Carbohydrates

These are a group of naturally occurring compounds that contain carbon, hydrogen and oxygen in their molecules. Carbohydrates can be classified into two main groups:

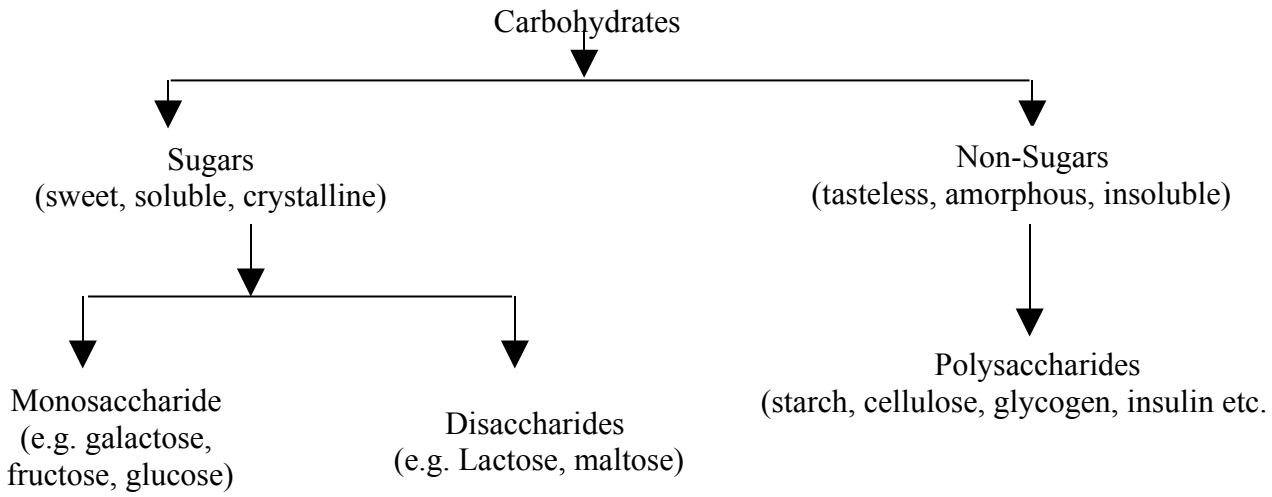
i) Sugars (ii) non-sugars

Sugars possess names ending with-ose e.g. fructose, glucose, lactose, sucrose, galactose etc. Structurally, they can further be classified as monosaccharide and disaccharides. Monosaccharides are simple sugars forming the simplest group of carbohydrates. They have between three and six carbon atoms in their molecules. The most commonly occurring simple sugars in plants and animals are the hexose-sugars. Their chemical formula is $C_6\ H_{12}O_6$. Examples are glucose (grape sugar). Disaccharides are formed as a result of combination of two molecules of monosaceharide sugars with the elimination of one molecule of water. Most commonly occurring disaccharide sugars include sucrose (cane sugar), maltose (malt sugar) and lactose (milk sugar). They have more complex structures than the monosaccharides. Generally speaking, sugars are crystalline in nature, soluble in water and have sweet taste.

Further classification of carbohydrates includes the polysaccharides (non-sugars). They are formed by the condensation of a large number of simple sugars. Therefore, they are very large molecules and their chemical formula is $(C_6\ H_{10}\ O_5)_n$ where n is indicates a very large number. They can be broken down by acid hydrolysis into the component monsaccharides as the ultimate products. Examples of polysaccharides are, starch, glycogen (animal starch) cellulose, and insulin. They all conform to the general molecular formula $(C_6\ H_{10}\ O_5)_n$ stated above in cellulose n is about 3,000. Generally,

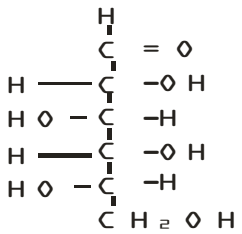
polysaccharides are non- crystalline, (i.e. amorphous) insoluble in water and are tasteless.

Below is figure 3.2 showing an outline classification of carbohydrates.

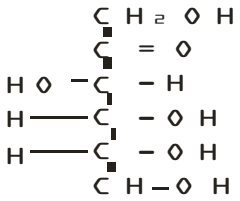


Structure of Sugars

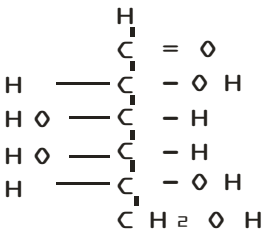
Sugars, especially simple sugars can exist in both open chain or cyclic forms. For the purpose of this course only the structure of simple sugars shall be shown. Disaccharides and polysaccharides have more complex structures, the structure of which transcends the scope of this study/ course



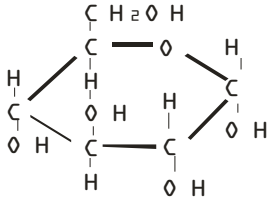
(a) glucose



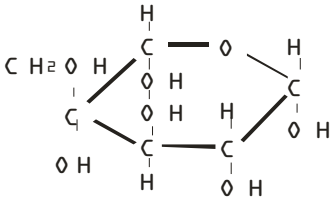
(b) fructose



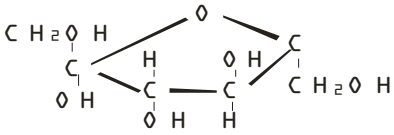
(c) galactose



(d) glucose



(e) galactose



(f) fructose

Uses Of Sugars And Non-Sugars

a) **Glucose**

i. it provides an immediate source of energy for the sick and sportsmen.
ii. It is used in the synthesis of sweet and jam.
iii. it is a useful raw material in the production of ethanol by fermentation.

(b) Non sugar (polysaccharide)

Starch

i. It is used principally as food.
ii. Industrially, it is used to produce ethanol and glucose.
iii. In textile industries and in the laundry, it is used as softening agent.
iv. Used as an adhesive to fasten material.

(c) **Cellulose**

i. it has no food value, but it is important as roughage in our diet to promote proper functioning of the digestive system.
ii. It is the main raw material used for manufacturing paper.
iii. It is used in the manufacture of cellophane, various types of rayon, cellulose, ethanoate (used for making films, lacquers, and textile fibers)
iv. It is used for making artificial leather and in painting automobiles.

Test for Simple Sugars

i) Add Fehling's solution I and II to glucose solution in a test tube and boil. A brick red precipitate is formed or
ii) Add Bendict's solution to an equal amount of sugar solution, boiled and allowed to stand.

A red orange or yellow precipitate is formed; indicating the presence of a simple sugar.

iii) **Text for complex sugar**

First boil the complex sugar solution with dilute hydrochloric acid to convert it to simple sugar. The resulting solution is made alkaline by the addition of drops of caustic soda. Then, add Benedict's solution. A red orange or yellow precipitate indicates the presence of a complex sugar.

iv) **Text for starch**
Add a drop or two of dilute iodine solution to a slice of yam or boiled rice in clean glass slide. The yam slice or rice grain turn blue black in colour.

Exercise 1.2: Gives an outline classification of the carbohydrates.

3.4 Proteins

Proteins are a group of nitrogen containing compounds. They constitute an important class of food. Proteins are necessary in order to build new cells and replace old ones. Proteins are found in the protoplasm of plant cell, muscles (flesh or vertebrates, milk and cheese and egg).

Chemically their molecules contain, carbon, hydrogen, oxygen, nitrogen and in some cases, sulphur. Some proteins are generally insoluble in water but are soluble in dilute mineral acids and alkali (soluble bases).
When proteins are exposed to drastic conditions such as excessive heating, extreme pH or treatment by surface active agents, they tend to loose their biological activity, and undergo changes in their properties. Thus, is because the very delicate structure which depends on hydrogen bonding and other relatively weak forces are broken and the molecules loses its shape.

All proteins be it animal or plants are built up from smaller units called amino acids. There are about 20 naturally occurring amino acids. Most proteins contain one amino group ($-NH_2$) and one carboxylic acid group (-COOH) and are said to be neutral. Those with more than one carboxylic acid group are said to be acidic and those with more than one amino group are basic. Animals proteins are built up from about twenty amino acids.
Amino acids have the general formula.

$$\begin{array}{c} R \\ | \\ H - C - COOH \\ | \\ NH_2 \end{array}$$

Generally proteins can be classified as:

i. Physiologically active proteins e.g enzymes, hormones etc.
ii. Structural proteins.

Uses of proteins to man

(i) They form part of the structure of living organisms e.g a considerable amount of proteins is found in muscles, bones etc.
(ii) Enzymes are proteins which catalyze biochemical processes and the digestion of food.
(iii) Hormones are also proteins.
(iv) It is essential for growth and replacement of old parts
(v) Deficiency of proteins in human diet causes a disease known as kwashiorkor.

Test for proteins

Addition of Millions reagent to a colloidal solution of protein which is heated gives a deep red colour or precipitate.

Exercise 1.3:

1. How can you classify proteins?
2. Outline any 5 uses of proteins

3.4 Vegetable oils and Animal fats

Vegetable oils and animal fats are widely distributed in both plants and animals. Along with carbohydrates, proteins and mineral salts, they are necessary component of man's diet.

Oil and fats are lipids. They are substances which contain a high percentage of carbon, hydrogen, but very little oxygen. They are examples of esters. Fats have two main functions. They provide energy (mass for mass two and a half times energy as much as carbohydrates) and they are also carriers of the vitamins A,D,E and K (Vitamins B and C are water soluble).

The products on hydrolysis of vegetable oils and animal fats with caustic soda, indicate that they are esters of long chain carboxylic acids. The other products of the hydrolysis is the trihydric alcohol, propane 1, 2, 3-triol, commonly known as glycerol. Naturally occurring materials such as corn- oil cottonseed oil, coconut oil, tallow, bacon grease and butter are all triglycerides of different carboxylic acids.

Production of Margarine.

Selected vegetable oils such as groundnuts, palm kernel palm oil which have been highly refined are hydrogenated (that is heated to about 200^0c in the presence of a catalyst of finely divided nickel, and hydrogen bubbled under 2-5 atmospheric pressure). The hydrogenated oil is emulsified with 17% by mass of milk, which has been cultured to give it flavour. Vitamins A and D are then added to increase the food value.

Saponification

When a fat or oil is hydrolyzed by prolonged hydrolysis with caustic soda or caustic potash, it is converted into the sodium salt of the acid and propane 1, 2, 3-triol. The sodium or potassium salts of the acid constitute soaps and the process is known as saponification

$$\begin{array}{lcll} CH_2OOC\text{-}R & & CH_2OH & RCOONa \\ | & & | & | \\ CH.OOC\text{-}R^1 + 3NaOh & \rightarrow & CHOH & R^ICOONa \\ | & & | & | \\ CH_2OOC\text{-}R^{II} \quad \text{alkali} & & CH_2OH & + \quad R^{II}COO.Na \\ \text{Fat} & & \text{propane} & \text{soaps} \\ & & \text{1, 2, 3 – triol} & \end{array}$$

Fats and oils are also used to prepare detergents which are also sodium salts of long chain fatty acids. The process of formation follows a series of chemical reaction steps. The commercial use of oil include, the use of peanut oil for making margarine, cornoil is used for cooking and castor oil is used as a powerful purgative.

4.0 CONCLUSION

Man is blessed with abundant food resources in his environment. These food resources are naturally occurring. They are available in various forms, derivable from plants and animals. Apart from providing men with nourishment, these food resources provide useful means of energy, body maintenance, growth and repairs. These food resources are also of commercial value.

5.0 SUMMARY

In this unit, you have learnt the following:

- Man's environment is endowed with abundant natural resources.
- These natural (food) resources exist as carbohydrates, proteins, and fats and oils.
- Resources are natural endowment found in man's surroundings.
- Other naturally occurring resources but non-food resources also exist in man's environment.
- All the food resources are found to be useful to man domestically, commercially and industrially.
- In addition, they provide man with energy, maintenance, growth and repairs.

6.0 TUTOR-MARKED ASSIGNMENT (TMA)

1. Write short notes on,
   a) Structure of carbohydrates
   b) Structure of proteins
2. What are the uses of fats and oils?

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UNIT 2 RUBBERS AND RELATED PRODUCTS

CONTENTS

1.0 INTRODUCTION

In the previous unit we discussed about natural products (resources) with particular emphasis on food products. In this unit emphasis shall shift to another natural product (rubber) found in human environment that has been found very useful to mankind. You will also learn in this unit about Rubber-related products such as synthetic rubber, vulcanized rubber and plastics.

2.0 OBJECTIVES

At the end of this unit your are expected to be able to:

- Explain the meaning of raw rubber
- Describe briefly the production of raw rubber
- Mention any five synthetic rubbers state their constituent monomers.
- Outline the uses of each of the synthetic rubbers mentioned in (1) above

3.0 MAIN BODY

3.1 The Raw Rubber

Raw rubber is a natural product (resource) which is obtained from the rubber tree (plant). The Biological name for the plant is Hevea brasiliensis. It is made by making a cut on the tree bark, and a thick white liquid called latex oozes out; when the latex is collected and heated, it changes into an elastic solid called raw rubber. The rubber is a tough smooth and clear material. If it is masticated by tearing into

shreds, it turns into putty-like mass which can be molded. It remains a plastic and it is readily deformed. If sulphur is added to raw rubber during mastication, and the masticated rubber is put in a mould, and molded to shape and heated, it forms an elastic materials which is not permanently deformed. Chemically, raw rubber is made up of 2-methyl buta-1, 3-diene monomers known as isoprene.

Exercise 2.1: Describe briefly the process by which raw rubber is made.

3.2 Synthetic Products

In order to make the best use of the opportunity provided by nature in raw or natural rubber, man has made frantic efforts to change the raw rubber to the forms that can be of immense benefit to him. This has led to the production of derived products such as:

a) Vulcanized rubber
b) Synthetic rubber

a) Vulcanized rubber

Natural rubber is soft because there are few cross-links and it is easily oxidized because of the large number of double bonds present. To rectify this and convert rubber into a form suitable for such purposes as car tyres, it is vulcanized. Vulcanization involves treating natural rubber with sulphur which forms cross linkages using the double bonds. The product is both harder and more resistant to oxidation than natural rubber. In this condition rubber is a thermosetting material (plastic) (i.e. after heating and molding, it remains set and when heated again will not soften.

When rubber is vulcanized, the sulphur forms, bonds with the molecules during heating. On cooking, the mastication has disentangled the molecules and the sulphur has linked the molecules.

b) Synthetic rubber.

Synthetic rubber is made from a variety of unsaturated compounds. The first synthetic rubber was poly (2-chloro buta 1,3-diene) or neoprene. Synthetic rubber does not occur naturally. It is often made by co-polymerising but 1,3-chene with syrene in the proportion of 75 percent to 85 percent styrene. The polymerization agent is an aqueous emulsion of potassium persulphate. Neoprene is an example of synthetic rubber which is very similar to natural rubber, made from 2-chlorobuta 1,3-diene (chloroprene). An aqueous emulsion of chlroprene polymerizes at 30^0c forming neoprene the synthetic rubber. Other synthetic rubbers

have been made such as styrenebutadiene rubber (SBR) Thiokol, poly (buta 1, 3-diene) and poly (2-methyl propene) of these SBR is the most useful, and all-purpose synthetic rubber.

SBR is obtained by the copolymerization of phenylethene (styrene) with three parts of aqueous buta 1, 3-diene. It is vulcanized by carefully heating it with about 3 percent by mass of sulphur. This gives SBR and synthetic rubber. It has characteristic elasticity and hardness.

SBR rubber is often used in making vehicle tyres and foot-wears because of its high resistance to abrasion. Other rubbers are butyl rubber, a copolymer of but – 1-ene and 2-methyl 1, 3-diene. After vulcanization, it is used for inner tubes and other uses which require a soft rubber. Neoprene described above, (i.e. copolymer of 2-chlorobuta 1,3-diene and 2-methy 1 buta 1,3-diere) is used for hoses, shoot heels and burisen tubing.

Exercise 2.2:

1. Mention any five synthetic rubbers state their constituent monomers.
2. Outline the uses of each of the synthetic rubbers mentioned in (1) above.

3.3 Plastics

A plastic is a substance that is molded in a hot press and hardens on cooking. The first plastic materials (celluloid) were made in 1868, on commercial scale. It was made from cellulose and camphor. It was used to make photographic files, a variety of small articles. It was highly inflammable, though other plastics have eventually replaced it. The next important one was bakelite invented in 1909; and is mainly used for small articles such as cups, and especially accessories, due to its insulating nature. It is also important in the development of radio receivers, and transmitters since that time several other plastics have been synthesized.

Types of plastics

There are two main types of industrial plastics. These are:
i) Thermoplastic plastics
ii) Thermosetting plastics

i. Thermoplastic plastics: These are materials which often on heating and then harder again on cooling. They are also known as thermo softening plastics. On heating, they can be remolded to desired

shapes. Thermosoftening plastics are usually linear molecules which are held together by weak van der waal's bonding. The weak van der waal's forces are usually disturbed by heat, and equally easily reform when the compound is cooled.

Polythene (polyethylene) is a typical example of thermoplastic material. The basic unit of polythene is ethene ($H_2C = CH_2$). Ethene polymerises when subjected to high temperatures and pressures in the presence of little oxygen into a substance called polythene. It consists of long chains of many hundreds of ethane molecules joined together, polythene which is a plastic is tough, light and easily molded into shapes. Other examples of thermoplastics include, polyprene, polystyrene, Nylon terylene and Perspex.

ii. Thermosetting plastics: These are plastic materials that remain set and on heating will not soften for any possible remolding. Thermosetting materials (plastics), once they have been molded, cannot be softened. This is because their formation involves chemical bonds forming across the molecule between the polymeric chains. The energy necessary to break any linkages in the resulting macromolecules results in chemical decomposition.

Polyvinyl/chloride, (PVC) is an example of thermosetting plastics. It is formed when vinyl chloride polymerises under pressure in the presence of oxygen. It is used in the manufacture of gloves. It can also be used in such things as handbags, raincoats, luggage, tank linings etc. It can equally be molded into plastic articles such as tubings, electrical insulation, radio components and cable coverings. Bakelite is one of the earliest examples of thermosetting plastics used in making light objects. Other example include, urea methanal.

Exercise 2.3:

1. What are (a) Thermoplastics (b) Thermosets?
2. Give examples of themosets and thermoplastics, stating their uses.

Desirable properties of plastics

Practically, everything around us is made of some kind of plastic. The following conditions have made our present plastic age possible.

i) Plastics have properties that make them suitable for many purposes. They are strong, but light, inert to air, water and other chemicals, resistant to fungal and bacterial attacks, and good insulators of heat and electricity.

ii) They can be molded into any desired shape and requirements; they can be made into hard, rigid blocks, thin flexible sheets, fibres that can be made into ropes and fabrics and very light foams. They also have a wide range of application.
iii) The raw materials for manufacture of plastics are readily and cheaply available from the refining of crude oil. The boom of the plastic industries has contributed to the growth of the plastic industry.
iv) Plastic materials can be produced at very low cost by using moulds and automated manufacturing processes.

Problems Associated with the use of Plastics

There is a heavy dependence on crude oil, since petrochemicals provide the bulk of the raw materials needed for making plastics. This poses a serious problem as the world's oil supply is exhaustible. Alternative energy sources that are being explored do not provide the raw materials needed for making plastics.

Most plastic materials are non-biodegradable and can not be decomposed/broken down by microbial action into simple organic forms. Therefore, they cause serious land pollution problem. Burning plastic objects would not be a good alternative as this would liberate toxic vapours or gases into the atmosphere, thereby causing air pollution.

4.0 CONCLUSION

In this unit, you have been exposed to the fact that man is endowed with other natural resources in addition to the natural food products. As a result of his interaction with the environment and his quest to maximize the use of the abundant resources his at disposal have been able to synthesize a number of other products which have a wide range of applications.

5.0 Summary

In this unit you have learnt about the following:
- ❖ Rubber is a natural product obtained from the latex of the rubber tree.
- ❖ Apart from the natural rubber (raw rubber), there also exist synthetic ones (vulcanized and synthetic).
- ❖ Rubber is needed in making car tyres, tubings, hoses, shoe heels and Bunsen tubing.
- ❖ Plastic is a synthetic product which is of immense importance to man.

- There are two main kinds of plastics. These include, thermoplastics (themosoftening) and thermosetting plastics
- The two forms of plastics are very useful, domestically, commercially and industrially.
- Man is able to derive maximum utilization from plastic products because of certain striking features that make them manipulable.
- The boom which the plastic industry now enjoys may soon dwindle unless the problems of over dependence on petrochemical products as the only source of raw materials for making plastics is promptly addressed.

6.0 TUTOR-MARKED ASSIGNMENT (TMA)

1. Distinguish clearly between natural (raw) rubber and synthetic rubber
2. a) What are the likely problems which may confront the plastic industries in the near future?
3. What are the prospects of the plastic industry?

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UNIT 3 MINERAL RESOURCES

CONTENTS

1.0 INTRODUCTION

In the last two units, we have been discussing some natural resources with which man is richly endowed. The units were dedicated to natural food resources and important tree resource (rubber). Besides these natural resources, a number of other abundant deposit of other natural resources abound beneath the earth crust. These resources are termed mineral resources. Nigeria is one of the few countries that is richly endowed with the presence of these mineral resources. Examples of such resources are Iron ore, petroleum, bitumen, coal, limestone etc. This unit will be committed to discussing these mineral resources.

2.0 OBJECTIVES

At the end of this unit, students should be able to:

- Identify the mineral resources in Nigeria.
- State the location of these mineral resources in Nigeria
- State the importance of these mineral resources to mankind.
- State some of the problems associated with the availability of these mineral resources.

3.0 MAIN BODY

3.1 Iron Ore

Iron ore is one of the indispensable metals, needed for industrial development, because it is a constituent of every equipment, machine, tools, automobiles etc. and materials used in homes, and industries. Iron

is usually found in the combined state as ore; usually in combination with oxygen.

Examples of these include hematite (Fe_20_3), siderite (F_eC0_3) and magnetite (Fe_30_4). The extraction of iron from its ores involves the removal of impurities followed by reduction of the oxide at a very high temperature in a blast furnace.

Deposits of iron ore are found scattered all over Nigeria such places include Agbaja, Hakpe, Ajabonoko, Kotokarfi, Agbende Okudu, Nsude hills and Muro hills. Iron ore deposit is the bedrock of steel industry and with about 3 billion tones of iron ore reserve in the country, one would expect the steel industry to be working at full capacity. This is yet to be realized as our major steel industries (Ajaokuta, Hakpe, Aladja, and Oshogbo) are either at the construction stage or being forced to close down due to non-availability of raw materials.
Some of the factors militating against the expected development of steel industry in Nigeria include,

i) Extraction of iron from its ore is a capital intensive project which demands huge and consistent funding. This is in part why the yet-to-take off Ajaokuta steel industry will supply raw iron to other steel industries, when it finally takes off.
ii) The extraction of iron from its ore also involves advanced technology that requires a large number of expertises.
iii) There is the problem of lack of cooperation from host community where iron ore deposit occurs as a result of politicking
iv) Frequent change in government and government policies over the years has not helped matters in this connection.
v) Government insincerity and lack of commitment towards developing this sector of the economy poses another problem.
vi) Another major problem is financial misappropriation.

Exercise 3.1

1. Mention any five states in Nigeria where iron ore could be found
2. What factors militate against the development of steel industry in Nigeria?

3.2 Coal

Coal is one of the valuable natural (mineral) resources. It is a bye-product of plant remains or debris that have been buried over a long period of time. The physical and chemical transformation of the plant debris, which prevent decay usually lead to the formation of coal. The

transformation of plant debris into coal is called coalification, which may take million of years to achieve.
Coalification takes place in six fairly district and successive stages. These are the peat, lignite, sub-bituminous, bituminous, semi-anthracite and anthracite stages. The quality of the coal formed depends on such factors as the nature of the starting plant debris, temperature, pressure, moisture content, oxygen content, acidity etc.

About 30 percent of world reserve of coal is found in USA, China and former U. S. S. R. In Nigeria, coal was first discovered in Udi near Enugu in 1909, but the actual mining did not commence until 1915. Several other deposits have since been discovered across the country in such locations as Enugu, Ezimo, Inyi, Orukpa, Okaba, Asaba, lafia obi etc.

Although, exploitation of coal in Algeria started in 1915, production has been on decline since then due to initial problem posed by the last civil war and the recent discovery of crude oil. Other reasons for decline in the production of coal include: its low heat output, untidy appearance, bulkiness which raise high transport cost, and environmental pollution.

Uses of Goal

Coal provides a fair percentage of world's energy source. Its utilization is both domestic and industrial. At home, it is used mainly to produce heat energy for cooking and house warming during cold weather condition. It's industrial applications include generation of electric power, forming of industrial boilers for steam generation, fining of kilns, ovens etc.

In Nigeria, notable application of coal include;

a) Power Generation

i) Orji power station: - which receives its supply form Enugu and Inyi deposits.
ii) Onitsha power station**:** - that receives its supply from Asaba and Onitsha deposits, generating about 1200 MW (mega watts) of electricity.
iii) Makurdi power station: - obtains its coal supply from Okaba and Ogboyoga deposits.
iv) Numan power station: - receives coal from Gombe and Lainja deposit.

(b) Cement manufacturing: - the Nigeria cement company Nkalagu uses coal for fining its kilns.

(c) **As a source of chemical**: - A number of chemical can be derived from coal, which are of immense industrial importance. Examples include graphite, activated carbons, re-carbonization materials in iron and steel making.

(d) **Transport**: - Coal is used in locomotive engines.

Exercise 3.2

1. Mention the stages of the formation of coal.
2. Outline 2 domestic uses and four industrial uses of coal.

3.3 Petroleum

Petroleum or crude oil is a mixture of many hydrocarbon compounds. It is a bye product of bio-transformation of remains of plants and animals. Petroleum is separated into its fraction or constituents by fractional distillation process. Some of the products of the refined crude oil are gases, gasoline, kerosene, diesel, fuel oil, bitumen and lubricants.
Crude oil and the associated gases provide about 75 percent of the energy used in the world. Apart from this, some of the hydrocarbon compounds found in it serve as raw/starting materials for many industrial products such as plastics (see unit 12), drug, textile material, soap and detergent etc. All these made petroleum to be most treasured and cherished natural resources. A number of oil deposits have been discovered in Nigeria after the initial location in 1956 at Olobiri. About thirteen states across the country have been designated, oil producing states. In all the states oil exploration and exploitation are at different stages of development. Today, Nigeria produces about 2 billion barrels of crude oil and exports more than 85 percent of her total production earn currency. However large deposit of crude oil in Nigeria led to the establishment of four refineries in port Harcourt, Kaduna, and Warri. However recent happenings, reveal that Nigerians do not enjoy, the maximum economic benefit they ought to have enjoyed from its resource. The following are some of the reasons.

i) Oil spillage.
ii) The Niger-Delta crisis
iii) Problem of environmental pollution
iv) Perennial scarcity of petroleum products.
v) Politicking
vi) Over dependence on crude oil for income.
vii) Environmental degradation arising from oil exploitation activities.

Exercise 3.3

1. Why has Nigerian been denied maximum benefit accruable from crude oil?
2. Suggest ways of combating these problems.

Influence of Petroleum on Nigerian Economy

The oil industry has dominated the world's economic scene for quite some time. The impact has been both positive and negative on the lives of Nigerians. Some of these are discussed in this section.

o) The positive influence include

i) Socio-economically, the oil industry dictates the pace of political, social and cultural progress in this country. Virtually every aspect of our lives has been influenced directly or indirectly by petroleum.

ii) The crude oil resource has enhanced the growth of Nigerians natural income since the late 1960, when it became the major source of government revenue.

The negative Impacts

The following are some of the problems posed by the presence of crude oil in our society.

- Oil spilage arising from normal operations or spills from piperuptures.
- Loss or destruction of land.
- Destruction of land to construct pads for wells, pipelines or storage tanks.
- Land sinking as oil and gas are withdrawn
- Pollution of surface and ground waters arising from run-off and leaking from damaged pipes
- Air pollution by hydrocarbon compounds and sulphur compounds.
- Release of drilling muds which may contain heavy metals such as barium which is toxic to aquatic plants and animals.
- Aesthetic degradation from the presence of off shore oil-drilling platforms which some people considered to be unsightly

Exercise 3.4

Write a brief but concise essay on the problems and prospects of Nigeria's crude oil on Nigerians.

3.4 Bitumen

Bitumen is another fossil fuel which Nigeria is blessed with. The term bitumen and Asphalt are often used interchangeably. For the purpose of this course, asphalt will be regarded as mixture of bitumen and some impurities. Bitumen can be defined as a class of black and dark coloured solid semi-solid or viscous substances, natural or manufactured, composed principally of high molecular mass hydrocarbon of which aspartic tar, pitches and asphaltenes are typical.

Uses of bitumen/asphalt

i) The main application of bitumen is found in construction highway streets, and drive ways air fields, parking area, petrol station and industrial floors, tennis courts and play grounds, such as basket balls floors.
ii) Asphalt is good in roofing all kinds of buildings ranging from individual homes and factory buildings.
iii) Bitumen can be converted into synthetic crude, from which petrol, diesel, kerosene, grease are obtained.
iv) In the production of sulphuric acid, phenol, and petro-chemicals.
v) In the protective coating and hydraulic structure
vi) In the manufacture of battery cases, tyre, automatic brake lining and insulating and sound proofing.

Exercise 3.5

i. Outline the uses of asphalt/bitumen

3.5 Limestone

Limestone is a sedimentary rock whose major component is calcium carbonate. Other constituents of limestone are clay, iron, pyrite, quartz and magnesium. There are two main theories on limestone formation. These include

i) Biogenic precipitation from sea water. Limestone resulting from this source is referred to as autochthonous limestone
ii) Allochthonous limestone, believed to have been formed form mechanical transportation and deposition of pre-existing limestone.

Limestone is an important environmental resource it is the basic raw material for the manufacture of cements. There are many deposit of Limestone in Nigeria in areas like Nkalagu, Ewekoro, Mfawsing, Ogbolokuta, Yandev, Kanbanu and Ashaka.

It also funds its application in the manufacture of fertilizers (especially phosphate-rich fertilizers), in addition, thermal decomposition of limestone gives lime and carbon (iv) oxide. It is equally very important in glass manufacturing.

4.0 CONCLUSION

No doubt, Nigeria is endowed with quite a number of mineral resources, which if properly harnessed can lift the standard of living of her citizenry. However, there is need for standing national policy for proper management and utilization of these God-given resources. Preservation, renewal and regeneration of natural resources should be embarked upon, while illegal mining should be completely wiped-out

5.0 SUMMARY

- There is abundant supply of mineral resources in Nigeria.
- These mineral resources are located across the whole country, Nigeria.
- The presence of these mineral resources in our environment has a lot of socio-economic influence. A number of problems are also associated with their exploration and utilization.
- Examples of the mineral resources that we have discussed in this unit include, coal, petroleum, between, Iron ore and limestone.

6.0 TUTOR-MARKED ASSIGNMENT (TMA)

1. Advance reasons for the decline in the level of production of the coal industry in Nigeria.
2. What are the uses of (a) Bitumen/asphalt (b) Limestone?

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UNIT 4 VEGETATION AND WATER RESOURCE

CONTENTS

1.0 INTRODUCTION

In this unit, you would be exposed to resources that nature has provided man in vegetation and water bodies. These two resources are natural and renewable. You will also be exposed to the economic importance of these two natural resources as they affect man.

2.0 OBJECTIVES

At the end of this unit, students would be able to

- List and explain the different kinds of vegetation in Nigeria.
- State the economic importance of Nigeria natural vegetation.
- List the importance of water resources to mankind.
- Describe the limitations of Nigeria water resource.

3.0 MAIN BODY

3.1 VEGETATION RESOURCE

The natural vegetation of a particular place refers to the community of plants that covers the region. These include trees and grasses, which are of natural origin. It covers both the natural and man-made vegetation of an area. The vegetation forest depends largely on such factors, soil type, fall, and human activities. Nigeria has two main distinct natural vegetation belts. These are forest and savannah.

Soil and Rainfall constitute two major factors which determine the type of vegetation in an area. Soil for example is a mixture of mineral matters, humus, water, air and micro-organisms. Soils vary in their chemical composition from place to place because they are derived from the underlying rock materials. Some countries are endowed with fertile soil for cultivating virtually all types of crops. Nigeria has soil types that are suitable for trees and arable crops. e.g. cocoa, rubber, coffee, timber, gedu, cassia which are examples of trees and food/cash crops such as beans, cotton, melon, corn etc.

In desert regions, the soil lacks essential plant nutrients and required moisture to support plant population, be it trees or food crops. Soil, apart from supporting plant population, is also useful in making pots and building houses.

Exercise 4.1:

Discuss the role of soil in sustaining plant population in an area.

Types of Forests in Nigeria.

As stated earlier on, Nigeria vegetation can be classified into forest and savanna. This section will be committed to discussing the various kinds of forest and their economic values.

In Nigeria, three kinds of forests can be identified. These are, the mangrove swamp forest, the evergreen rain forest and the higher open forest. The mangrove swamp forest is often referred to as salt water swamp because the soil is water logged by saline water. The major economic plant (the mangrove) which occurs in different species is used in building canoes and boat, coconut is another common feature of the mangrove forest.

The evergreen rain forest is found immediately inward of the salt water swamp forest. The forest is characterized by heavy rainfall. The forest houses big tree with large buttresses. Example of such trees include Rafia palm, which is usually tapped for a sweet local wine.

The high or open forest is also characterized by high rainfall. The forest is arranged vertically in three distinct layers based on the height of the trees. The lower storey consists of shrubs and ferns which form undergrowths. This middle storey are plants of about 20-30 metres high with dark green leaves. The trunks of the trees are woody, making them useful for many purposes. The top storey is populated with tall trees which may be up to 60 meters in height. Example of trees that may be found in this region include, Iroko, mahogany, tropical cedar. This

region also supports the cultivation of many tree cash crops such as cocoa, rubber, coffee etc.

Exercise 4.2:

Describe the features of the following

a) Mangrove rainforest (b) Evergreen rainforest (c) High open forest

Savanna Vegetation in Nigeria

Three distinct savanna belts can also be identified in Nigeria. These are the Guinea Savanna, Sudan Savanna and the Sahel Savanna.
The Guinea savanna occurs mostly in the middle belt of the country where the annual vain fall is between 100-150 cm. Grass is the predominant plant here; dotted with economic trees such as oil bean, locust bean, shea butter and isoberlina. The Guinea savanna is often called parkland savanna because of the arrangement of grasses and trees, which appears like a park.

The sudan savanna lies to the north of guinea savanna, where the annual rainfall is less than 100 cm. It consists mainly of short grasses. Economic plants found in this region include dum palm, the silkcotton and baobab trees. The sudan savanna also supports the cultivation of crops such as cotton, millet, groundnut and rearing of cattle.

Areas in Nigeria with annual rainfall of less then 50 cm are often referred to as sahel savanna. They usually experience long period of dry season (between 8-10 months) every year. The area is virtually covered with very short grasses, which are sparsely dotted with thorny shrubs like acacia and gum Arabic tree.

Exercise 4.3:

Write a detailed but concise essay on savanna vegetation in Nigeria.

3.2 Economic Values of the Natural Vegetation

In this section, we shall examine the benefits of the vegetation resources in Nigeria The forest habours trees such as Iroko, Mahogamy etc. and as a result produces timber from which plans are made. Lumbering and associated activities like saw milling provide job opportunities for a sizeable number of Nigerians. Planks, which are produced from timbers are used for roofing houses, constructing canoes and for making fumitories. In recent times, Nigerian timbers and planks are being exported to neighbouring African countries.

Bamboo and some other trees found in the forest and savanna serve as major raw material for pulp and paper industry. Trees and grasses remain very good sources of heat energy for cooking in the rural areas. Recurring shortages of kerosene and cooking gas have made urban dwellers to turn to forest products for energy as most families in cities now take solace in the use of charcoal for cooking. Forests also harbour animals which serves as sources of animal protein for men.

The savanna belt which is predominantly covered with grasses is an extensive pasture land which allows for the rearing of animals in the area. Substantial amount of meat consumed in this country come from this part of the country. Animals like cattle, sheep and goats of various species are reared in a large scale in this area. Case crops such as groundnut and Colton are also grown in this region. Conversely, the forest zone supports the cultivation of cash crops such as cocoa, coffee, palm, rubber etc. Food crops grown in the forest region include yam, cassava, maize etc. It should be placed on record that, cotton, cocoa, and groundnut were the mainstay of Nigeria's economy before the discovery of crude oil.

Health wise, the natural vegetation has contributed immensely to the well being of Nigerians. The use of the bark, fruit, leaves or roots of some plants for the treatment of different kinds of climate or diseases are enormous. The contribution of vegetation resources to tourism and reserves are also worthy of mentioning.

3.3 Decline of Nigeria Vegetation Resources

Nigeria vegetation being an exhaustible resources, though can be replenished if properly managed, is found to be on the decline, in quality and quantity. The following are some of the factors that have contributed to this.

i) Bush banning
ii) Developmental activities
iii) Overgrazing
iv) Mining and exploitation activities
v) Lumbering
vi) Natural factors (e.g. long drought)
vii) Agricultural activities.

Exercise 4.4:

1. Write a short note on the economic values of Nigeria Natural vegetation to Nigerians.

3.4 Water Resources

Water resource consists of the rivers, lakes streams, springs, seas and oceans. Nigeria is equally endowed with notable examples of these water resources. Notable rivers in Nigeria include Niger, Benne, Osun Hadejia, Sokoto, Kadina. etc. there is also lake Chad in Nigeria, while Nigeria is bound in the south by the Atlantic ocean.

The features of rivers in Nigeria include.

i) The volume of water in them varies from season to season.
ii) Rivers in the south take off from the western highlands and flow to the sea, whereas rivers in the northern part of the country take off from the North central plateau and move in different directions.
iii) Nigerian rivers are located with weathered part of the soil on which they flow. Some of these materials remain suspended in the water while some are dissolved.
iv) The topography of the land on which they flow has a great influence on their usage. For instance, rivers that are intercropped by many rapids are suitable for building dams for hydroelectric power generation, whereas, rivers with little or no rapids are suitable for navigation.
v) Nigeria rivers vary in length. For instance, River Niger and Benue are the two long rivers in Nigeria that have their sources outside Nigeria. Other short but notable rivers include, Sokoto, Osun, Ogun Hadejia, Imo Owerri and Katsina etc.

Exercise 4.5:

1. Mention the features of Nigeria rivers

3.5 Nigerian Water as a Resource

Water is one of the indispensable needs of man, its contributions to man's well-being is unquantifiable. Starting from home, water is needed by man for drinking, cooking and other domestic uses. Man also depends on rivers and streams as sources of water for cooking and other domestic purposes.

Apart from domestic utilization, majority of the industries require water in large quantity for their operations. These include washing, production, generation of steam and cooling etc. Some industries rely so much on water that they have to be cited very close to source of water (river) e.g. Nigerian sugar company limited, Bacita, located near river, Niger.

Agriculturally, water is important in food production. Rivers and streams harbour a wide variety of fish and other aquatic animals which serve as sources of proteins. A number of River Basin authorities have been established to raise the level of food production in the country in addition to providing job opportunities for the citizenry. In the same vein, some rivers have been dammed for the purpose of generating electricity e.g. Kanji Dam (Niger) and Shiroro dam, (Kaduna), Lagos, port Harcourt and Calabar seaports were built due to the fact that the towns are very close to the atlantic ocean. The ports are of great economic values to Nigeria as goods imported into or exported out of the country pass through them.

In the area of transport, inland rivers serve as means of inter-and intra-city movements of people and goods. The people in the riverrine areas and people living around rivers such as Nigeria, Onitsha, Benne depend mainly on navigation for the movement of goods and people.

Exercise 4.6:

1. Name any five rivers in Nigeria, stating their location and their economic value.

3.6 Some Limitations of Nigeria Water Resources

Below are some of the limitation of Nigeria water resources (rivers).

- Seasonal variation in volume of water in our rivers
- Hardness of water, which makes it unstable for some applications.
- The presence of some land forms along the courses of rivers e.g. hinders navigation.
- Industrial activities which have rendered some rivers unfit for both domestic and industrial application e.g. pollution in oil producing areas.

4.0 CONCLUSION

It is evidenced from our discussion in this unit that water is an indispensable natural resource which nature has provided man with. The role of water in the well-being of man is unquantifiable. Its contributions to man's wellbeing can be seen in the areas of drinking, crop production, energy generation, transportation etc. you have also learnt about some Nigerian, rivers and their importance and limitations.

5.0 SUMMARY

In this unit, you have learnt the following things:

- Water is an indispensable resource at man's disposal.
- Water harbours fish, and other valuable aquatic animals which serve as one major source of man's animal proteins.
- Water is very useful in cooking, washing energy/power generation, and in industries.
- There are notable rivers in Nigeria, such as Rive Niger, Benue, Hadejia, Sokoto, Imo and Owerri etc.
- Nigeria rivers provide for inter-and intra-city transportation of goods and people.
- People living in the river-rine areas depend largely on water as a means of transporting goods and services.
- Water is also important in crop production.

6.0 TUTOR-MARKED ASSIGNMENT (TMA)

i. Discuss the role of water as an in dispensable resource at man's disposal.

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UNIT 5 CONSERVATION OF NATURAL RESOURCES

CONTENTS

1.0 INTRODUCTION

It is an established fact that, man has an abundant array of resources at his disposal that are continuously being harnessed for his well-being. For instance, the roles of these resources in the areas of nourishment, energy generation, housing, building, transportation and income generation are unquantifiable. But the rate at which these resources are disappearing from our environment is alarming, such that a drastic step is desirous in order to ensure continuous supply and availability of the resources. In the light of this, this unit will focus on efforts being made to ensure continuous and steady supply of resources through conservation.

2.0 OBJECTIVES

At the end of this unit, students should be able to

- Define the term conservation
- Outline the need for conservation of resources.
- Mention some organizations that are responsible for conservation the world over.
- Distinguish between renewable and non-renewable resources.
- Mention and explain the various methods of conservation of resources.

3.0 MAIN BODY

3.1 MEANING AND THE NEED FOR CONSERVATION

At the beginning of this unit, it was shown that the world's resources at man's disposal are fast disappearing from the Earth's surface. Man's activities in agriculture, fishing, dumping of refuse in water has made water bodies so bacteria-ridden, that he can neither drink nor swim in it. The water bodies are filled with junks and refuse that one can hardly imagine its once natural beauty.

They present environmental crisis has risen because man has in various ways disrupted the natural cycle of life which characterize the ecosystem. As such anything removed from the ecosystem need replacement. While deforestation, soil loss, degradation of water sheds, loss of vital water supplies and reduced agricultural productively pose serious problems, to continued development, they are a part of a broader problems that desire urgent attention. Along with these are the problems of misuse of chemicals (dangerous) shortages of domestic supply of energy, over fishing, overgrazing and marine pollution. These pose the serious problem of impeding our development in the near future.

With man's activities and associated environmental hazards and problems, the only saving grace for man is to embark on a very speedy and effective conservation efforts and environmental Education.

However, the main issue is whether or not man should exploit natural resources. The main crux of the matter is that he reserves the duty to preserve the total environment even while exploring some of its resources and exploitation must be sustained. Man's actions should be such that serve the needs and desires of the present generation, without compromising the survival and well-being of future generation. This is what conservation stands for. Hence we can define conservation as "the wise use of naturally available resources in such a way that wastage, loss and harm are prevented or reduced.

Generally, conservation involves exploitation of natural resources through rational use to ensure their continued use and preserving the quality or original nature of the natural resources.

Having discussed the meaning of conservation, what then are the rationale for conserving our natural resources. Reasons for conservation include.

i) To reduce indiscriminate destruction of natural environment

ii) To preserve rare and valuable species of animals and plants for future generation to recognize; thereby preventing their extinction.
iii) To preserve naturally beautiful sceneries e.g. Osun Osogbo, Ikogosi warm spring etc for their aesthetic values.
iv) To ensure steady and continuous cycling of some scarce mineral resources such as gold, tin, silver etc.
v) To enhance man's continued use of natural resources such as water, animals, plants and food resources .
vi) To ensure steady supply of mineral resources for research purposes and,
vii) For prevention of natural ecosystem.

Exercise 5.1:

1. Why is it necessary that man should conserve his natural resources?

3.2 Some International Concerns of Conservation

Conservation efforts in the world and indeed Nigeria have been a great concern for the United Nations to the extent that the EARTH SUMMIT was held between June 1-12 1992 at Rio de Jenerio, Brazil. Similarly UN held a conference on Environment and Development (UNCED) the conference sought to promote environmental code of ethics.

The Global Ecological Marshall Plan (GEMP), by 1995 planned to seek support for saving the environment with the motto. "Keeping this earth habitable for our children'. The GEMP has the following objectives to achieve.

i) To protect the climate
ii) To save the tropical forest
iii) To stabilize the population and
iv) To promote East-West environmental cooperation.

The effect of increasing population of the world and its attendant poverty which has direct link with environmental degradation has a high correlation between poverty and pollution as noted by the world commission and development (WCED) also known as Brunotland Report which says in the World Health Magazine of 1990 that.

> "*Poverty pollutes the environment, creating environmental chaos in different ways. Those who are poor and hungry will*

> *often destroy the environment in order to survive.*

It went further to say that people activities will result into such environmental hazards as deforestation, overgrazing over use of marginal land, overcrowding etc. The international union for the conservation of Natural Resources (IUCN) working under the an spices of Ecosystem conservation group (EGG) published a book "the Red Data Books". The book published information about 286 types of fish, 189 amphibians and reptiles, 428 birds and 385 mammals. They also described 250 out of the estimated 25,000 endangered species of plants and 200 examples of threatened insects, molluscs, corals, worms and other invertebrates.

3.3 Conservation Agencies.

There are bodies whether government or private which are responsible for conserving natural resources. These include

i) The federal government and state government that make laws on conservation. For example in 1983, the Nigeria conservation foundation was established to conserve forest and wildlife.
ii) The local governments also enact conservation bye-laws or regulation and enforce them.
iii) The ministries of agriculture and natural resource at the state and federal levels have officials and departments responsible for soil, forest, animals and water conservation.

Voluntary agencies or organizations also promote conservation, such include;

a) The society for the promotion of kindness to animals (S. P. K. A) which are established in some of our educational institutions.
b) The Natural wildlife conservation society (N. W. C. S) is another body having conservation concern.
c) In countries like Britain there is the Royal society for the prevention of cruelty to animals (R. S. P. E. A.)

Exercise 5.2:

1. Mention any four international organization that showed concern for conservation.
2. Mention any five agencies in charge of conservation in Nigeria

3.4 Conservation in Nigeria

Renewable and non-renewable resources form the core of the much depleted natural resources with which Nigeria is endowed. Renewable

resources include those resources from forests, wildlife, fisheries, soil and water. These are natural resources which could be regenerated. Non-renewable resources cannot be regenerated. Examples are petroleum, limestone, coal etc. uncontrolled and indiscriminate exploitation of these resources coupled with ever increasing population has made reservation programme inevitable in Nigeria.

Part of the conservation efforts in Nigeria had been the establishment of National parks set up to pursue conservation and balanced development of the nation's natural resources for the future, working towards sustainable development efforts for the much needed relief to the communities that live in harmony with the parks the nation and humanity in general. The parks were set up to preserve endangered species such as, elephants, leopards, pythons, chimpanzee etc. It was also meant to preserve timber species that are being exploited on daily basis, and to prevent indiscriminate felling of trees (especially the mature ones).

Furthermore, the Natural Resources Conservation Council (NARESCON) was established by Decree No 50 of 1989 and inaugurated in February, 1991 in fulfillment of 1968 OAU conservation treaty on protection of plants and animals to which Nigeria is a party.

The Biological Resources Development Department under the auspices of the NARESCON has been promoting research into and encourage the development of indigenous vegetables, ornamentals and medicinal plants. It is also the duty of NARESCON to locate cites and species of conservation interest, sharing responsibility for the conservation of Tran boundary biomes. It also emphasizes sustainable management areas in productive use of timber wood grazing and other forest products.

Exercise 5.3:

1. Discuss Nigeria's effort in conserving and preserving her natural floral and fauna.

3.5 Method of Conservation

There three main methods of conservation these are:

i) Establishment of forest and games reserves in various locations to assist in preserving plant and animal life. A number of these games reserves are found located in different parts of Nigeria. Examples are Yankari games in Gombe state, Kainji games reserve, the Borgu games reserve old Oyo National Parks (Oyo state) sand River (platoon) etc.

ii) Establishment laws in order to protect and conserve natural Resources. This kind of law will prohibit

a) indiscriminate felling of trees without official permission
b) indiscriminate bush burning
c) deforestation and encourage a forestation or reforestation
d) the shooting of endangered species such as elephants
e) the exploitation of numeral by individuals.
f) indiscriminate killing of fishes by means of toxic chemicals like gamalin 20
g) shooting of animals inside the games reserves without permission.

ii.) Conservation Education, by making people aware of the need for conservation through various steps such as;

a) showing programmes on the natural television about the need for conservation.
b) embarking on advertised campaigns for tree planting on television and radio, using slogans such as, "plant a tree per day" and "fell a tree and plant two in turn" etc
c) embark on radio campaign programmes against indiscriminate fishing with toxic chemicals.

Exercise 5.4:

1. List the three main methods of conservation.

4.0 CONCLUSION

In this unit you have been exposed to the fact that, degradation and destruction of environmental systems has assumed a massive proportion the world over, Nigeria inclusive. In some developing countries, it poses a serious threat to sustainable development. These and many other reasons have necessitated the clarion call for "conservation" to avoid total disappearance of natural resources from our environment.

5.0 SUMMARY

In this unit you have learnt that

- Man is endowed with abundant resources in the environment which he lives.
- Man has been using these resources to his own advantage.
- Man's activities have led to depletion and abuse of these natural resources.
- Serious environmental degradation and problems arise as a result of man's interaction with the environment.
- There is need to conserve and preserve the natural resources because of posterity.

- ❖ In order to aid conservation, some international organizations have shown concern for the phenomenon.
- ❖ There are certain agencies in Nigeria whose sole responsibilities are to see to the conservation of natural resources in the country.
- ❖ There are three main methods of conservation.

6.0 TUTOR-MARKED ASSIGNMENT (TMA)

1. (a) Distinguish clearly between renewable and non-renewable resources in Nigeria.
   (b) Enumerate the advantages of enacting a conservation law in a country

2. (a) Define "Conservation"
   (b) What actually informed the clarion call for conservation?

7.0 REFERENCES/FURTHER READINGS

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