NATIONAL OPEN UNIVERSITY OF NIGERIA

SCHOOL OF EDUCATION

COURSE CODE: SED 822

COURSE TITLE: SCIENCE TECHNOLOGY AND SOCIETY

SED 722: SCIENCE, TECHNOLOGY & SOCIETY

COURSE GUIDE

NATIONAL OPEN UNIVERSITY OF NIGERIA

COURSE GUIDE SCIENCE, TECHNOLOGY AND SOCIETY

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COURSE OUTLINE

Introduction:

Science, Technology and Society (STS) is a three-credit course. It is a core course for all those offering Masters in Science Education M. Sc (Ed). The course consists of twenty-six units' approximately five modules. The course assists you in understanding and interpreting the natural world as well as enhancing your effective participation in any academic discourse on STS. It will also widen your knowledge on some of the issues raised such that when you intend to teach them at any level of our educational system they become easy. The course is spelt out under the following headings: nature of STS, interaction of STS, biotechnology education, Science of the millennium and environmental education.

What you will learn in this course.

The overall aim of the course in Science, Technology and Society is expose you to the general socio-cultural impact of the products of science and technology on humankind. The course is developed on the premise that the awareness of technological development and its associated consequences are a must for every citizen. The course will further inform you that technology ranges from material fabrication, weaving, artifact, automobiles to the very floor you are standing on. For those of you who have been reading wide and paying attention to issues around you, you will accept that science does not only constitute the basis of our material comfort but also a means of achieving technological development and economical survival.

It will help you to pay attention especially to what happens in the community that is, the awareness of changes taking place and the challenges faced by individuals. Some of the issues raised in the course will also assist you accepting that science and technology is the prime mover of our society. Simply put, it is civilization. As more discoveries are made in science, technological breakthroughs become apparent. The society is the recipient of all the scientific and technology output. It is therefore necessary to be aware of happenings around and the consequences of such happenings on the quality our life.

Aims of the Course.

This course aims at providing a detail explanation of science technology and society, interrelatedness of the concepts, approaches to teaching STS, Science and technology in African and modern societies, technology transfer, linking STS, biotechnology, genetic engineering, modern information technologies, environmental education and issues in science and technology

Course Objectives.

To achieve the aims of this course, the course sets overall objectives. In addition, each unit also has specific objectives. The Unit objectives are always included at the beginning of a unit, you should endeavour to read them before you start reading through the unit. You may as well want to refer to them during your study of the unit to check on your progress. You should always look at the unit objectives after completing a unit. In this ways, you can be sure that you have done what was required of you by the unit.

The wider objectives of the course as a whole are stated below. For you to say you have achieved these objectives, you should have successfully achieved the aim of the course. On successful completion of this course, you should be able to

1. Discuss how;-
   (a) science has affected technology
   (b) science has affected society
   (c) technology has affected science
   (d) technology has affected society
   (e) society has affected technology
   (f) society has affected science

identify what constitutes science of the millennium and strategies for coping with them.
discuss how the environment has been affected by the activities of man.
draw out the implications of technological advancements on the quality of life.
explain how man has misused the knowledge of science and technology to his own detriment.
analyse the energy crises.
analyse the impact of various forms of environmental degradation on society.

Working through this Course.

To complete this course, you are required to read the study units which a times include reading materials obtained from journals, articles, read set of recommended books and other materials prescribed by your tutor. The articles are intended to serve as a kind of lecture notes to introduce you to the topics being discussed in the units

covered. Where necessary the names of the authors and relevant references have been included. Take time to go through each of them carefully. Each study unit contains activities to enable you follow the trend of what you are reading and be sure you understand it. There are Tutor-Marked-Assignments which you are expected to complete and submit to your tutor for assessment. There will be a final examination at the end of the course.

Assessment.

There are two aspects to the assessment of this course. First are the Tutor Marked Assignments, second is a Written Examination. In doing the assignments, you are expected to apply information, knowledge and technique gathered during the course. The assignments must be submitted to your tutor for formal assessment in accordance with the deadline agreed upon in the Assessment file.

The work you submit to your tutor for assessment will count for 50% of your total course mark. At the end of the course, you will need to sit for final written examination of three hours duration. This examination will also count for 50% of your total course mark.

Tutor – Marked Assignments (TMA).

There are twenty-six marked assignments in this course. You are encouraged to submit all the twenty-six except any counter directive from your tutor, in which the best required number will be counted. Make sure that each assignment reaches your tutor on or before the deadline given in the Assignment 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 will not be granted after the due date unless there are exceptional circumstances.

Tutors and Tutorials.

There are 12 hours of tutorial; provided in support of this course. You will be notified of the dates, times and location of these tutorials, together with the name and phone number of your tutor, as soon as you are allocated a tutorial group. Your tutor will mark and comment on your assignments, keep a close watch on your progress and on any difficulties you might encounter and provide assignment to you during the course. You must mail your TMAs to your tutor well before the due date (at least two working days are required).They will be marked by your tutor and returned to you as soon as possible.

Do not refuse to contact your tutor by telephone, e-mail or direct discussion if you need help. The following might be circumstances in which you would find help necessary. Contact your tutor incase:

1. you do not understand any part of the study units or the assigned readings;
2. you have difficulty with self-tests or exercises;
3. you have a question or problem with an assignment with your tutor's comments on an assignment or with the grading of an assignment.

You should try your best to attend the tutorials. This is the only chance to have face contact with you and to ask questions which are answered instantly. You are free to raise any problem encountered in the course of your study. To maximize the benefit from course tutorials, prepare question list before attending them. You will learn and gain a lot from participating in discussions group actively.

Summary.

SED.722 intends to introduce you to Science, technology and society with particular reference to the general socio-cultural impart of the products of science and technology on humankind. Upon completing this course, you will be equipped with the proper knowledge of technological development and its associated consequences on living organisms and its environment. You as a science teacher will also be in a better position to discuss and teach the students issues relating to how science, technology and society affects each other, such that they will be aware of happenings around and the consequences of such happenings on the quality of their life. You will as well be able to answer these kinds of questions.

(a) What is science, technology and society?
(b) What is the justification for inclusion of STS in Secondary and Tertiary Institutions' Curricula?
(c) What does the current Nigeria National Development Plan have for STS?
(d) Mention the vital issues central to the teaching and learning of STS?
(e) How does STS relate?
(f) What are the attitudes a science teacher needs to develop to function effectively in School?
(g) Describe the educational objectives of biotechnology.
(h) Discuss how genetic engineering works
(i) Discuss the impact of research on space exploration
(j) List the ecological education content.
(k) List areas where people in your community have misused science and technology knowledge
(l) List alternative sources of energy
(m) Discuss some of the challenges faced by developing nations.

SED 722: SCIENCE, TECHNOLOGY & SOCIETY

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NATIONAL OPEN UNIVERSITY OF NIGERIA

UNIT 1

NATURE OF SCIENCE, TECHNOLOGY AND SOCIETY

1.0 Introduction

You have read the course guide and the general introductions to this course. In this unit, you will learn the meaning of science, technology and society. The three areas will be treated as a single discipline. The discipline referred to as science, technology and society (STS) is an integration of the three areas. You will learn how science affects the society and how the society affects science; how science affects technology and how technology affects science; how society affects technology. The three areas put together will lead us in this course, to study the quality of life. Quality of life depends on our values. In this unit you will specifically learn the ideas and definitions educators and scientists have about STS.

1.1 Objectives

When you finish the unit, you should be able to,

- Explain what STS is.
- Describe five features of STS.

1.2 Meaning of STS

STS is an abbreviation for Science, technology and society. STS is the new concept in science teaching and learning. Yager (1992), states that STS is recognized as a reform in science education across the world. Emphasis has been shifted from Integrated Science to STS by UNESCO and other stake holders in science education. STS provides a context for science study and thereby becomes more appropriate for all learners. (Yager 1992). The NSTA defines STS as the teaching and learning of science in the context of human experience.

Activity 1.1: Define STS

1.3 Features of STS

NSTA has identified eleven features of STS programmes. These features according to (Yager 1992) indicate the importance of instruction over

curriculum and indicate how the context of human experience is attained. STS programs are those which include:

- Students identification of problems with local interest and impact.
- The use of local resources (human and material) to locate information that can be used in problem resolution.
- The active involvement of students in seeking information that can be applied to solve real life problems.
- The extension of learning beyond the class period, the classroom, the school.
- A focus upon the impact of science and technology on individual students
- A view that science content is more than concepts which exist for student to master on tests.
- An emphasis upon career awareness especially careers related to science and technology.
- Opportunities for students to act in their communities as they attempt to resolve issues they have identified.
- Identification of ways that science and technology are likely to impact on the future.
- Some autonomy in the learning process (as individuals are identified and considered).
- Yager states that STS is focusing upon current problems and issues and attempts at their resolution as the best way of preparing students for current and future citizenship roles. This according to him means identifying local, regional, national and international problems with students, planning for individual and group activities which address them. Emphasis on STS is responsible decision making in the real world of the student.

We can attempt defining each of the words. Science is the systematic study of nature, both living and nonliving aspect of nature including natural phenomena like thunder, weather etc. Technology is the organization of knowledge for the achievement of practical purposes or a set of skills, techniques or activities for shaping materials and fabricating objects for practical ends. Society is the system of collective, cohabitation of groups of individuals with mutual understanding, benefits and common goals.

The three, science, technology and society aim at increasing our ability to comprehend and apply the concepts of scientific and technological systems. STS can be therefore defined as the discipline that raises a generation of citizens who understand the nature of things in the environment; a generation of citizens who are aware of changes taking place around them; a generation who can adjust to the changes in the environment; a generation who is

equipped to deal with forces that influences the future, a generation who can take her future in her own hands.
Science is dynamic, so is technology and society. As science and technology, the society is affected both positively and negatively. The society becomes complex in accepting and using new technologies.

1.4 Conclusion

STS is another way of saying" integrated science, technology and society.
Science educators have formed a discipline from the three. When we say STS, we are talking about a discipline that embodies the relationship of science and technology and how the two shape the society and vice-versa.

1.5 Summary

In this unit you have learnt
what science is
what technology is
what society is
what the abbreviation STS is
You have learnt the features of STS

1.6 Tutor – Marked Assignments

(i) Briefly explain the concepts of Science, Technology and Society
(ii) In a tabular form differentiate among the three concepts.

1.7 Reference

Proceedings of International Organization of Science and Technology Education
(10STE), 1989, 2000.

Proceedings of International Council of Association for Science Education
(ICASE), 1992

UNIT 2

TEACHING OF SCIENCE, TECHNOLOGY AND SOCIETY

2.0 Introduction

Science is a body of knowledge pursued by scientists. What the scientists do is referred to as the process. Knowledge derived from science lead to products, which are often referred to as technology, like in manufacturing. All these take place in the society. Therefore science, technology and society are intricately linked.

2.1 Objectives

When you finish this unit, you will be able to:

- Define science, Technology and society
- Differentiate among the nature of science of, nature of technology, and nature of society.

2.2 Why STS?

Many students study science in individual compartments like Physics, Chemistry and Biology, but they do not know their relevance in the community and to their individual lives. STS cover every aspect of the pure sciences.

Activity 2.1

(1)Identify chemistry, Biology, Physics in a simple process like Photosynthesis.
(2)Trace energy flow to its source in a typical meal.
(3)What is the danger of having too many automobiles in a crowded city?

When you finished writing your exams in Physics, Chemistry and Biology you thought that was all there is to those subjects. Those subjects are part of your life. An automobile is a product of Science, what you call technology. We use cars and in the community (Society). It took a lot of Physics

knowledge, Chemistry knowledge to manufacture a car. The smoke from a car constitutes health hazard.

The chemist will tell you how carbon monoxide is hazardous to your health. STS is a form of integrating knowledge from the various sciences. STS takes you into consideration because you live in the society.

2.2. Nature of STS

2.3.1 Nature of Science

Science is believed to be a systematic study of nature. Those who study science are called scientist. What is peculiar about scientist is that:

(1)They do not accept any information as fact until they gather evidences and other scientist came up with this same finding, in this scientists are said to be skeptical (Skepticism).
(2)They like to look into everything asking why and how questions (curiosity).
(3)They work and keep on working at whatever they suspect will give then a clue to what they are looking for (Perseverance/Persistence).
(4)They take things step by step and they aim at accuracy (Systematism). It is very easy for them to discover things and even the unexpected because of this alertness.
(5)They do not like to work in isolation, even if they do they show each other what they have found (Cooperation).
(6)Scientists are objective, open-minded, honest, restrained, willing to change opinion, they are critical minded, etc.

Because of these (the above attributes) of Scientists, science is said to be dynamic, constantly moving, the knowledge changes. What you know yesterday and today may not be an acceptable fact tomorrow because a theory may have to change when new observations are made. Science is therefore tentative.

2.3.2 Nature of Technology

Technology is the product of science. Technologists are scientists. Have you seen a technologist who is not a scientist? Because of this connection, technology can be said to dynamic and tentative. Do you agree with this statement? It is true, that is why we have technological advancement. Think of how much changes have taken place around you.

Activity 2.2

List changes you consider technological that have taken place since you left Primary School. (You may choose a particular example e.g. agriculture, Medicine, Transport, even your home).

2.3.3 Nature of Society

The Sociologist will tell you that their main job is to study society. The society is made up of community of people. Among these people are scientists and technologists. What proceeds from the work of the scientists and technologists are used up by the society. When for instance a plane is developed by the scientist and technologist, the recipients (users) are the people in the society. Society itself is not stagnant. Society is dynamic. Look back to your village that you were growing up. It is possible that you have electricity now, pipe borne water, road that connects your village to their own etc. There are more plans to turn your village to a much better place than what you currently have. It is like science and technology-dynamic and tentative.

Activity 2.3
Discuss the effects of Science and Technology on Society.

2.4 Conclusion

Scientists and technologists abode in a community (society) they see the need of the society. As one grows, the other grows. If one is stunted the other will be stunted. Any factor that affects the society has effect on the scientist and the technologist who are also part of the society.

2.5 Summary

In this unit you have learnt that within any society, there are scientists and technologist. Anything that affects one affects the other. Science is dynamic and tentative so also is technology and society.

2.6 Tutor–Marked Assignments

1. Discuss how the nature of Technology affects the nature of Society.
2. Describe the quality of a good Scientist

2.7 References

Proceedings of International Organization of Science and Technology Education (IOSTE) 1989, 2000.
Proceedings of International Council of Association for Science Education

(ICASE), 1992.

UNIT 3

A JUSTIFICATION FOR THE INTEGRATION OF STS IN THE PRE-COLLEGE SCIENCE CLASSROOM

3.0 Introduction

This Unit is designed in such a way that the reading material helps you to get a grasp of the current thinking of practitioners on the subject. The objectives listed under cover the Unit only. The reading material is set to develop your reading skills and as well test your level of assimilation. So carefully go through it.

3.1 Objectives

By the end of this unit, you will be able to:

- Explain the four goals that science and technology education should address.
- List the attributes of a scientifically literate person.
- Discuss the rationale for integrating science, technology and mathematics in the precollege classroom.

Activity 3.1

Read the article with the following questions as guide:

1. Who is the author of the article?
2. What is the main issue presented by the article?
3. How has the issue been viewed before this time?
4. What is the author saying is the contemporary view of the article?
5. What is the author's main contribution to the issue being discussed?
6. List major differences before and now with respect to trends in science education?
7. What are your own interpretations of what he/she is saying?
8. What are your own reservations?
9. Hazard a guess as to what you think of where we are going with respect to this concept.

Note

After going through it, attempt to answer the questions raised in the objectives for the unit. If you cannot do so effectively the first time, go through the article again until you are able to do so comfortably.

A Justification for the Integration of STS in the Pre-college Science Classroom.

Herbert K. Brunkhorst
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A major challenge facing science educators today, especially pre-college science teachers, is what has been referred to as the "essential tension between science education for personal development and science education for professional initiation" (Layton, 1982). Science education for professional initiation is the prevalent view in the United States today. Many curriculum decisions center on arguments about the balance of exposure to the various disciplines of science. These arguments assume that there is a quantity of exposure to science. Information that is important for all individuals who aspire to a high school diploma, Unfortunately such an emphasis is only appropriate for about 1.5% of high school graduates who go on to obtains bachelor degrees in science or engineering. It follows that the other 98.5% of students have not served well. Such a view of science limits its value and importance as part of the schooling for all. It contributes to the creation of erroneous view of the meaning, processes and values of science. Several recent nation science foundation status studies (Helgeson, 1977;weiss, 1978; Stake and Easley, 1978) and follow-up studies Harms and Vager, 1981) have identified the major problem in science education to be its value in preparing persons for further study in science. The national science for all students Board commission of the national science foundation has included science for all students as one of its basic needs (1983a). However, some people have noted that the "need" of science for all students is superseded by the "need" to produce more and better scientists and engineers.

The current "crisis in science education" in the United States has brought about a renewed interest in science education. This renewed interest has caused many state legislatures to demand more rigors and increase science requirements. Though some of this attention is overdue; the result is forcing more non-college bound students into academic subjects less valuable. These

students could benefit more from a practical curriculum emphasizing the technology and societal implications of science. Lest we forget that we live in a predominantly scientific and technological world made up of predominantly nonscientific people, such a practical program could also benefit the college bound student.

Project synthesis represented a major research effort funded by the National Science Foundation to develop criteria for excellence in science education. These criteria were used to determine discrepancies between the actual state conditions revealed by the NSF status and other assessment efforts conducted during the late 1970s. One of the more creative aspects of project synthesis was the formulation of four justifications for school science. These four clusters were identified by a national panel of experts as the proposal was drafted and served as one of the primary organisers for the research effort. The four goals clusters include:

Personal needs. Science education should prepare individuals to utilize science for improving their own lives and for coping with an increasingly technological world.

Societal issues. Science education should produce informed citizens prepared to deal responsibly with science related societal issues.

Career Education/Awareness: Science education should give all students an awareness of the nature and scope of a wide variety of science and technology related careers open to students of varying aptitudes and interests.

Academic preparation: Science education should allow students who are likely to pursue science academically as well as professionally to acquire the academic knowledge appropriate for their needs. A review of the actual condition revealed that most teachers and most existing programs included objectives only in the area of academic preparation. In fact the researchers involved in the project synthesis study reported academic preparation goals in evidence 98% of the time in science classrooms. Currently most of the K 12 science curriculum in the United States does not concern itself with materials or strategies to affect the daily lives of students to any great degree. The content is not organized around nor does it even consider basic problems related to the interactions of science, technology and society.

Miller and his colleagues at the University of Northern Illinois (Miller, 1980; Voelker, 1982), have conducted extended research studies in the area of science “attentiveness”. Science attentives are defined as persons who exhibit interest in one area (in this case science/technology), demonstrate basic

knowledge, and can (on their own) pursue such interests and deepen their knowledge. When the three criteria were used for both science and technology, 90% of all high school graduates failed. The 10% who were attentive to science, achieved these conditions in ways and means unrelated to school science. These studies suggested that parents, and other nonschool experiences; i.e. travel, television, and out-of- school activities were more important in producing attentives than did school science.

Another area which has recently provided justification of a new rationale for school science comes from the field of cognitive science. Klofer summarized work focusing on the implications for classroom practice (Klopfer, 1984). Generally the findings indicate that much of the science learned in school has no real meaning for large numbers of students. Even college science majors have misconceptions of basic science. The research indicates that students learn primarily from experience and that the misconceptions they hold come from their real world experience. When this world view is in conflict with the science or textbooks or the classroom, the students either reject the school science thereby doing poorly, or they play the school game and do rather well. In any event, the students still retain their experiences based explanations.

Why the increased emphasis on science, technology and society at a time when the political and business leader in the United states are recommending a return to the days of rigorous fact oriented science course reminiscent of the post- Sputnik era?. The reasons can be found in the growing feeling that science and technology have become so pervasive in our society that virtually all citizens must become scientifically and technology literate. The interactions of science, technology and society have generated a nearly paradox. Even though the issues have their origin in scientific knowledge and technological achievements, the issues created by these advances in science and technology can only be resolved by moral judgment and political choice. Such a situation mandates an informed citizenry and suggests a pedagogical shift for the pre-college science teachers.

What has been neglected in science teaching is the notion that most subject areas can be taught on three levels; i.e. facts, concepts and values. The values levels will provide the greatest relevancy to students because through values science becomes aligned with social realities. Also facts and concepts take on a new significance. Students suddenly find that they have a need to know! They find knowledge is a critical component of thinking and though large quantities of knowledge do not guarantee effective thinking, lack of knowledge certainly prohibits it.

The National science Teachers' Association in its position paper on science for the 80s has asserted that the goal of science education during the 1980s is to develop scientifically literate individuals who understand how science, technology and society influence one another and who are able to use this knowledge for their every day decision making. The scientifically literate person has a substantial knowledge base of facts, concepts, conceptual frameworks and process skills which enable him/her to continue to learn and think logically. This literate individual both appreciates the values of science and technology in society and understand the limitations of each (NSTA, 1982).

NSTA also has adopted a list of attribute for a scientifically literate person. The list includes:

Uses science concepts, process skills and values in making responsible every day decision;

Understanding how society influences science and technology as well as how science and technology influences society;

Understands that society controls science and technology through the allocation of resources;

Recognizes the limitations as well as the usefulness of science and technology in advancing human welfare;

Knows the major concepts, hypotheses, and theories of science and is able to use them;

Appreciates science and technology for the intellectual stimulus they provide;

Understands that generation of scientific knowledge depends upon the inquiry process and upon conceptual theories;

Distinguishes between scientific evidence and personal opinion;

Recognizes the origin of science and understands that scientific knowledge is tentative and subject to change as evidence accumulates;

Understand the applications of technology and the decision entailed in the use of technology;

Has sufficient knowledge and experience to appreciate the worthiness of research and technology development;

Has a richer and more exciting view of the world as the result of science education; and

Knows reliable sources of scientific and technological information and uses these sources in the process of decision making

Unfortunately, there is no evidences from any of the national science Foundation status to show that any existing science course contribute positively to the development of persons with such traits.

A model for school science programs which might contribute positively to the development of attributes describing a scientifically literate person was adopted unanimously by the expert curriculum task force assembled by the National Science Board Commission (NSF, 1983b). The NSB Task force identified a science technology society focus as a central theme and recommended the following structure for school science:

K - grade 6. An integrated, hands on approach is needed to focus on the relationships between humans and the total environment. Problem solving must be emphasized, including the acquisition and analysis of data.

Grades 7 & 8 There should be two primary emphases:

(1) on human science, including human biology and personal health; and
(2) on development of quantitative skills in science. Computer based experiences should be used appropriately to assist in developing quantitative skills that will be needed for more complex. Applied problem solving in grades 9 - 10 skill in quantitative analysis of data, application of probability, and estimating skills are examples.

Grades 9 & 10 A two year sequence, required for all students to address science, technology and scientific reasoning, applied to real world problems. It should integrate knowledge and methods from physics, biology, earth science, and chemical, as well as applied mathematics. The rationale for this sequence is that students need to have certain developmental tasks required in this course. It is a much higher level course than is generally recognized as “general science” for non science students.

Grades 11 & 12 One one two B semester course in physics, biology, chemistry, and earth science should be available for students who wish to go on to further academic study in science related course and should not replicate college level course. They build on and assume as prerequisites the skills and knowledge in the various science disciplines that students acquire in the science, technology, society course in grades 9 & 10. A third S/T/S course should be available (and required) for the non collage students.

The connecting links, the rationale, and objectives of this model program coincide exactly with the goal clusters mentioned in Project Synthesis.

Emphasizing a science, technology and society approach in the precollege science curriculum demonstrates to students how social and political climates often determine what scientific activity is valued or ignored and what questions are chosen to be studied. Such an exposure helps students to become aware of the limitations of science while also receiving a more realistic view of the scientific enterprise. Students also gain an awareness and sensitivity to morally relevant facts arising from the interaction of science, technology and society. Exposure to ethical arguments stretches the student's perceptions and perspectives. Such dilemmas encourage the student to carefully examine his/her own values and begin to examine them from another's point of view. With an emphasis on ethical reasoning and the process of valuing, students establish a body of knowledge so that opinions are not based on ignorance. They become better equipped to think and choose alternatives while gaining some appreciation how entwined facts and values can become.

Students become more tolerant. They see gaps in information, assumptions that cannot be proved or disproved, and realize that more knowledge does not always lead to greater understanding. The types of questions found in the interactions of science, technology and society often have concepts not completely understood, variables too difficult to control and data too ambiguous to interpret. Probably the greatest benefit of such frustration is that it allows rational people to disagree and respect each other's right to rationally come up with different conclusions. With a greater emphasis on critical thinking, relevant independent thinking required to deal with the complex problems inherent in the interactions of science, technology and society.

3.2 Tutor-Marked Assignments

(i) Compare the justification for integration of science, technology and mathematics in the precollege classroom in U.S.A with that of Nigeria.

(ii) Discuss the attributes of a Scientifically Literate person as adopted by NSTA.

3.3 References

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UNIT 4

NIGERIAN NATIONAL DEVELOPMENT GOALS FOR STS

4.0 Introduction

To study Nigerian national Development Goals for STS, you should be able to lay your hands on some of the documents on National Development Plans and bring out the goals for STS. This unit will expose you to the first four plans. Since independence Nigeria has been involved in planning for the development of the country and its citizens. The first plan started in 1962 to 1968, the second from 1970-1974. Third from 1975- 1980 and fourth from 1981-1985. All these plans were initiated by the National Economic Council.

4.1 Objectives

By the end of this unit, you will be able to:

- Evaluate the goals of STS in Nigeria over time.
- Criticise the goals of STS in each of the plans.
- Access the extent of implementation of these plans.

4.2 First Plan which lasted from 1962 – 1968

The Objectives of the First Development plan was to achieve and maintain the highest possible rate of increase in the standard of living and the creation of the necessary condition to this end. This included public support and awareness of both the potentials that exist and the sacrifices that will be required.

The designers of the plan made conscious effort to set and quantify the national objectives as well as ensure a common national planning framework. They aimed at a target saving of about fifteen percent of the Gross Domestic Product (GDP) by 1985, which was an annual investment of 15% of the GDP during the period. The highest priorities were accorded to agriculture, industry and the training of high and intermediate manpower.

The first year of the plan was essentially a period of preparation: detailed costing designing and planning of projects and similar preparatory work. Agriculture still occupied a dominant position in the economy accounting for about 65% of the GDP. The fastest growing sector of the economy was mining.

Projects successfully completed were:

The oil refinery, Nigerian Security Printing and minting company, Paper mill, Sugar mill, The Niger dam, The Niger Bridge, Some Trunk roads, Port Extension, The First National Development plan was to judge to be successful. In the field of Insurance the plan established the Nigerian Insurance Company, Various Chambers of Commerce, the Lagos Stock Exchange and the Nigerian Institute of Management.

Activity 4:1

What is National Development Plan?

4.3 Second Plan

The second National Development which lasted from 1970 to 1974 was the first in the series of plans and programmes of action to help achieve the agreed national objectives and priorities. The five principal national objectives were to establish Nigeria family as:

a united, strong and self reliant nation
a great and dynamic economy
a just and egalitarian society
a land of bright and full of opportunities for all the citizens and
a free and democratic society.

The background issues in the country and the character of the civil war had demonstrated the necessity that Nigerian must remain a united nation. The defense and security of the state was geared to the objectives of national unity and the evolution of a well integrated national community.

The pursuit of a strong and united nation as a fundamental social aim prevented the exploitation of any ethnic group, class and similar sentiments. Nigeria cannot be truly strong and united without a prosperous economic base. Therefore, it pursued relentlessly the task of development to make the economy strong, dynamic and responsive to the challenge of world competition.

The country was fortunate to have resource potential, so it directed its energy towards the achievement of the most rapid rate of economic development feasible as a means of raising the quality of life of the people. Emphasis was placed on growth as a precondition for a meaningful distribution of the fruit.

A just and egalitarian society put a premium on reducing inequalities in inter-personal incomes and promoting balanced development among the various communities so the ultimate goal of economic development was the welfare of the individual. He should be able to have equal access to all facilities and the opportunities which could help him realize his potential and develop to full personality.

It was the primary objective of this policy to promote and maintain at all times the unity and interdependence of the national economy. There was also the harmonization and effective co-ordination of all the policy measures by all decision makers for consistency, clarity and workability. The volume of resources which can be raised by a community is a function of what the proceeds are used for as well as how they are used, so the goal was on how the country, can raise funds. The plan also dealt with honest and dedicated leadership which could go very far in stimulating a greater sense of sacrifice in a community and thereby sustain a successful self-reliant economy. Government also regulated the use of major national resources like land, mineral resources for the benefit of the community at large as well as control the essential and growth sensitive sectors of the country in the field of commerce, industry, fuel and energy, construction, transport, finance and education. An important element of social justice for nation was a worthy objective of balanced development as between different Geographical areas of the country. The objective was to move rapidly to the achievement of a minimum economic and social standard for every part of the country.

Full employment of resources, especially of the labour force was a necessary policy objective for an economy dedicated to rapid growth and social harmony. Government created on a continuing basis the appropriate social-economic environment for maximum utilization of productive factors.

Development Priorities.

The highest orders of national priorities were accorded to agriculture, industry, transportation and manpower development. Government allocated a great part of the resources to these sectors of the economy

in order to generate the necessary impetus for growth. In the second order of priority rating were social services and utilities such as electricity, communication and water supplies. Except for Defence and security which were in a class by themselves, the order service was in the third order of priority. The national scale of priorities was duly adjusted at the state level to accommodate differences in the stages of development and in the varying ecological and social conditions. Thus manpower development in one part of the country entailed the rapid extension of primary schools, while in another, it meant concentration on technical and secondary education and yet in another it meant rationalization of University education. Objective here was to upgrade the level of available manpower for full employment. These were the priorities of the National Development Plan:

The reconstruction of facilities which have been damaged by the act of war.

The rehabilitation and resettlement of persons displaced by war

The rehabilitation and resettlement of demobilized Armed Forces Personnel.

The establishment of an efficient administrative service in the new state

The correction of defective existing public policies in the area of economic development.

The achievement of a rate of growth per capita out put sufficiently high to bring about a doubling of real income per head before 1985.

The deliberate creation of opportunities for gainful occupation.

The production of high-level and intermediate level manpower

The progressive improvement of knowledge about the economy's resource development.

The promotion of balanced development between one part of the country and another especially between urban and rural.

The rapid improvement in the level and quality of social services provided for the welfare of the people. On the field of education the goal was the restoration of facilities and services damaged or disrupted by the civil war. Another was the development and expansion of education at all levels in order to achieve higher enrolment ratios as well as improve quality at these levels while at the same time, reducing the educational gap in the country. The Objectives were:

Formulation of measures to restore and reactivate educational facilities and services disrupted by the war.
Continued expansion and development of primary education
Development and expansion of secondary education.
Continued development and expansion of technical education.
Expansion of teacher's training programme.
Development of Universities.
Financial assistance to students.
Further development and expansion of Adult Education Support for research programme in the field of education.

Activity 4: 2
How is the National Development Plan related to National Goals?

4.4 Third Plan

In the third National Development Plan of 1975 1980 the specific short term objectives aimed at facilitating the ultimate realization were as follows:
Increase in per Capita income
More even distribution of income
Reduction in the level of employment
Increase in the supply of high level manpower.
Diversification of the economy
Balanced development
Indigenisation of economic activity.

The primary goal was to achieve a rapid increase in the standard of living of the average Nigerian. It was the plans objective to raise the GDP of Nigerians by 90% Per annum in real terms. An important objective was to spread the benefits of economic development so that the average Nigerian would experience a marked improvement in his standard of living. A major effort was made to ensure that the problem of unemployment was brought under control.

The third plan included programmes and projects aimed at ensuring an adequate supply of all categories of manpower required for sustained economic growth. Adequate provision was made for training in all sectors of the economy. The industrial sector of the economy was diversified through the implementation of a wide range of building materials, agro-allied, petrochemical and other industrial projects. The plan was structured to generate growth simultaneously

in all geographical areas of the country. The plan also checked Rural Urban migration by promoting the development of the rural areas.

Nigerians were encouraged to participate in domestic trade, industry and other economic activities by the Nigerian Enterprises Promotion Decree of 1972. While foreign enterprises continued, the policy was directed at ensuring that Nigerians entrepreneurship was present and dominant in all sectors of the economy. Priorities were also given to projects that directly benefit the rural population. Due to the importance given to the oil sector government revenue increased. This gave rise to more foreign exchange for the country.

With respect to income distribution, the plan adopted that the public sector subsidized facilities for the poorer sections of the populations. These include electrification, water supply, health services, housing. As a necessary step towards the longer term objectives of ensuring that all Nigerians have equal opportunities to participate fully in the national development, the universal free primary education was introduced during the plan.

Some employment oriented projects were articulated and included in the plan. The bulk of the plan was made up of construction projects of one type or another which absorbed a large number of labour during implementation. The plan gave special attention to vocational training of various types so as to ensure that new entrants into the market have skills.

Large programme of expansion of secondary, technical and university education were included, aimed at overcoming the shortage of high level manpower. Training provisions were made in all sectors.

Activity 4:3

What are the priorities of the third plan?

4.5 Fourth Plan

The fourth National Development plan 1981-1985 marked the beginning of the third decade of Nigeria's existence as an independent nation. The overriding goal in this plan was to bring about of an improvement in the living condition of the people. The main goals were as follows:

Increase in the real income of the average citizen.

More distribution of income among individual and socio-economic

groups
Reduction in the level of Unemployment and Under-employment
Increase in the supply of skilled manpower
Balanced development
Increased participation by citizens in the ownership and management of productive enterprises.

Greater self-reliance
Development of technology
Increased productivity

The promotion of a new national orientation conductive to greater discipline, better attitude to work and cleaner environment.

Agricultural production and processing was given the highest priority. A rapid growth in agricultural production was indeed an essential component of the strategy of self-reliance which was a major objective of the plan. The next priority was education and manpower development. It was well known that shortage of skilled manpower constituted the most serious bottleneck to the capacity of the economy to absorb the increasing volume of investment made possible by the oil revenues.

The next goal was the strengthening of the economic infrastructures particularly power, water supply and telecommunications. The expansion of these facilities was accompanied by increased emphasis on maintenance. In land transportation emphasis was on the railways. They planned to construct new standard gauge line during this period. The development of water transportation received increased attention. In the road sub-sector there was proper maintenance and development of secondary and tertiary roads.

Housing and health was given the next priority. Manufacturing received more emphasis and the Government pursued the implementation of the major industrial projects such as steel and petrochemicals. It also encouraged the private sector to invest more in manufacturing through appropriate incentives. Because of the presence of crude oil as the main source of government revenue. The basic strategy was that of using the money to ensure an all-round expansion in the productive capacity of the economy.

The use of domestic resources, both human and material in the planning and execution of projects were encouraged. The growth of

indigenous contracting capacity was also encouraged with respect to civil engineering construction.

In the area of infrastructure the plan emphasized on consolidation and maintenance of existing facilities so as to prevent the gain of the previous plan being lost through rapid deterioration.

Adequate attention was also given to the training of skilled manpower required to undertake the necessary maintenance. Efforts were also made to diversify the economy away from the overdependence on oil. Plans were made to look into the export potentials of existing industries such as textile, tyres, coal, pulp and paper. The traditional export crops like cocoa, groundnut, palm-produce, rubber etc. were actively exploited.

In the field of Education the goals were based on the broad objectives and policies of the national policy on Education. The policy recommended the re-organization of the primary school curriculum in line with the objective of a broad based education. The proposed curriculum made adequate provision for agriculture, home economic and health education.

Secondary School was divided into two phases, (1) junior secondary (ii) senior secondary. The new system shifted emphasis toward pre-vocational and vocational training. In technical education more technical colleges and vocational training schools were built, for the training of craftsmen, artisans and technicians. It also planned to provide one technical college and one polytechnic in each state.

Emphasis was also placed on the expansion of the number of qualified teachers. In the field of higher Education emphasis was on developing post-graduate facilities and new universities to be built with emphasis on technological disciplines. In the field of Adult and Non-formal Education more facilities were provided for improving In-service courses for teachers to prepare them for adult education.

In special education more educational institution for handicapped children were provided and efforts were made to train more teachers. The educational services were to bring quality to education by establishment of relevant curricula, providing locally produced textbook and producing school science apparatus locally.

Activity 4:4

List the sectors in their order of priority as reflected in the fourth plan:

4.6 Conclusion

From the various development goals in Nigeria since independence you will notice the overriding aim has been to bring about an improvement in the living condition of our people and all the major objectives are woven around this goal. The changes you have noticed and have taken place from one plan period to another have been largely the result of experience gained in the implementation of successive plans.

4.7 Summary

Among the things you have learned in this unit are: objectives of the First to Fourth National Development Plan in Nigeria and programmes of action of the Federal Government. The priorities of the Federal Government for the periods which the National Development Plans covered.

4.8 Tutor-Marked Assignments

- describe the major programmes of events in each of the National Development Plan
- briefly access the extent of implementation of the fourth National Development Plan.

4.9 References:

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Second National Development Plan 1970-1974, Federal Ministry of Economic Development and Reconstruction, Lagos.

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UNIT 5

CHANGING SCIENCE EDUCATION: STS IN THE CLASSROOM

5.0 Introduction

This section is addressed to the teachers who want to bring about change to STS in their school or classroom. The move from teaching 'valid' science, of the type which lives in a world of its own on the text-book page, to teaching STS, where the science is relevant to the student and includes technological response to individual needs and cultural values, is a big step. Somewhere along the line there has to be a teacher who has seen the world of science and learning through new eyes.

5.1 Objectives

By the end of this unit, you will be able to:

- Identify the new approaches to teaching science.
- Discuss some vital issues central to the teaching and learning of STS.
- Contribute to the diverse opinion teachers hold about the teaching and learning of STS.

Activity 5:1

Read the article with the following questions as guide:

1. Who is the author of the article?
2. What is the main issue presented by the article?
3. How has the issue been viewed before this time?
4. What is the author saying is the contemporary view of the article?
5. What is the author's main contribution to the issue being discussed?
6. List major differences before and now with respect to trends in science education?
7. What are your own interpretations of what he/she is saying?
8. What are your own reservations?

9. Provide a guess as to what you think of where we are going with respect to this concept.

After going through it, attempt to answer the questions raised in the objectives for the unit. If you cannot do so effectively the first time, go through the article again until you are able to do so comfortably.

Changing Science Education: STS in the Classroom
Professional Action

It is the teacher with a new idea about what science education should be about who makes the real difference to how children learn science. One reason for this is that the decision to change is not brought about only by a taste for something new, but also by an active dissatisfaction with the present teaching and learning situation.

Choosing whether or not to teach STS might appear to be either a matter of curriculum choice, or of teaching strategy. In reality the choice is more profound than either. It concerns teachers' basic professional intentions and attitudes. The decision may also bring to the surface, and challenge, some well-established attitudes towards science itself which teachers may have picked up during their own school or college education. As young science students did they think of 'the scientific method' as the hallmark of truth? Was it just for trained scientists? In STS the domain of science and technology is the domain of all human society, not just of a few enthusiasts.

Freedom of teacher choice has always had its opponents. It is only a school science department that has discussed and decided upon its aims and intentions which is able to explain to parents and others the how and the why of the particular course of science which they would like to teach.

Teaching Strategies

Some suggestions for teaching methods are suggested by consideration of the educational themes for STS, which are: responsibility and concern for outcomes, environmental threats to the quality of life, economic and industrial aspects of technology, the fallible nature of scientific theories, the multicultural dimensions of science and technology, and opinions on politically controversial issues.

It is beyond the scope of this essay to discuss all possible teaching methods. Indeed this is a subject on which experienced teachers would largely be able to make their own informed judgments.

Talking about Experiments

The usual good classroom practice includes interesting practical work to be done in small groups who discuss their plans for doing the experiment and their interpretation of the results (see part 3). This makes a suitable start for the second theme, so long as the follow-up emphasises the imaginative 'modelling' which generates the theory/explanation. This needs to be consistently taught.

Using Television

Both the last two themes will profit from the use of television excerpts in the classroom before the relevant science is taught. The scene needs to be set outside the classroom. For consideration of science and technology in other cultures some cross-disciplinary work with the geography department within the school has often proved successful.

Group Discussions

If the issue is contentious, as in the last case, most teachers will want to encourage the students to think out their own views. Sometimes this is done after the relevant science has been taught, sometimes, it leads the curricular work to emphasise its importance and provide more incentive to learn. In either case it has implications for a new kind of classroom strategy.

There has been a fairly long tradition of classroom 'discussion' of controversial issues in the humanities and in social studies, where it may be used as an occasion for teaching the skills of debate or oracy. This had two dimensions. First it was considered to be important for students to be able to express themselves, and secondly to be able to marshal evidence in an even-handed way. Making personal value positions explicit was not part of this program, as it must be for serious STS work.

The promotion of more genuine discussion did not become an issue until the 1960s. This was designed to go beyond the closed agenda of weighing up the evidence from both sides of the case and coming to

the supposedly 'logical' conclusion. For the first it was accepted that value judgments were not only acceptable but might even transcend the paper data. It followed from this that the resulting decision making was itself a fallible process: there would be no 'right answer'. The objectives were to let the students work out their own positions.

That posed another problem what was the teacher's role during the discussion? She or he could no longer direct the discussion towards some 'uniquely correct' result, and it began to seem very important that the teachers did not try to intrude their own values. In such personal matters there should be absolutely no indoctrination. Out of this debate was born the notion of the 'neutral chairman'. The teachers could certainly run these new types of discussion, but they should take care to give no inkling of where their own opinions lay. This proved very difficult. In STS, or any other course devoted to the notion of encouraging concerned citizenship, it was particularly hard and, in some sense, quite self-defeating. If the implicit message was that adults should become involved in civic issues then it was surely odd to find that the very teacher who had transmitted the message was pretending not to abide by it.

Being a 'balanced chair person' or a 'devil's advocate' was not much better. There are certainly some occasions when either one or the other has its merits. Teachers who tried to introduce appropriate strategies for discussion learnt the hard way that large class groups were not able to 'discuss' in any meaningful way, and that small friendship groups of students felt more free to talk about social issues without the direct participation of the teacher. This meant that the students had to arrange, lead, and report on their discussions for themselves. Each group thus became a symbol of free speech within a democratic society, listening to each other and reporting any agreements reached. It was an important landmark for the classroom, and for STS.

DARTs and role-play

Special teaching activities may be needed whenever the students are being asked to extract information from some 'text' (this applies to posters, videos and cartoons as well as the more normal written passage). No experienced teacher needs to be told that students do not just sit quietly reading and absorbing information. Probably the best way to proceed is to provide an activity which makes them search the text in some interesting way. These sort of activities are sometimes

called DARTs Directed Activities Related to Text (Davies & Greene 1984). They include making posters, writing newspaper headlines (very useful for local STS issues), sequencing cards (for historical work), and carrying out role-play (where social responsibility is being emphasised).

It may be worth pointing out that the students need to be protected from any simple form of copying. 'Write in your words' from a written text is no more interesting than 'draw a comic strip' from an information source which is already visual, such as a cartoon video.

Successful role-play requires information briefs for the preparation stage, but not completes scripts. Acting to prepared scripts allows for none of the personal empathic reaction that is the main purpose of role-play for STS. It may be valuable to let a small group of students (two or three) discuss the character brief together, with some questions which will help them get into role. ('Jabs for James Phipps' in exploring the Nature of Science (Solomon 1991) give an example of this method).

The words 'role-play' and 'simulation' have been used interchangeably in a lot of writing about classroom strategies, but they are not the same. The purpose of mechanisms of management, planning and decision making will be understood. It is especially useful for learning about

Industrial Decision Making and Public Inquiries.

In role-play, on the other hand, students take on parts and act them out in order to hand, students take on parts and act them out in order to feel their way into the likely reactions of the characters, as they perceive them. Although 13 year olds are unlikely to make a convincing job of acting out the part of a company director, they are much more able to throw themselves into the role of a child living near some environmental hazard. In role-play the students' power to bring characters to life extends their sympathy and sense of responsibility.

Industrial Simulation

There are quite a few of these on the market, but they need to be chosen carefully. The 'agenda for controversy is already written into the materials in most cases. That does not mean that the resources are

without use, for their purpose is probably to show students something of the complexity of industrial and economic decision making. This is not a world which our school students have already entered, nor, by the nature of industrial management, is it likely that many ever will. However, it is important, at least for our older students, that they get an opportunity to hear about it so that they do not always cast industry into the villain's role in pollution and other issues

Teaching simulation requires familiarity with the process. It is almost impossible to carry out an industrial simulation without the help of an industrial sponsor. This is clearly a strategy, which requires careful organisation. Those who fear that this may lead to a one-side presentation might reflect that the opposing interest (probably an environment group) have a case which is less in need of simulation to make its managerial structure comprehensible. Obviously it is essential to ensure that all sides of any controversial issue are given 'equal time'. Controversy between different groups in society is treated by different methods from industrial awareness because its objectives are basically different, even if their content does overlap.

Philosophies of STS

Different teachers will be bound to approach the teaching of STS in slightly different ways. Enough has been written in this essay to show that STS does have a number of deep themes in its approach. Some teachers have summed up all of these, to their own satisfaction, in the simple phrase 'Science is about people'. In every one of the themes in STS this can be illustrated. However, it is probably a mistake to allow such a short slogan to be one' only guide.

At the other extreme are those teachers who confine STS to the 'extras' category. First learn the science, they say, then add on the social dimensions. This approach is almost always doomed to failure because such attitudes are immediately recognised by the students, who then pick up the same dismissive attitude. However, a teacher who is new to STS may well want to begin in a small way, using one piece of resource material, and then pause before starting another. Most who have begun in this way have grown more enthusiastic.

This essay began with some examples from the history of science in society because STS is about the nature of science itself. It describes how society fashions its science and its technology. That alone would constitute an incontrovertible reason for teaching science in the STS way. It is simply more correct in its description of science and technology. But it is also true that the 'people-aspect' of science and technology which STS teaching stresses is both popular with students and valuable in terms of their general education. Finally it is the content of STS courses, the important issues and the concerns these raise, which commend it for all our future citizens.

Activity 5.2

- Which approach (or approaches) in STS education do you feel most comfortable with? Why?
- What is your rationale for advocating a particular approach to STS education? (Remember to take into account your local school and community context).

5.2 Tutor-Marked Assignments

a. Write a concise abstract for the article.

b. Reflect on your educational practice. In what way are you dissatisfied with the present teaching/learning situation?

c. Identify and describe which of the teaching methods you will recommend for teaching of science at primary and secondary levels of education.

UNIT 6

INTERACTION OF SCIENCE, TECHNOLOGY AND SOCIETY (60)

6.0 Introduction

In developed nations, the benefits of science and technology in solving practical problems have become so necessary that they have made science, technology and society an interrelated discipline. STS is introduced into the curriculum as a single subject that caters for four areas of knowledge: the cultural and human context, solution of practical problems (at times problems created by S&T), scientific knowledge and science for personal development (because science is seen as part of our every day life).

6.1 Objectives

By the end of this unit, you will be able to:

- Relate science, technology and society.
- Discuss how concepts can be taught in an STS pattern.

Activity 6:1

Read the article with the following questions as guide:

1. Who is the author of the article?
2. What is the main issue presented by the article?
3. How has the issue been viewed before this time?
4. What is the author saying is the contemporary view of the article?
5. What is the author's main contribution to the issue being discussed?
6. List major differences before and now with respect to trends in science education?
7. What are your own interpretations of what he/she is saying?
8. What are your own reservations?
9. Provide a guess as to what you think of where we are going with respect to this concept.

After going through it, attempt to answer the questions raised in the objectives for the unit. If you cannot do so effectively the first time, go through the article again until you are able to do so comfortably.

Linking Science, Technology and Society

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Australia

In recent years the interrelationship of science, technology and society (STS) has become a key component of science curricula. As an example, the science guideline in Victoria, Australia of the Ministry of Education (1987) states the following goal:

> "Scientific knowledge, the solution of practical problems, the cultural and human contexts of science and opportunities for personal developments are four aspects of science. They should be given similar emphasis at all levels of school and should be integrated in their presentation".

Similar quotes can be found in many other curriculum statements in a range of countries. Frequently the addition of STS components is taken to mean that following the study of some set of key concepts some everyday examples are reviewed. The injection of STS components into a science programme can occur in several ways including the use of a discussion of a new piece of technology to start a unit. An examination of the technological uses of some aspects of science at the conclusion of the unit and a concurrent study of STS and science aspects throughout the unit. Frequently STS components are poorly linked with their supporting science concepts and as a consequence students are less likely to interrelate the two sets of concepts and/or use the ideas to solve problems in two settings.

In a recent senior examination, physical science students were asked to describe the steps a factory engineer could take to reduce power loss in a given system. The system comprised water driven alternator, several kilometres of power lines, a transformer and low voltage cables leading to the factory. Students had completed the theory relating to transformers and the advantages of high voltage transmission. They had also studied the power grids of the local

electrical authority as an example use of the "science". Many of the answers suggested that links were not made between theory and technology and that most of the students could not transfer their knowledge to the new situation. Example of some of the answers included:

- Power loss would be minimised if the alternator was removed from the system.

- Power loss is equal to V_2/R so in order to reduce power loss, voltage should be kept at a minimum. But in order to keep power at a constant rate the current should be maximised, i.e. P=VI if V is a minimum then I should be at a maximum. Transmission voltage should be low but because the power loss is also = I^2R then the current cannot be too large and the resistance must be of an appropriate value in the transmission lines.

- With respect to the power lines, the best thing that the engineer could hope for would be the introduction of super conductors.

- To reduce the loss, thicker wires could be used. This allows a greater current to be placed through the wire. Less transformer stations could be placed in between to reduce the loss. Another way of avoiding loss is by insulating the wires.

Clearly educators and curriculum developers must look closely at how STS issues and concepts are taught if improvements are to be made to the students' science learning and/or their ability to translate this learning into real life situations.

This paper will describe the approach taken by Victoria College
Centre for Studies in the curriculum (VCSC) and the Southern Eastern Co-ordinated Area Programme (SECAP) in developing an STS resource kit in the area of fibre optics. The VCSC was established at the Rusden Campus of Victoria College as a result of the interest and involvement of staff in various curriculum activities including materials development. SECAP is a State Government initiative that fosters and co-ordinates co-operation between schools, higher education and local industries in the area of science, mathematics and technology education. SECAP is based in the Rusden Campus and is a joint venture between Victoria College, Monash University and
local schools and industries.

In an earlier paper (Treblico 1987) the VCSC approach to developing learning material was described. The general principles given in this paper were followed in preparing the Fibre Optics Kit, however four additional principles were seen as being important. These were:

- Linkages between concepts and examples cannot be assumed to happen and must be built into the learning activities.
- Students must interact with the curriculum materials including worksheets, videos and experiments if learning is to occur.
- Many students have difficulty in interpreting diagrams and in moving from 2D to 3D conceptualisations. Practice in this skill needs to be included if students are to make sense of available print-based resources.
- Most students need opportunities to verbalise the concepts they are learning if effective links are to be made between known concepts and new material.

Gagne (1970) proposed the need to have concepts taught via a hierarchical approach and there have been many science based research studies that have confirmed his ideas including a study by Beeson (1977) involving electrical concepts.

Piaget's theories concerning the learning of concepts and the development of reasoning skills conceive of their acquisition via a maturation process and a series of developmental stages. As students mature they move from minimal reasoning skills to an ability to learn more abstract and/or complex concepts. Subsequent research, such as that discussed by Donaldson (Donaldson 1978) has suggested that the acquisition of language skills is a key factor in student development and their ability to deal with abstract relationships. Piaget's ideas strongly support the notion that students learn more effectively when they are actively interacting with the learning materials.

Recent studies by Osborne (Osborne and Freyberg, 1985) have shown that children relate, or try to relate new concepts or ideas to their previous learning. The generative model of learning, arising out of these studies states that new ideas in short term memory are interpreted by ideas already held in long term memory.

They suggest a multi phase teaching model in which students interact with the learning materials. In these phases' students, via activities, focus on old concepts, solve problems involving new ideas and repeatedly reinforce new concepts via interaction with the learning materials. In the light of these theories and their implications for

learning concepts the following principles guided the writing of activities for the Fibre Optics Kit:

- Careful thought needs to be given to ensure that the order in which concepts are introduced follows a logical sequence so that for example reflection at a mirror surface precedes reflection/refraction at a media interface and this precedes total internal reflection which in turn precedes reflection inside a fibre.

- Students are introduced to concepts using "concrete/hands on" experiences so that experiments involving reflection/refraction in simple systems is studied before tackling the more complex reflections that take place in fibres.

- Throughout the activities students need to be given opportunities to explain concepts in their own words with explanation moving from simple to more complex situations.

- Where the Fibre Optics Kit utilises existing materials such as videos and information packages, worksheets need to be developed that use these materials in a way that requires students to process and interact with the materials.

A recent article by Lowe (1989) highlighted the role of illustrations and diagrams in text and curriculum materials. In developing print-based units for a physical science course in Western Australia he concluded that:

"Illustrations can be seen as far more than icing on the instructional cake. They can take the role of a full partner with text in the explanatory process.

In order for maximum benefit to be gained from the combination of text and illustration, careful analysis of the subject matter is necessary. From such analysis, explanatory responsibility can be partitioned most appropriately between text and illustration.

Like most text examples, illustrations are likely to be far more effective if, rather than simply being presented, they are set in a context whereby students explore the concepts and relationships they embody".

In addition to these principles and based on our experiences the VCSC believe that many students have difficulty in moving between 2D and 3D illustrations and real models. If this is true then curriculum writers cannot assume that because a clear illustration accompanies the text students will understand the material. Some illustrations may even make the acquisition of new concepts more

difficult for students. In developing the Fibre Optics materials the writers were conscious of this potential difficulty and:

- Related diagrams to reality by use of models, practical activities, videos and everyday examples.
- Gave students frequent opportunities to link models with 2D and 3D illustrations.

Kit comprises five components:

- An existing optical light kit common in Victorian Secondary Schools.
- A series of five activities designed to complement the experiments of the existing materials and extend the concepts associated with light transmission to communication via optical fibres.
- An existing set of Telecom project folders.
- A set of five worksheets designed around the project kits.
- A video relating to fibre optics and associated worksheets.

The scope and linkages between the elements of the kit are illustrated in the next page.

Science Concepts	Teaching Strategies Simple	Technology	Society
Reflections Light rays	Known Light bo experiments Completing sentences Completing diagrams	Smoke signals Semaphone Telegraph lines Telephones	Why send messages? Morse and its Implications
Reflection Refraction	Light box experiments Prediction of results Recording in sentences		Telephone lines and impact on society
Total internal Reflection	Tabular recording To Light box experiments		Transmission via Continuous lines

	Prediction of fibre reflections		Microwave. Fibre Optics Speed, Speed!
Reflection in fibres	Fibre experiments Recording results Transmitting messages	Digital encoding	The impact of fast Communication
	Unknown complex		

Finally, if STS concepts and linkages are to be formed it would seem to be logical to incorporate these ideas throughout the sequence rather than relegate them to the end as examples of uses of the 'science'. In addition most STS materials uses contentious issues such as nuclear power and IVF as a basis for linking science and society. This project chose to utilise a non-contentious issue whose underlying conceptual base was less complex than say nuclear energy. In this way social and political beliefs did not cloud the learning although the potential social effects of the introduction of the new technology were still great. Accordingly:

In writing the worksheets and activities, aspects of the new technology were progressively included in the development of the science concepts.

As indicated at the start of this paper our purpose was to describe one approach to developing STS materials. The approach was not seen to be the only, or the best way to link the science, technology and society aspects of a topic area. We do, however, believe that the approach adopted, recognises and attempts to take account of some of the difficulties encountered in science classrooms.

6.2 Conclusion

The 'reader' in this unit suggest that if the linkages between concepts and examples must be of any value, they must be built into the learning activities. Students must interact with the learning material for learning to occur.

6.3 Summary

STS has been introduced into the school curriculum in developed nations. There are suggestions on how to teach science with STS. Some of these suggestions are:

- Educator and curriculum developers must look closely at how STS issues and concepts are taught if improvements are to be made to the students' science learning and/or ability to translate this learning into real life situations.
- Students must interact with the curriculum materials including work sheets, videos and experiments if learning is to occur.
- Most students need the opportunities to verbalise the concepts they are leaning if effective links are to be made between known concepts and new materials.

6.4 Tutor-Marked Assignments

- Write a concise abstract for the article.
- Discuss the interrelatedness that exist in Science, Technology and Society.
- Describe how you will integrate the VCSC and SECAP approaches in developing STS into your teaching of science.

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UNIT 7

SCIENCE AND TECHNOLOGY EDUCATION AND THE QUALITY OF LIFE

7.0 Introduction

This unit is designed in such a way that a reading material is presented to help you grasp the current thinking of practitioners on the subject. The material is set to assist you in various ways. So, carefully go through and attend to the activity below.

7.2 Objectives

By the end of this unit, you will be able to:

- Discuss the role of science in the task of preparing citizens.
- Identify the science attitudes a teacher needs to develop, to enable him function effectively.
- Analyse the role of science and technology in our contemporary society.
- Explain ways teachers can handle extremely complex situation in dealing with learners who do not have sufficient knowledge, experience and maturity.

Activity 7.1

Read the article with the following questions as guide:

1. Who is the author of the article?
2. What is the main issue presented by the article?
3. How has the issue been viewed before this time?
4. What is the author saying is the contemporary view of the article?
5. What is the author's main contribution to the issue being discussed?
6. List major differences before and now with respect to trends in science education?
7. What are your own interpretations of what he/she is saying?
8. What are your own reservations?
9. Hazard a guess as to what you think of where we are going with respect to this concept.

After going through it, attempt to answer the questions raised in the objectives for the unit. If you cannot do so effectively the first time, go through the article again until you are able to do so comfortably.

Science and Technology Education and the Quality of Life

Myriam Krasilchik

Brazil has approximately 130 million inhabitants, but how many of them are actually responsible citizens?

An immediate answer would be: all those who vote and who comply with their civic duties. Although this criterion may be used to characterize the citizen, it covers only a few of those elements that make up a broader concept of citizenship. Being a responsible citizen also implies in knowing one's rights and obligations, in thinking for oneself, in having a critical view of the society in which one lives and, especially, the disposition to transform reality for the better. Thus, the first important decision that a citizen must make is that of resolving to exercise his citizenship.

However, besides the personal qualities, the exercise of citizenship depends also on the space that the citizen has in which to act, actually voting and participating in the decision making process of his community. In certain countries and communities, this space is already assured. In many other cases it must still be conquered by those who really wish to take advantage of their rights and who intend to bring about the changes they consider essential to strengthen the institutions and manage to build a fair and pluralist society. The community does not always have the opportunity to manifest itself, and it is possible to verify that in countries with several degrees of development and different political structures, the citizens must find forms of participation that involve popular movements, public manifestations and the formation of pressure groups to bear influence on the decisions that are made in realms outside of the reach of the majority of the population. Besides these, other spaces are also used, other forums of argumentation are law courts (legal reasoning); scientific communities (scientific reasoning); medical specialists (scientific, legal, and moral reasoning). (MANENSCHIJN, 1985).

Thus, reorganization of the society always implies in the development of a collective thinking in which the school comes to be also a forum

of reasoning about the struggles of the contradictory forces that make up the society, involving the practice of teachers and students.

Within the curriculum, science courses play an important part in the task of preparing citizens, as is indicated by the current movement which seeks to relate science and the society of which this meeting is an integral part. Many of the subjects necessary to youths find in the scientific disciplines a niche which is appropriate to their development: thinking for oneself, obeying reason instead of blindly obeying authority; being capable of analyzing the control processes that are used on the citizen; systematizing the partial, fragmented knowledge acquired in one's daily life through contact with the family, with friends, and at work, so as to understand what one is doing, why one is doing it, and how one should do it; understanding and accepting the complexity and multiculturality of the society in which one lives; understanding the different levels of decision in which one must act to solve conflicts that demand decisions which may be any one of various levels (individuals, family, community, national, or international),understanding the role of science and of the scientists within contemporary society. To achieve these aims, it is up to science teachers to develop a series of attitudes which include, among others: intellectual rationality and honesty; the capacity to analyze problems based on observation and on one's own interpretation of facts and evidence; curiosity and a desire for new knowledge; an interest in study and recognition of the limitations of one's own knowledge; recognition of the possibilities and limitations of science and of technology; the capacity and disposition to take action in the attempt to solve problems. Thus, the already overloaded science teacher has to make decisions when dealing with societal issues which include:

The issues

The science teacher must be able to bring to the surface everyday themes that are of interest to the students themes that are derived from their concrete problems and relate them to more general situations that will lead to a broad and profound analysis of dynamic and complex processes which demand knowledge in many areas.

The problem of the pollution of a river or of a certain region is intimately related to production problems in the region under consideration, and therefore, to economic problems, Discussions held in developed and underdeveloped countries as to the use of nuclear power involve aspects such

as technological progress, potential dangers, and the use of alternative sources of energy.

Issues such as population growth, the use of urban and rural space resources, the use of medicines, sanitation, agriculture, all involves decisions that depend on a sound basis of information and knowledge, as well as judgments as to their desirable or undesirable effects, which depend on the codes of values of the community and on the life quality that the community desires.

The role of science and technology in contemporary society is worthy of special attention on the part of the science teacher. Both suppositions of fearful respect which alienate a great many citizens, and the adoption of a suspicious attitude which attributes most of humanity's problems to the scientists, must be avoided.

Access to information on science as a social activity, in language which is accessible to the majority of the population, must begin in the schools which have, among other obligation, that of developing the capacity to analyze information and values transmitted by the media and which may represent interests of certain groups instead of representing the interest of the community in its broadest sense. Frequently science is used as an argument in debates on political, philosophical, and religious ideas. Many controversial themes have a scientist dimension which is invoked to justify clearly ideological position. The rights of the scientist and of the citizen when it comes to options about what sort research should be carried out, and what should be done with the results of the research, are also issues that must be faced in class.

Ethical teaching dilemmas

Teachers have to handle extremely complex situation in their dealings with students who do not yet have sufficient knowledge, experience, and maturity. An essentially ethical problem arises from this situation: how is it possible to discuss values with students without indoctrinating them? Is it possible for the teacher, whose relationship with the students is a matter of hierarchy, to remain neutral when faced with a problem which involves the adoption of an ethical and moral standard? To my way of thinking, no teacher can claim total

neutrality since his opinion is already manifest in his choice of matter to be dealt with these matters.

To quote MONOD (1974). “Values cannot possibly be derived from any sort of objective knowledge. But if you think about it a bit more, you find that, in fact, objective knowledge cannot exist, cannot begin to exist, unless there is an active choice of values to begin with."

Only by creating situation of conflict, by exposing the interest involved without using his authority to impose opinions, can the teacher help to form citizens capable of deciding for themselves what sort of actions to embark upon in their search for the general welfare and to achieve the changes they consider necessary. A crucial part of the process is the development of the capacity of argumentation involving sincerity and capability in the desire to convince and to listen to others who may have arguments that could cause us to change our minds. Although any proposition as to linear procedure may be simplistic, some steps are an integral part of the process of decision making as related to societal issues:

- One must identify moral, ethical issues, which implies, basically, in distinguishing between facts and values;
- One must develop procedures for analysing societal issues. This step involves consideration of the information that will be necessary in making a decision, and of the principles that must guide solution of the conflicts;
- One must choose one alternative from among the many that are available and it put into practice.

To educate for freedom without restricting the school to the role of forming malleable, manageable citizens is the great challenge which faces today’s science educators. And in this case, the voice of caution tells me that this challenge will be net, not by giving in to the temptation of grandiloquent slogans, but by sticking to the reality of the classroom. With all its possibilities and limitations, the transformation of which is one of our fundamental objectives.

7.2 Tutor-Marked Assignments

- Write a concise abstract for this article
- Identify and discuss some of the attitudes you will suggest for a newly employed science teacher to imbibe.

- Discuss what you consider as the role of science and technology in society

7.3 Reference

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UNIT 8

BIOTECHNOLOGY EDUCATION

8.0 Introduction

Biotechnology is a synthesis of a number of disciplines which depend on inputs from a wide range of scientific and technological fields. It is a fairly new science that has emerged out of the interaction of disciplines in the area of Biology, Chemistry, Biochemistry and engineering.

The application of Biotechnology ranges from current issues as, waste treatment and waste disposal processes, to food production and so on. These are of interest not only to professionals of science and technology but also of the society in general.

In order to promote the growing interest in Biotechnology there is the need for interaction between the educational institutions, industries and research institutions. This brings in the question of Biotechnology education that is, considering the interaction of science, technology and society and how the concept of Biotechnology can be introduced into the educational institution in Nigeria. What impact would this have on the curriculum and how would the introduction of Biotechnology education affect or aid the needed scientific and technological break-through in Nigeria. It is necessary to acknowledge at this point, that most of the ideas discussed in this paper on the adaptation of Biotechnology to education and training are based on the report of the "Working Group of the Royal society on Biotechnology and Education", London, 1984.

8.1 Objectives

At the end of this unit, you be able to:

- Define biotechnology
- Discuss the applications of biotechnology
- Mention biotechnological processes
- Define biotechnology education
- Describe the educational objectives of biotechnology

- Discuss the effect of biotechnology education on the curriculum with particular reference to Community, Secondary, Technical and University education.
- Explain the challenges and limitations of biotechnology]
- Discuss biotechnology in Nigeria

8.2 What is Biotechnology?

Johnson (1987) defined Biotechnology as the technical use of biological knowledge in production: He says it includes a number of technologies, originating from molecular Biology. In this broad definition, the process of bread-making with the use of yeast, alcohol fermentation, selection of domestic animals etc, are included.

Biotechnology according to Ozoro (1979) refers to the science whereby technical tasks are performed normally under the direction and supervision of biological scientist, contributory to biological experiments, tests and analysis and develop industrial public health, agricultural and other practical applications.

Kille (1987) expressed his own idea of Biotechnology as the application of biological organisms, systems and processes to manufacturing and service industries. He explained that, in particular, it is the expansion in the industrial use of microbial and other cells, together with the demands these new manufacturing processes will place upon close integration and understanding between biologist, chemist and engineers.

Ejike (1983:1) explained that Biotechnology is a new science that is synthetic in nature that has developed from the interaction of fundamental disciplines like genetics, biochemistry, chemical engineering, microbiology, physiology, and all aspects of process of technology. He added that Biotechnology provides a basis for the development of new industries out of the existing traditional ones.

Biotechnology according to Liberman, et al. (1986), can be defined as "the application of biological systems to technical and industrial processes". This according to them implies the integration of all biology, including molecular biology, genetics, microbiology, cell biology, biochemistry with chemical process engineering in a way that develops the full potential of each of these systems.

The above definitions of Biotechnology give interplay of Biology and technology. In other words, the technological application of biological findings in industries in order to improve the quality of life.

Liberman et al (1986) explained that academic and industrial applications of Biotechnology can be divided into two general categories: research/development and production. (This breakdown agrees with Kille (1987).

Activity 8:1
Define biotechnology

8.3 Applications of Biotechnology

A break down of the discipline shows that it derives from the activities of organism such as bacteria, fungi and yeasts. And has vast opportunities in the application in waste treatment and waste disposal processes, plant tissue culture, food production, single cell protein research, the derivation of animal feedstuffs from Lingno cellulose and fermentation technology; other applications include: technology of renewable raw materials, researches on environmental pollution, photobiological researches, short and long term effects of ionizing radiation on biological systems. Also Biotechnology approaches, find valuable application in researches in immunology and parasitology, the aging process, plant and animal pathology and pest technology. (Kille, 1987: Ejike, 1983). In his account, Kille (1987) added that biotechnology is useful in resource recovery by fermentation, the production of pharmaceuticals, the production of pharmaceuticals, biological pesticides, agrochemicals, the production of gaseous fuels, chemicals and solvents.

8.4 Some Biotechnological Processes

Detail account of the processes are not necessary for the discussion of this nature on; Biotechnology education. What is done here is just a brief mention of a couple of biotechnological processes. These include:

Production of earthworms as a potentially economical source of protein. Alcoholic fermentation of raw sweet potato by a non-conventional method using endomycopsis Fibuligera. Making of drugs For instance, the production of insulin from micro-organism by the process of biotechnology, which takes on week instead of fifteen

months as in the case of the previous methods. Invitro-fertilization (IVF). Bartels (1984), stated that a woman in this programme is induced to super ovulate by means of a fertility drug, thus producing five or six ripe eggs. These are collected in an operation called Laparoscopy. These eggs are fertilized by the husband's sperms. Increase agricultural yield. Biotechnology has led to high-yield of crops and livestock, thus helping to expand the world's supply of food. (Bartels, 1986).

Activity 8:2
List four biotechnological processes

8.5 What is Education?

The contemporary English Dictionary defines education as "the result of teaching or the training of the mind and character". The Greek idea of an educated man was one who was mentally and physically well-balanced, while to the ancient Romans, emphasis was placed on oratorical and military training. In recent times the ideas of looking at education as an end in itself has changed to that of a process of getting "initiated" or an induction in to the society. (Fafunwa, 1974).

Fafunwa, (1974:7) defined education as the aggregate of all the processes by which a child or young adult develops the abilities attitudes and other forms of behaviour which are of positive value to the society in which he lives. Education, as a discipline, is a field of knowledge dealing with how to teach effectively. Dictionary meaning).

The emphasis in education is that, the educated person should be useful to himself and the society in which he lives and not to be a misfit. Kemeny, (1959) said that "education is not to have arrived but to travel with a different view". Precisely, one would say that education is a continuous process which takes place through out life.

8.6 What is Biotechnology Education?

This brings us closer to the focus of the discussion. Biotechnology is a fairly new development in science and technology, which has such a wide range of practical daily life application. Biotechnology education would offer the generality of society, the awareness of

current developments in science and technology and even help in

training for a better and effective living in society, to improve the quality of life.

Looking at the definitions of Biotechnology and Education, it may not be out of place to say that Biotechnology Education is the training of mind and character of the applications of biological findings to technology with respect to new industrial prospects. Considering the fact that Education itself is a discipline or a "field" of knowledge dealing with how to teach effectively, addressing the issue of Biotechnology education could also imply teacher preparation for Biotechnology.

Every known formal process of education, separate a working curriculum which states the aims and objectives, content and methods, as well as evaluation of its outcomes. This paper is proposed to briefly discuss Biotechnology education at the three main levels of education that is primary, secondary and tertiary levels. However, the first question to be addressed is "why study Biotechnology Education?

Activity 8:3
How will you explain biotechnology to a Junior Secondary (JS) One student?

8:7 Why Study Biotechnology Education?

A philosophical approach to any issue would include the "what", "how", "who" and also "why of such a debate". The question, "why study Biotechnology education"? Could forward several reasons in which case, it would not be out of place to even say; that it is for the very purpose of philosophical manipulation of the issue at hand.

However, Kille (1987), gave some reasons for considering education and training for Biotechnology. These include: the fact that Biotechnology is fast becoming a vogue. The need to differentiate and identify the skills and activities of the new industries in Biotechnology, from the older, more traditional industries using biological systems such as fisheries, forestry, brewing, farming etc. And also to examine ways in which educational systems can be adapted to meet the new requirements.

Educational programmes would also increase public awareness of their potential and counter any exaggeration of their hazards.

Educational programmes provide the necessary training for those who will be involved in these new industrial developments.

Activity 8:4
Why do you need the knowledge biotechnology education?

8.8 Educational Objectives of Biotechnology

According to Kille (1987), Demain and Solomon (1986), the objectives are based on the activities associated with the new industry which they identified as research, development, production control and marketing. Kille maintained that the educational and training programmes of schools, technical colleges and universities must between them take into account these four career outlets in Biotechnology.

Research: People with post-graduate training who will provide the basic ideas, technique and materials for industrial innovation from their scientific and engineering research.

Development: People with good honours degrees or diplomas in technology who will translate new ideas into manufacturing processes and into economically viable products and services.

Production control: People with degrees or technical training who will monitor and control the manufacturing processes.

Marketing: People with a wide range of training and qualification in financial, sales and management roles in industry,
those interested in investment policy, political decision making, advertising and public relations. The aim of Biotechnology education is therefore to produce individuals required in each of these groups, who have acquired an understanding of microbiology, genetic engineering and other relevant areas of Biotechnology.

Activity 8.5
Mention the four career outlets in biotechnology

8.9 Effect of Biotechnology Education on the Curriculum

'Biotechnology as Kille' 68 explains will require a much broader understanding of biological and physical sciences, which goes beyond their purely academic interest towards their industrial application and management.

Therefore, he suggests that changes in curricula should not just
produce subject specialist but must also take into consideration the

social and industrial relevance of the training in the educational programme.

Another aspect which the curricula of educational training should take care of is the attitude among the teachers in the educational institutions, students and their parents. This is in particular reference to too much emphasis on "paper qualification".

Biotechnology will require a number of posts to be taken by professional technologists and technicians. This means that, educators in the schools and ministries of education have to pay more attention to providing **courses** that would be of real social and industrial relevance and therefore attract greater number of people other than the purely academic.

Kille (1987), expressed that such a curriculum should not be less rigorous than those used at present, especially as even the numerical demands of Biologist of the industries could well increase the rigour. His suggestion is that, the graduates of the educational institutions should have a broadly balanced background in Physical and Biological sciences, which will be applied to the professional demand of Biotechnology.

The educational demands of Biotechnology are many, but this does not necessarily call for the introduction of new subjects into the already overloaded curricula, but instead a reorganization of existing educational resources are recommended.

Activity 8.6

What does the school gain in the introduction of biotechnology to the school curriculum?

8.9.1 Adapting Biotechnology Education into the Various Educational Institutions.

The issue here is how the Biotechnological requirements could be adapted into the various educational institutions and still retain curricula suitable for other careers.

Johnsien (1987:76) says that.
The purpose of secondary school is to teach the students not how to use technology but to evaluate technology on the basis of a general

awareness of how the technology is used and how it affects society and the environment.

8.9.2 At the Junior Secondary School (J.S.S.) Level.

It is suggested that while maintaining a broad spectrum of basic science in the J.S.S. level, the following could be introduced into school courses. An awareness of some of the application of biological science in industry. Discussion of some problems facing engineers in plant using biological materials. The great importance of numeracy of biologists. Difficulties would be encountered if all of these have to be introduced into the schools. But a co-operation between the professionals and the schools would reduce this problem. The vital point is for the introduction of Biotechnology, as one aspect of Biology.

8.9.3 At the Senior Secondary School (S.S.S.) Level

At this level, the students are in their pre-university years, and quite a lot done is in assessing and preparing the students for tertiary education. Hence the inclusion of biotechnology requirement will have great effect on the existing curriculum (Kille, 1987; Johnsen, 1987). The need therefore, is for teachers to ensure that students receive a balanced view of the opportunities for employment in biological industries, and alternatives to degree courses must be made clear to them.

This calls for a selectivity to ensure that syllabuses teach both key scientific principles and generate the necessary awareness and skills for future scientists and engineers.

8.9.4 For Teacher Preparation in Secondary Schools

Considering the speed with which biotechnology is developing, relying on just the pre-service education and training of teachers will be too slow. If any reasonable impact is to be felt then, there is the need for devising other alternatives such as;
in-service programme of refresher and re-orientation courses for teachers.
The teachers in addition to lectures and practical work should have direct industrial contact, to give them an understanding of industrial and business problem.

The liaison between industry and the school should be strengthened with the help of professional bodies and industrial organizations.

8.9.5 Learning Experience and Materials

With the fast trend and development in Biotechnology education, there is the need for the revision of previous textbooks and provision of suitable reading materials in the schools. Other experiences could be provided the schools in the form of visual-aids, laboratory exercises, suitable biology materials, especially in the field of microbiology, simple genetic engineering and Biochemistry.

8.9.6 Technical Education

Biotechnology is very much dependent on technical education, which will provide a wide range of skills and abilities. There is the need for the production of more technicians and technical assistance, (that is the middle level manpower), than those with the honours degree, with who will be required for the control and monitoring of industrial biotechnological processes.

This implies that the minds of parents and students should be disabused of the mere pursuit of the "golden fleece" and turn attention to the production of middle level manpower. The government could assist by raising the status of these technicians.

To implement this, Kille (1987) suggested that a few more colleges could be created in addition to the already existing ones. They should retain flexibility and adaptability by providing courses which concentrate on a firm foundation in technique and skills of these subjects which contribute to biotechnology, and leave the specialist training to the in-service training schemes of industries.
The technical colleges could also provide sandwich, day-release or other forms of re-orientation and refresher courses for training staff.

8.9.7 The University

The Universities could serve the following functions:
Training of professional technologists with good honours degrees or equivalent.

- Provide new ideas for the use of biological systems from their research.

- To the development of small - scale laboratory systems into industrial processes.
- In order to serve these purposes, the University should have such educational objectives as, the application of biological science to be given more prominence in the curriculum.
- The students should be acquainted with constraints on biological systems in manufacturing plant.
- The students should be made aware of the physical and engineering problems.
- The Universities, number of subject departments and over all size. The question now is what strategy should be adopted to the greater advantage, for the Universities to put their resources in staff, equipment and those of local industries.

As we mentioned earlier, biotechnology is a combination or synthesing of a number of other professions. The universities could re-organise their courses in such a way as to incorporate the requirements of a Biotechnology department, with little demand for extra resources. For instance, there could be provision of engineering courses for biologist, and in return, the biologist could provide for chemical and process engineers.

At the post graduate level, the universities could focus mainly on academic research in the various fields, incorporated into biotechnology. Also there could be refresher courses for post graduate students.
Another way the universities could function is by influencing the attitude in secondary schools to industry and commerce, by modifying entrance requirements. This will in turn affect the teaching and assessment in the schools. Teachers, parents and students through this, could also come to appreciate better, the potentials for the new biological industries.

8.9.8 Community Education

The need for biotechnological literacy of the general public can not be over emphssised. According to Kille (1987), the exploitation of biotechnology for maximum social and economic development will depend to a great extent on changing the attitudes of a wide spectrum of the population. The mass media can be used in the task of

persuading and assisting in educating the public, especially in creating an awareness in those not academically oriented. This could be

reinforced by giving talks, exhibits, seminars, to give more detailed technical information of the requirements of Biology.

Community education on biotechnology could aid in changing the general attitude of the people and also influence decision making of those in positions, such as education officers, civil servants, industrialists and financiers.

Activity 8.7

How does biotechnology depends on community and University education?

8.9.9 Challenges and Limitation of Biotechnology

Biotechnology demands the application of a wide range of skills and also offers a wide range of potential services for the new industries.

Special courses in biotechnology, may not be necessary nor desirable, except in a few cases. One problem which stands clear, especially with regards to developing countries is that the introduction of such courses would impose a heavy drain on the existing resources of schools and universities.

Also it is unlikely that adequate number of staff is available with the necessary scientific and industrial experience. This means that the schools and university curricula must be sufficiently continued and well balanced not only to serve the existing traditional profession, but also these new industries.

8.9.9.1 Hazards of Biotechnology

Liberman, et. al. (1986) identified certain sources of hazards of biotechnology with three properties of micro-organisms: The potential for undetected genotypic or phenotypic changes to alter a tested and approved process.
The potential of a few strains to cause disease.
The ubiquity of organisms which can contaminate the system.
The concern is for the need to maintain aseptic conditions.

8.9.9.2 Biotechnology in Nigeria

The issues on biotechnology education as have been discussed in this paper are very relevant and applicable to the Nigerian situation.

However, certain specific observations could be made on what effect the implementation of the concept of Biotechnology will have in Nigeria. And for a developing country like ours; that is pursuing scientific and technological breakthrough, for economic self-reliance, Biotechnology offers a lot of opportunities, these include:

1.Provision of Job opportunities for unemployed graduates in science and technology related fields. They could be absorbed into the schools as professionals who would bridge the gap between the schools and industries. And also assist the teaching staff to team-teach certain aspects of the syllabus. The "Nigerian dream" of a food for all by the year 2000 AD", "Health for all by the year 2000 AD" and so on could well be achieved through the active implementation of Biotechnology in the country's educational institutions, and industries.

2.Biotechnology offers opportunities for the training of middle level manpower in the form of technicians, technical assistance and so on. The government could make provision for the training of senior secondary school learners, who have not been admitted into the universities to take up these positions and fill in the gap that is required by Biotechnology.

In spite of, the fact that there is this conscious pursuit for the "golden fleece", "paper qualification" in Nigeria, if the status of these technicians are raised by the government, more people will be attracted to it. Certain problems are envisaged, with the implementation of Biotechnology education in Nigeria. For most among these the chronic issue of lack of funds. Biotechnological processes as useful and as laudable as they are, are very expensive. Except the Nigerian economy has other means of obtaining revenue, than the oil industry, it would be very difficult to meet the financial demands in Biotechnology.

Another problem could arise from the "thinking pattern" of Nigerians themselves, who are more interested in reaping the financial benefits of any venture, than putting in the labour it requires. This attitude of Nigerians has greatly affected the technological progress in the country.

Human factors such as resistance "to change" and "conservatism" of people could also constitute a hindrance on the effective implementation of biotechnology in Nigeria.

Activity 8.8

List four human factors that can hinder the effective implementation of biotechnology in Nigeria.

8.9.9.3 Conclusion

This paper has not gone into the details on the various Biotechnological processes, as space would not allow for this. However, a framework of how the concept of Biotechnology can be worked into the various levels of education has been given.

Implementing the Biotechnology education may not necessarily require resources independently, on its own, but a reorganization of the existing ones could be done in such a way as to provide for Biotechnology.

The hazards of Biotechnology seem less "threatening, unlike the case of nuclear waste; especially with the promise of the treatment of waste disposal. It is hoped that when the different areas of Biotechnology are properly exploited, it would provide answers for such problems as environmental pollution, famine and so on.

8.9.9.4 Summary

In this unit you have learnt the meaning of biotechnology, applications and processes of biotechnology. You have also learnt biotechnology education with emphasizes on educational objectives, effects on curriculum, adaptation into various educational institutions, community and technical education. The hazards, challenges and limitations of biotechnology are also discussed. And finally the implications for Nigeria education

8.9.9.5 Tutor-Marked Assignment

(1) discuss the need for biotechnology education in our Junior and Senior Secondary School Curriculum.

(2) discuss the opportunities Nigeria as a nation will derive from biotechnology.

8.9.9.6 References

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UNIT 9

ROAD TO RECOMBINANT DNA TECHNOLOGY

9.0 Introduction

To study this unit, you should first understand the concept called DNA. The DNA (Deoxyribonucleic acid) is a molecule of inheritance on which hereditary information are stored in virtually every organism. It is located in the nucleus of cells found in the body. This little knowledge of DNA will assist you when going through the unit as a whole

9.1 Objectives

By the end of this unit, you will be able to:

- Narrate the trends in the development of recombinant DNA technology.
- Define the term cloning.
- Describe the process of cloning.
- Discuss the merits and demerits of recombinant DNA Technology.

9.2 Trends in the Development of Recombinant DNA Technology

Our knowledge of the living cells date to 1665 when Robert Hooke describe the spaces he observes in slice of cork. In 1838 and 1839. Schleiden and Schumann formulated the cell theory which shows that the cell is the basic organisation unit of the living organism. On a closer look, one would appreciate the fact that the living cell is the epitome of ingenious design. Although DNA was first isolated in 1869 by the Swiss biochemist Friedrik Miescher, it was not until 1943 that DNA was conclusively identified as the primary genetic material. The brilliant experiment that shows this was performed McLeod and McCarthy who investigated the previous finding of Griffith. From that point the pace of research on the DNA molecule become rapid and intense.

The foundation for what is now known as Recombinant DNA Technology or Genetic Engineering was laid by Watson and Crick (1953) in the British Journal ‘Nature’. They came up with the finding on the double helical structure of DNA and to propose the mechanism

of DNA replication. After then Kormbery proposed the mechanism of DNA replication. After then, Kombery (1958) isolated DNA polymerase .Between 1961, and 1966, the genetic code was completely worked out, in 1963, the discovery of the reverse transcriptase could be regarded as another landmark on the road to recombinant DNA ligase in 1967 and the restriction enzymes in 1970.Thus, stage was set for the take-off of the new technology-Genetic engineering.

Armed with these three types of enzymes: reverse replication, DNA ligase and restriction endonuclease, Scientists now have the ability to create new forms of life by splicing together DNA (or genes from various source. In fact, the first recombinant DNA molecule were synthesized at Stanford University, USA in 1972, the following year, the 'pandora's box' was opened at the Gordon Conference on nucleic acids held in New Hampshire, U.S.A.

Activity 9.1
What does DNA stand for?

9.3 Genetic Cloning

Benoaji (2000) defined cloning as the isolation and proliferation of individual genetically unique cells. It is a kind of high resolution separation method for DNA molecules which could be difficult to resolve by any other means.

The word "clone" was first used to describe a population of cells or organisms, all derived from a single cell or organism by asexual multiplication. All members of the clone look exactly alike since they posses the same genetic constitution. The birth of recombinant DNA technology made it possible to clone a specific gene, or a segment of it in bacteria. This procedure was appropriately termed" gene cloning". Later it also became possible for new combinations of unrelated genes to be constructed in the laboratory so the genes from different organisms (or species) could be spliced together in vitro to create new, recombinant, products.

These novel genomes could then be introduced into dutiable cells and amplified many times by the DNA synthesizing machinery of the host.
The major steps involved in DNA cloning include:
Construction of the recombinant molecule. A DNA fragment of interest is covalently joined to a DNA vector (or vehicle). The vector

must be able to replicate autonomously in an appropriate host. The most commonly used vectors are bacterial plasmids and the lambda bacteriophage for cloning in Escherichia coli.
Introduction of the recombinant molecule into host cells the recombinant molecule is re-inserted into the cell e.g. bacteria.

Activity 9.2
What is the meaning of gene cloning?

The cells which contain the recombinant DNA molecules with the gene of interest as then selected and separated from the remaining cells which do not.
The selected cells can then be amplified many times. During this process, the recombinant DNA molecules will be replicated and expressed in the host cells. This technique is useful for the synthesis of large quantities of scarce proteins such as human insulin or growth hormone.

9.3.1 Advantages of Recombinant DNA Technology

Cloning has made it possible to obtain large amounts of particular genes to determine the functions of segments of nuclear and organellar DNA, and to map genomes. Particularly useful application of the techniques is studies in which the controlling regions for prokaryotic and eukaryotic genes are cloned with an eye towards understanding the regulation of gene expression at a very basic level.

DNA cloning has a lot of potential benefits for mankind for example, it can be used to synthesize large quantities of antibiotics, enzymes and (insulin) hormones. In the near future it should be possible to introduce nitrogen fixing genes into the genomes of crops plants thus eliminate their requirement for nitrate fertilizers. Its technology has made it possible to cure diseases which for a long time have afflicted mankind. These include heamophilia, sickle cell anaemia, some inborn error of metabolism, etc. Quite recently, a vaccine was produced, through this technology, which could be beneficial in controlling or eradicating malaria. It is at present undergoing clinical trials and may soon be introduced into the market.

The recombinant DNA technology has also been used to achieve tremendous advances not only in the field of medicine. Agriculturists have used the new technology in producing hybrid crops with better yield and greater nutritional values. With the present recombinant

DNA technology, carrying out of cloning in the laboratory is easy and not laborious. Other beneficial proteins could be manufactured by the same process.

The technology at present can be afforded cheaply and rapidly. Cloning from higher plants, micro-organisms, animals including mammals is now achievable. The most beneficiary of this technology are the couple(s) who are rendered infertile by one thing or the other can now clone and produce their own child through test-tube babies.

Activity 9.3

Name the other areas of human endeavour apart from Medicine where recombinant DNA technology can come into play

9.3.2 Disadvantages of Recombinant DNA Technology

It leads at times to the creation of organism (monsters) - animal or human whose biological activity cannot be predicted.
Large scale production of cancer - causing viruses.
The creation of penicillin - resistant recombinant E. coli.
It requires an expert in the field to carry out the cloning.
Human being, if cloned by asexual reproduction may be denatured.
Not all those who may need can afford it.

9.4 The Future of Recombinant DNA Technology

Before the birth of recombinant DNA technology, geneticist and molecular biologists were contented with the cloning of bacterial and some other microorganisms, as well as cells in tissue culture. Plant breeders also cloned higher plant by propagating them asexually through simple techniques such as cutting and grafting.

Higher animals usually do not reproduce asexually, therefore, in order to clone an animal it is necessary to micro surgically remove the nucleus from a fertilized egg or inactivate it with ultraviolet (uv) rediatuib, then replace it with a nucleus taken from a somatic cell. Such an experiment was first carried out with frogs by Gurdon 1968 at Oxford University.

The recent announcement in the world press of the successful cloning of higher mammals caused a big stir around the world. A group of Scientist at the Roslin Institute in Edinburgh, headed by Dr. Ian Wilmut, successfully cloned a sheep which they named “Dolly”. Another group of Scientists at the Oregon Regional primate research Centre in the United State simultaneously

announced the cloning of two rhesus monkeys. A monkey it is generally accepted is the next - of - kin to man in the phylogenetic scale of biological evolution. The question was them can man be cloned? If yes, then the next question is should man be cloned? The answer belongs to the realm of bioethics.

Indeed, the story of a man who spent over a million dollars to attain a clonal reproduction of himself has already been documented in a book written by David Rorvick and published (1978). The procedure used demanded that a body-cell nucleus, containing a full set of 46 chromosomes, be implanted in an ovum, the nucleus of which had been destroyed. The resulting embryo was then implanted in the uterus of a woman. This achievement was made possible by a technique which was developed in 1973: the technique of Invitro fertilization (IVF) usually referred to as "test-tube babies". This technique made it possible to remove eggs from the ovaries of woman who were healthy in every sense, except that they were infertile as a result of irreparably damaged fallopian tubes. Their eggs would be fertilized in the test-tube with the sperms of their husbands and then implanted in their own wombs.

As is always the case, every technique developed to solve medical problems is also subjects to abuse. It soon became normal practice to remove eggs from one woman fertilize it in a test-tube and then transplants it into the womb of a second woman who could not produce her own eggs. Furthermore, women who simply did not want to undergo the difficulties of carrying a pregnancy or going through labour pains began to hire other woman to bear children for them at a reasonable fee (surrogate mothers providing wombs for rent). There are already speculations about by passing surrogate mothers by developing artificial wombs (incubators) in which the growing embryo could be developed and the baby collected after nine months!

The development of the IVF techniques was not without some unpleasant incidents. This technique is credited to Dr. L. B. Shettles, a professor at the Colombia Presbyterian Medical Centre in New York, in collaboration with Dr. Willians Sweeny, a clinical professor of Obstetrics and Gynaecology at Cornell University. The take off of IVF technology was thus, delayed by about a year. Bevis (1974) of Leeds University in England, who also did his experiments surreptitiously, announced in a press conference that three human embryos, conceived in test-tube, had been successfully implanted in the wombs of the three women who later gave birth to healthy babies. All three women were regarded as hopelessly infertile due to damage or absent fallopian tubes,

In Nigeria, test-tube babies are done and presently couples who cannot
reproduce sexually are now able to reproduce asexually through the process called clonal reproduction. It is carried out in some of the specialist hospitals including Jos by Dr. Araf.

Activity 9.4
How would you explain the meaning of IVF to an illiterate person?

9.5 Conclusion

DNA technology or Genetic engineering has been used to achieve tremendous advances not only in the field of medicine, Agriculturist have used the new technology in producing hybrid crops with better yield and greater nutritional value. It has also been used in the creation of oil-eating microorganisms to solve environmental problems created by oil spillage. It is my contention that if the eradication to all human disease recently orchestrated is to be achieved, this can only be made possible through genetic engineering or by the intervention of a supernatural strong hand from some place.

9.6 Summary

In this unit you have learnt the development of recombinant DNA technology and genetic cloning. The advantages and disadvantages of recombinant DNA technology as well as its future are discussed. In the next unit you will learn the continuation of the unit under the title genetic engineering.

9.7 Tutor-Marked Assignments

a) Explain how a clonal reproduction can be carried out in a man.
b) Discuss the need for inclusion of recombinant DNA technology in Science teaching at all levels of education in Nigeria.

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UNIT 10

GENETIC ENGINEERING

10.0 Introduction

This unit is designed in such a way that a reading material is presented to assist you to further understand what you learnt in the previous unit. Carefully go through the material and attend to the activities below.

10.1 Objectives

By the end of this unit, you will be able to:

- Explain the term genetic engineering.
- Discuss how genetic engineering works.
- Discuss the merits of transgenic.

Activity 10.1

Read the following article with the following questions as guide:

1. Who is the author of the article?
2. What is the main issue presented by the article?
3. How has the issue been viewed before this time?
4. What is the author saying is the contemporary view of the article?
5. What is the author's main contribution to the issue being discussed?
6. List major differences before and now with respect to trends in science education?
7. What are your own interpretations of what he/she is saying?
8. What are your own reservations?
9. Hazard a guess as to what you think of where we are going with respect to this concept.

After going through it, attempt to answer the questions raised in the objectives for the unit. If you cannot do so effectively the first time, go through the article again until you are able to do so comfortably.

Genetic Engineering

Ukwuru O. Joel

Since the second half of the century, biology has entered what some scientist have referred to as its 'golden age' From the discovery of the structure of DNA in 1953 to the ability to write the genetic code for a human, science of molecular biology has combined with genetics to give us a new and powerful biotechnology. It will have applications in industry, medicine and agriculture and many in other fields.

Its importance is reflected in the fact that United States now spends about half of her academic research budget on the life sciences. Past experiences have made scientists very aware of the social and ethical implications of their research and, they showed down their works in the 1970's while strict regulations and guidelines for genetic engineering were worked out. As scientists, a lot of responsibility for discussing the new issues that will certainly arise from our expanding knowledge of molecular genetic particularly those offering biology, the more informed our opinions are the more people are prepared to discuss the issues, the more likely we all are to benefit.

Genetic Engineering

Genetic engineering is the most powerful technique available in applied genetics and technology. It gives us the power to study and to change the genetic instructions of an organism, including ourselves. Other living organism can be changed for the benefit of humans and we are even beginning to manipulate our own genes to cure genetic diseases (genetherapy).

The basic techniques of genetic engineering involve inserting a new gene into an organism. The gene may be newly synthesized or transferred from another organism. This is possible in bacteria, in which case the genetic engineering turns the bacterium into a living factory for production of whatever protein the gene codes. For example the transfer of genes for human insulin, human growth hormone and Bovin Somato Trophin (BST).

Genetic Engineering of Bacteria

It is now a routine practice to be able to obtain copies of gene of any kind. In some cases only a single original molecule is required.

Making many identical copies of a molecule is called cloning. Traditionally, it relies on the use of plasmids or bacteriophages.

Plasmids are small circular pieces of DNA found in some bacteria. They are separate from the bulk of DNA and can replicate independently of the rest of the DNA. Bacteriophages (known as phages for short) are viruses that can inject their DNA into bacteria for replication. The pieces of DNA to be cloned are combined with either a plasmid or the DNA of a phage. This modified plasmid or phage DNA is called recombinant DNA. is the same given to DNA formed after a piece from one organism is joined to a piece from another organism. If it is inserted into a bacterium, it will clone (replicate) itself and as the bacterium multiples, so the recombinant DNA will multiply. If desired, the clone can be separated from the plasmid or phage DNA again. This allows, for example, its base sequence to be determined. While inside the bacterium the new gene may be active and used to make useful protein, such as human insulin, which would not normally be made in that cell. The protein can later be extracted.

The plasmid and phage is known as the 'vector' or 'cloning vector because it acts as a carrier for the DNA to be cloned. Inserting new genes into the embryo of plants or animals to create what are known as transgenic, (organisms which can pass their genes on their offspring) is more difficult.

Genetic engineering in bacteria can be broken down into five stages:
Stage 1: Obtain a copy of the required gene from among all the others in the DNA of the donor organism.
Stage 2: Place the gene in a vector.
Stage 3: Use the vector to introduce the gene into the host cell.
Stage 4: Select the cells which have taken up the foreign DNA (the DNA of the donor
Stage 5: Clone the gene.

Genetic Engineering in Eukaryotes

It is possible to genetically engineer eukaryotic organisms as well as bacteria organisms that have been genetically altered using the techniques of genetic engineering that are generally refereed to as transgenic. Because transgenic organisms offer an alternative to traditional method of animals and plant breeding, they offer an exciting new way forward in agriculture.

Improvements in crops and domestic animals by traditional method is slow process which relies a lot on chance because of crossing over on meiosis and random segregation of chromosomes during sexual reproduction e.g. it takes 7-12 years to develop a new cereal variety. Genetic engineering offers the chance to add new genes directly, without relying on sexual reproduction. It opens up the possibility of 'designer' plants and animals with disease resistance. Animals and Plants can become living factories for useful products other than food, just like bacteria in fermenters.

Advantages of transgenic can be summarized as:

A gene for a desirable characteristic can be identified and cloned. All the beneficial characteristics of an existing Varity can be kept and just the desired gene can be added.

- Sexual reproduction is not necessary.
- Transgenic is faster than conventional breeding.
- Application of Genetic Engineering for Human Insulin.
- Insulin is a protein in the pancreas which plays a vital role in the regulation of blood sugar level. Its deficiency is one of the causes of the disease diabetes milletus (sugar diabetes) where blood sugar level becomes raised with harmful consequences. Now more than 2 million people world wide use insulin and the world market is worth several hundred millions pounds a year.

Daily injection of insulin isolated from the pancreas of slaughtered pigs and cattle become the standard treatment, however, due to minor differences in the amino acid composition of insulin from species different to ourselves, and the traces of impurities, some patients were allergic to animal insulin and showed damaging side effects as a result of the injections. The ideal solution became possible with the introduction of genetic engineering.

Not all the genes are switched on at any time certain regions of DNA called promoter regions situated next door to the gene have to be activated before a gene is pressed. If the new gene is inserted in the middle of an existing gene. The switch for that gene may be used. The gene used in coli was for galactopsidase but is now trytophan synthease.

The original technique was developed by Eli Lilly and company and in 1982 human insulin. Marketed as 'humulin' became the first genetically pharmaceutical product to be approved for use.

Human Growth Hormone

Growth hormone is a small protein molecule produced in the pituitary gland. It affects all the tissues of the body, causing growth of almost all those that are capable of growing .Abnormally low levels of growth hormone in childhood results in dwarfism in which the body has normal proportions but is much smaller, intelligence is unaffected. Unlike the case with insulin where insulin from slaughtered animals will function in humans, the growth hormones of different animals work only in the species of origin. Treatment of dwarfism has relied on growth hormones extracted from the pituitary glands of dead humans and the supply was not enough to meet the demand. Another problem was that extract from pituitary glands were occasionally contaminated with the infectious protein that cause creutzfeldt-Jakob (the ame protein that causes mad cows disease).

Genetech, a Cartlifornia-based company, has produced human growth hormone (HGH) from genetically engineered bacteria which contain the human gene for the hormone. Its can be provided in large quantities and in a pure form. Regular infections of the hormone restore near - normal height in children suffering from growth hormone deficiency. The technique for producing the hormone is similar in principle to that for insulin.

Cleaning Up Oils Spills

An improvement in the use of micro-organisms is possible with genetic engineering to clear up waste in relation to treatment of sewage, recycling, (biological mining and conversion of organic wastes into useful products such as sugar, alcohol and methane.

Another potentially important example is the attempt to produce genetically engineered bacteria capable of cleaning up oil spills, example is the genetically engineered strain of pseudomonas, which can break down the four main groups of hydrocarbons present in oils (xylenes, naphthalene, octane, camphor) and can clean up oil in-water mixtures. It has been noted that relevant genes occurs on plasmids of naturally occurring pseudomopnas strains, but not all the four plasmids are present in a single strain.

It is interesting to note that experts at British Wild Life Park crossed a monkey's gene with those of a chicken to create the chimpanzee. The scientist mixed a chicken's DNA- the genetic program for all living cells with DNA from a cotton top tamaris monkey. The research team then implanted a chicken with an embryo grown from the new hybrid cells. The egg was kept at a constant 95F temperature to stimulate the tropical habitat of South American monkey. Charlie, the name given to newly hatched chimpanzee, is being hand reared on a special diet of bananas and corn in order to avoid a likely rejection by the northern hen. Vogel (1991).

The test tube baby is another scientific development through genetic engineering. The mechanism of the practice, however is basically the same, the sperm cells are collected and capacitated in a test tube. The capacitated sperm cells are introduced to the ovum and fertilization takes place in the test tube. Once the zygote is developed, it is immediately removed back to the interested would be mothers.

Presently, however, with the manipulation of genes, it is possible to shape the baby the way parents want the child before the delivery by the mother.

Genetically, engineered food also called FRANKEN FOODS is already part of life in United States and some European countries. According to the united state agricultural department one-third of the corn and more than half of the soyabean and cotton grown in the USA in 1999 were products of biotechnology

Benefits and Hazard- the Ethnical and Social Implications of Genetic Engineering.

From the earliest days of genetic engineering scientist have been very aware of the need to consider the political hazards and ethical issues associated with those new branch of biology. There was a focus on plan to clone cancer genes from viruses in E-coil. It was argued that if the genetically altered E-coil that lives in the human gut by transferring their plasmid, example by conjugation. It was also argued that human DNA, and DNA of other mammals like mice, could contain cancer-causing genes (oricogenes) and these might inadvertently get transmitted with neighboring pieces of DNA being used for genetic engineering.

In the 1980's an explosion of activity and interest was unleashed. Manufacturing companies quickly began investing billions of dollars into not just genetic engineering but all the biotechnology in agriculture, medicine, industry and waste treatment, in gene therapy.

The benefits of biotechnology in developing continent like Africa cannot be far fetched. The rates at which the population increases far more exceed food production.

In Africa, statistics suggested that by the year 2050, there will be an increase of 50% in population growth while cultivable land decreases. Biotechnology thus holds the key to Agricultural transformation which is essential for the global challenges of reducing poverty, feeding the continent's skyrocketing population and as well conserving the environment. In this way bio engineered crops could improve the food yield by 25% of the developed world to help feed their population in the future.

In the area of soil utilization, biotechnology could also solve problems of metal toxicity on farm land. Crops are being created that are drought resistant, more salt tolerant and more resistant to pests. Crop characteristics can be genetically altered for earlier maturity reduced post harvest losses and improved nutritional qualities.

Generally modified virus resistant cassava, a key source of calories to Africans can reduce the damage caused by virus on cassava.

Problems Faced by the Developing Countries.

The first problem with bioengineered crops is affordability since the biggest problem plaguing the Africa nation is poverty since there are wide economic disparities, development in the aspect of scientific breakthrough cannot be compared with the developed countries, hence expertise will be another problem.
Government insensitivity in African to genetic engineering research and biologically modified food is another problem, which could militate against it

10.2 Conclusion

Genetic engineering is very important aspect of science of life, although it has both merits and demerits. Critical assessment has proved that the advantages out weighed its disadvantages. Therefore it

should be encouraged to treat cases with genetic diseases such as breast cancer, cancer of the lungs, heart disease, diabetes, etc and for sustaining food production. Care should, however be taken to screen the gene of the organisms for genetic engineering.

10.3 Tutor Marked Assignments

1. Write a concise abstract for the article
2. Discuss the benefits that Nigeria as a nation will derive from allowing full knowledge of genetic engineering to be developed
3. Identify the factors militating against the developing nations of the World from having bing properly developed in area of genetic engineering.

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UNIT 11

SCIENCE OF THE MILLENNIUM

11.0 Introduction

The emergence of bioethics as a field of study is a contemporary phenomenon traceable to several causes. The issues of bioethics have captured the contemporary mind because they represent major conflicts in the area of technology and basic human values, those dealing with life and health.

11.1 Objectives

By the end of this unit, you will be able to:

- Define bioethics.
- Discuss the medical ethics in abortion, blood transfusion, health care, heart transplanting etc.
- Discuss the rationale for integrating science, technology and mathematics in the precollege classroom.

11.2 What is Bioethics?

Bioethics is a composite term derived from the Greek word bios (life) and e-thike- (ethics). It can be defined as the systematic study of human conduct in the area of the life sciences and health care, values and principles.

Bioethics encompasses medical ethics and extends beyond it. Medical ethics in its traditional meaning deals with values-related problems that arise in the physician-patient relationship.

In this unit you will learn some concrete ethical and legal problems such as:
Abortion.
Blood transfusion.
The child's right to health care.
Implications of homicide, suicide, cannibalism for bioethics.
Gene Therapy.
Heart Transplanting.
Human's right to refuse medical care.

11.2.1 Medical Context of Abortion.

In medicine the induction of death in the fetus to save maternal life has had a long tradition, ranging from the embryotomy for cephalopelvic disproportion to the removal of pregnancies implanted in sites other than uterus (ectopic pregnancies).Due to the present experiences of disease especially of the lungs, heart and kidney, in which it was thought appropriate to perform abortion for the immediate relief of patients.

An ethos arose that proclaimed that parents should have the number of children they desiord and at the time desired. Thus the procedure of abortion, which originally was linked to the preservation of maternal life and health, gradually changed to become a backstop to or an alternative to other methods of family planning.

Ethical Consideration on abortion

The American College Obstericians and Gynecologist, in a policy statement issued in 1976, take the view that abortion is a process of separating conflicting parties and does not primarily aim at destruction of the fetus directly. It therefore implies that interruption of pregnancy should, in the choice of methodology, maximise survival chances of the fetus.

In America , unlike other developed countries courts of law have not expressed an opinion on whether abortion is a process of separating mother and fetus or whether it may guarantee death of the fetus, whether necessary or not.

Activity11.1
What is bioethics?

11.2.2 Blood Transfusion

The process called blood transfusion is the introduction of whole blood or blood derivatives directly into the body's circulatory system. Efforts to meet the demand for blood must deal with the constraint s of short shortage life, safety limits for repeated donations, and exclusion of some potential donors to protect recipients from blood transmissible disease, notably serum hepatitis.

Ethical Problems of Blood Transfusion

Transfusion of blood generates three sets of ethical problem:

a. Religion.
b. Cultural altitudes toward blood.
c. Social organisation for securing blood, and maintenance of professional standards.

Confronted by cultural traditions not deeply recruitment programs must often overcome beliefs about evil resulting from the drawing of blood e.g. impotence, infertility, general weakness. Blood service policies are thus drawn into large ethical issues of interracial justices and equality.

On religious grounds, Jehovah's Witness oppose any transfusion as being a use of blood forbidden by God.

11.2.3 Children and Biomedicine

The recent trend in the United States is for increasing state intervention on behalf of the child's health. Status on child abuse, now in effect in every state of the United States, encourages or requires physicians and others to report. Suspicious to appropriate authorities, with civil or criminal penalties for failing to do so. In some jurisdictions a child may sue hi/her parent for a negligence tort. While the limitations of substituted judgment by parents can be argued in the traditional therapeutic setting.

Death: Homicide, Suicide, Cannibalism and War

11.2.4 Homicide

Within the society is, under one set of conditions or another, legally prohibited everywhere. It has generally been considered justifiable for husbands, in pre industrial societies to kill adulterous wives. Categories of homicide vary with a society's values and social organisation.

The Tiv of Nigeria for example practice 'ritual' (to obtain anatomical items for fetishes) murder of thieves, infanticide', accidental" killing (usually from poisoned arrows in communal hunts).

Suicide which occurs when a person takes his life as a form of revenge on others is legally prohibited. Cannibalism and war are

some form of killing which may spring from a number of motives both aggressive and affectionate.

11.2.5 Implication for Bioethics

This unit article points up the need to consider the bioethics of death in cross cultural perspective.
An anthropology view of the bioethics of death suggest that ethical judgment of the attitude and actions regarding death on other societies require ethnographic and essential framework in which to cope with the ethical dilemmas that confront our own society.

11.2.6 Gene Therapy

Gene therapy refers to the future possibility of introducing new, functional genetic information contained in molecules of DNA into human cells with the intention of treating human genetic disease.
More generally, the art of healing, which is the primary aim of medicine, has also been a major concern of religion and ethics. For instance the western tradition demonstrates the case in both its major sources: Among the Greeks, the Pythagoreans maintained an intimate relationship among ethics, religion and health; the Hebrews frequently conjoined salvation and healing.

11.2.7 Genetics and Law

Advances in reproductive technologies and the prevention and treatment of hereditary disease and creating a human being either by testube baby etc. raise questions basic to societal values, thus creating a nexus between law and genetics. Since law in other countries e.g. Nigerian on these subjects are scanty and difficult to access, this discussion will be limited to American law, which is derived in part from the English common law system.

Two landmarks decisions by U.S Supreme Court has increased the genetic counselor's flexibility in providing options to a family. That parents who carried the gene for sickle-cell anemia, a hereditary
defect of red blood cells, were written into law in thirteen states. The purpose of these laws was not to screen for disease, it was to warn healthy people prone about their procreative risks.

11.2.8 Heart Transplant

Opposition to heart transplantation on expressly religious grounds is typically in the United States and Europe.
The ethics of human experimentation, which continues to provoke controversy, was an initial problem with cardiac transplantation. Indeed early assessment of this procedure raised serious questions about whether both donor and recipient are sufficiently protected.

11.2.9 Ethical Issues

Procurement remains one of the two most critical problems as viewed by cardiac surgeons (Injection and infection together constitutes the other). Several countries have encountered this problem; and in the United States it is complicated by the fact that different states employ different criteria-ranging from silence (which implies current medical practice), yet there has been virtually no lay or scientific discussion of the ethical, economic, or technical implications of this type of human transplantation.

11.2.10 Human Right to Refuse Medical Care

Interventions by persons providing health care proceeds, as a general matter, only upon the permission of the patient. The restatement of what is usually called the doctrine of informed consent in terms of right to refuse medical care has several significant consequences. The fundamental objectives of the doctrine is to preserve an individuals right to accept or decline proposed diagnosis, prevention, or therapy as he or she chooses.

Despite the vigor with which the right is asserted, it may be qualified by countervailing interest. Particularly when a refusal of treatment seems likely to lead to a patient's death, serious ethical and legal doubts arise for commentators and decision makers alike.
It would be rather hollow to recognize a so-called right to decline medical care and then to disallow its exercise when a patient feels so strongly about the choices at issue that he or she is willing to risk death.

11.3 Conclusion

In this unit, you learnt that bioethics via systematic study of human conduct in the area of the life science and health care, values and principle.

11.4 Summary

In this unit you have studied the meaning of bioethics and some concrete ethic and problems such as abortion, blood transfusion,
homicide gene therapy, heart transplanting and human right to refuse medical care.

11.5 Tutor-Marked Assignments

- Discuss how you as a Science teacher will go about discouraging the female students from carrying out abortion?
- Explain the justification for the knowledge of bioethics in teaching STS at any educational level in Nigeria.

11.6 References

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UNIT 12

INFORMATION TECHNOLOGY

12.0 Introduction

This unit introduces you to Information Technology (IT). It starts off with brief description of IT history of internet and its operations. The unit also provides meanings to some Information Technology terminologies.

12.1 Objectives

By the end of this unit, you will be able to:

- Explain the meaning of information technology.
- Trace the history of Internet and how it works.

12.2 Meaning of Information Technology (IT)

Information Technology (IT) is the use of computers and Communication systems such as Internet (network of networks of computers all over the world) and World Wide Web (WWW) (the Internet in a linked multimedia form) to manage and share information of an organization world wide. It is responsible for the greatest technology revolution in world history. It is regularly used for all sorts of critical applications such as playing traffic control in crowded skyways, saving lives, flying aircraft, running nuclear power stations, processing orders, controlling production or taking bookings, enhancing education training, transferring vast sums of money and controlling missile systems.

12.2.1 The Nature of Internet

Internet is the network of networks of computer all over the world and everybody is freely exchanging information. Nobody knows exactly how big the Internet is because it is a collection of separately run smaller computer networks with no single place where all the connections are registered.

12.2.2 The Trends around the World

As of September 1995, over 80, 000 networks were part of the Internet, with 180,000 networks in 1996. In 2001, about 56 million networks are connected on the Internet Worldwide (Stair, 1998).

12.2.3 The History of Internet

The first networks linking computers had begun to emerge as early as the 1940s. It was the 1970s networking that became cost-effective and reliable for ordinary computer users to transmit data between computers over long distance.

Activity 12.1
What is Internet?

12.2.4 Internet in Nigeria

There is no specific data of the emergency of Internet in Nigeria. However, academic research emerged with the establishment of Nigeria University Commission (NUC) in 1962. The purpose was to improve communications in the Nigeria university system and eliminate the current embarrassing isolation of our academics and researchers from their counterparts in other parts of the world.

12.2.5 How the Internet Works

The Internet transmits data from one computer called a host to another. If the receiving computer is on a network to which the first computer is directly connected, it can pick the message directly. If the receiving computer sends the message to another computer connected, the sending computer sends the message to another computer that can forward it. It is quite common for a message to pass through a dozen forwarders on its way from one part of the Internet to another. The computer pass data around in chunks called packets each of which carries the address of its sender and its receiver. The set of convention used to pass packets from one host to another is known as the Internet Protocol (IP). The best known is the Transport Control Protocol (TCP) etc.

12.2.6 Internet Services

The Internet services range form sharing of resources, interaction between person-to-person, entertainments, promoting cultural

awareness, supporting language learning, enabling research and development and investment purposes as follows:

12.2.7 Service Description

E-mail: Enables you to send text, binary files, send images to others
Telnet: Enables you to log on to another computer and access its public topic
FTP (File Transfer protocol): Enables you to copy a file from another computer to your computer

Activity 12.2
Mention the role of computer in the operation of internet.

Gopher: This is a menu driven system that was first attempted to make the Internet more accessible before being overtaken by the far friendly web.

WWW: The fastest and most active growing aspect of the Internet that retrieve, format, and display information (including text, audio graphics and video) using hypertext links.

Usenet Newsgroups: Arranging groups on electronic bulletin boards.

Archive: It Searches database of documents, software, and data files available for downloading.

Chatting: This enables interactive conversions.

Teleconferencing: This allows a group of people to "confer" simultaneously via telephone or via electronic mail group communication software.

Data conferencing: This is the process which includes the ability of two or more people at distant locations to work on the same document or data simultaneously.

Videoconferencing: Teleconferencing that also has the capability to let participants see each other "face to face" over video screens.

Electronic Data Interchange (EDI): This is the direct computer-to-computer exchange between two organizations of standard business transaction documents such as invoices, bills of lading, or purchase

orders. EDI differs from electronic mail in that it transmits an actual structured transaction as opposed to an unstructured text message such as a letter.

Electronic Funds Transfer (EFT): This EFT or Automatic Transfer Money (ATM) or Western Union Money Transfer (WUMT) describes a system to transfer funds by sending electronic data to his bank. For example, to make payments to a supplier or pay salaries into employees' bank accounts or transfer funds from one bank account to another account. For example, to deposit to current account. EFT must involve the banks themselves.

World Wide Web Services: A system that involves over 30,000 independently owned computers that work together as one in an Internet.
Tim Berners-Lee at CERN, the European Center, developed this for Nuclear Research in Geneva.

Point Cast: delivers national, International, business, industry, and company news, weather reports, transport, sports scores, entertainment news http://www.point.cast.com

In-Box Direct: Allow Users to create a personal newspaper form news wires, trade journals, Industries and transport http://www.netscae.com.

On-line Career Centre: Offers listings of Jobs and profiles of companies, users can search the listing by keyword http://www.occ.com.

Sports Line USA: Enables users to check the progress of favourite teams while games are in progress http://www.Sportsline.com.

12.3

Activity12**.3**
What does the following IT terminologies stand for? WWW, EDI, EFT & ATM?

Conclusion

Information technology (IT) is the recent revolution in communication system in the world. IT has successfully turned the world to a global village. Although, it is costly to have IT

fully
develop in an organisation but
its usefulness to all sectors of
human

endeavours cannot be compared with anything.

12.4 Summary

This unit has successfully introduced you to information technology with particular reference to the internet, some of the terminologies used in information technology are discussed. Reading material on Internet will be provided for you in the next unit.

12.5 Tutor-Marked Assignments

- Identify ten applications of information technology to a nation.
- Discuss how teaching/learning of science can be enhanced with the use information technology.

12.5 References.

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UNIT 13

BOLTS AND NUTS OF THE INTERNET

13.0 Introduction

This unit is designed in such a way that a reading material is presented to assist you to further understand what you learnt in the previous unit. Carefully go through the material and attend to the activity below.

13.1 Objectives

By the end of this unit, you will be able to:

- Discuss in detail the history of the Internet.
- Identify the various forms of Internet and how they work.

Activity 13.1

Read the article with the following questions as guide:

1. Who is the author of the article?
2. What is the main issue presented by the article?
3. How has the issue been viewed before this time?
4. What is the author saying is the contemporary view of the article?
5. What is the author's main contribution to the issue being discussed?
6. List major differences before and now with respect to trends in science education?
7. What are your own interpretations of what he/she is saying?
8. What are your own reservations?
9. Provide a guess as to what you think of where we are going with respect to this concept.

After going through it, attempt to answer the questions raised in the objectives for the unit. If you cannot do so effectively the first time, go through the article again until you are able to do so comfortably.

Bolts & Nuts of the Internet

Visiting Academic to University of Jos, Nigeria

Now let's shift gears and look at what makes up the Internet. You may have heard people use the terms "Internet" and "World Wide Web" interchangeably, but the two terms describe distinctly different things.

The "Internet" is our word to describe the mesh of wires and network equipment that spans the globe. It is the physical foundation of our digital communication. The "World Wide Web" is simply one of dozens of services that have been designed to run on top of the Internet.

So let's start by looking at how the Internet came to be...

This isn't entirely unusual but it is true. The technology that we know today as the Internet was first designed as yet another tool in mankind's (and I use that gendered term purposefully) ongoing fascination with waging war. In this case, the Internet is a piece of fallout from the Cold War's nuclear arms race. Earlier on in the Cold War it was determined that nuclear weapons had the capacity to trash most of the technology military types used to communicate. The concern was not so much for the blast, but the electromagnetic pulse that accompanies a nuclear blast; which can wipe out the transmitter and receiver stations of radio, television, and telecommunications. So the strategic war planners were looking for what they called "hardened" communications infrastructure -- a protected physical copper wire between strategic facilities -- so that communications would remain unimpeded during a nuclear war.

At the same time a secondary impetus was forming. Computer scientists in the U.S. were building humongous machines capable of what, at least at the time seemed to be, astronomical calculations. But these machines were so large and so complex and so expensive that only a few could actually be built. Of course, researchers from all fifty states wanted to have access to these machines and the designers, using federal dollars, were looking for ways to share them. So while the military was using wires to hook up the military installations and strategic Centres around the United States, academic institutions were looking for ways to connect their researchers to the rare but formidable new breed of computer.

While the original Internet served just a handful of research institutions and researchers it was not long before other researchers demanded access to these resources and their institutions were added

to the network. With all the efficiencies and services available on the larger network, it took less than ten years before most universities in the United States and most government agencies were hooked up to the network. That's the nature of this almost biological process of building networks. Human beings making human decisions to bend this computer network technology to meet their human need to communicate and collaborate. Whether the decisions are being made on a personal level, as in two people purchasing modems and buying Africa online accounts so they trade email, or on an institutional level, as when a corporation buys time on a satellite so they can link their fifteen offices in seven different countries, the motivating factor remains constant -- communication and collaboration.

Now let's look at how a local area network gets built.
Dan and Julie share the same office and each of them has a noisy, low-quality dot matrix printer. They decide to upgrade their printing capabilities by buying a laser printer, which will cost them $800. They both want to print and so they wind up passing files back and forth on diskettes, though this get to be unwieldy. They contemplate buying a second laser printer, but neither of them prints so much as to justify the cost of two printers.

So for $40 each, they buy network cards and string a piece of wire between their two computers. With the click of a couple of buttons they are able to share the printer. Not only that but they also can share each other's hard drives and blithely swap files back and forth. Soon others in the office catch wind of this scheme and want in on the action. They all go out and buy $40 network cards and add a $100 hub to manage all the traffic between them, then proceed to share each others printers, hard drives, and other parts of their computers. After awhile there's enough people on the network that things start to bog down, so the company pitches in and buys a network server. This is essentially a dedicated machine with a humongous hard drive --that is up and running twenty-four hour a day, seven days a week and whose main purpose is to store and serve files to the other computers on the network.

This scheme is so efficient and so economical that eventually every computer, printer, scanner, and fax machine in the company is hooked up to this network.
Once the whole office was connected with these network wires, it's almost inevitable that sooner or later those using this small local area network (LAN) would want to be connected to the much larger global

Internet. Physically all it takes for the handful of computers on Dan and Julie's network to be connected to the millions of other computers on the worldwide Internet, is a single wire. A single wire that can handle the conversation between dozens or hundreds of local area network computers and the millions of Internet network computers. This "single wire" is a key concept in the building of the Internet.

Let's look at the another technology to better appreciate this concept: the telephone. If we wanted to have a hundred people in one city able to talk to a hundred people in another city via the telephone -- via an analogue, not digital, connection – we'd have to string a hundred wires between the two cities. But the Internet, using digital "packetized" communication, is able to handle thousands of transactions over the same wire almost simultaneously.

On a human/cultural level, the "single wire" concept provides the foundation for the rapid growth of the Internet. For instead of having a centralised authority responsible for building the network's capacity and providing all the connections, the Internet is essentially a set of standards. This allows individuals to use whatever wire they can lay their hands on to connect their computers to other computers that use the same standard to communicate. The decision-making becomes a local, if not individual endeavour. If I have a local area network with a hundred computers that I want to connect up to the Internet, all I need to do is find another individual or institution with an Internet connection who will, usually for a fee, let me share their connection. Thus the Internet grows. Pushed along by the human desire to communicate and collaborate, it grows like topsy, (some would say "bacteria") seemingly randomly and almost uncontrolled. Not a top-down bureaucratic sort of arrangement, but a grass-roots expression of real human need.

Imagine if one were able to take a picture of the Internet from a satellite and the only thing that showed were the connections that are used to conduct our digital data. What one would see is a map that demonstrated two things: first, who has a need to communicate with whom, and, second, who has the money to build communication networks. The Internet is a fascinating studies of human ingenuity -- humans taking whatever resources are at hand and turning them into a standard Internet connection to communicate. I should point out that my use of the term "wire" is not entirely accurate, since not all Internet connections are actually wires (they may be satellite or microwave or radio connections). But for now let's just stick with the

idea of that, on a physical level, the Internet consists of a bunch of computers wired together in a network of wires that can handle multiple, seemingly simultaneous conversations.

Now that we've "constructed" the physical Internet, let's look at what we can do with it. There are literally dozens of services that can be run over the Internet, like delivering faxes, or holding a text "conversation" with a group of people, or operating distant computers, or monitoring scientific equipment, or receiving news updates, or conducting real time voice conversations. I'm going to focus on the three most popular: email, FTP, and the World Wide Web. Electronic mail remains the prime use of Internet today. Many more people use e-mail than the World Wide Web. For many companies and institutions, it has become a critical part of their mission.

E-mail began as simply text files being written by one person at one computer and copied to another computer. Early system administrators and collaborators found this was a convenient way to communicate with each other and expanded upon the idea in a more formal manner by developing software to handle the transactions. E-mail has a powerful distinguishing trait: (this is important, so take note) e-mail is a store and forward technology. E-mail's store and forward capability allows you, as one sending a message, to not worry about the state of your receiver's computer, since you'll be sending the message to a POP server, which is assumed to be on the Internet and available twenty-fours a day. (And if it isn't, your server's software contains instructions on how to keep retrying the destination POP server until it responds.) You can press the send button, and rest reasonably assured that that pop server would eventually receive your message.

The recipient of the message -- the actual human being who is going to read it -- can log into their POP server from anywhere at anytime and have his/her messages forwarded to them. Whether they are attached to a local area network and their software automatically checks their in-box every five minutes or they are on an overseas assignment and they dial in once a month, the mail gets delivered. So here's a term that I hope you will learn and memorise and appreciate: asynchronicity.

A telephone conversation is a synchronous relationship. Both parties need to be attached to a similar device at the exact same time and for the duration of the event in order to participate in the

communication. In an asynchronous conversation, as in the case of e-mail, the communication is created at one space in time and received at another. That means that the data can take its time getting from one place to another, being transferred over slow modem lines, being transferred in batch after hours when the rates are cheaper, even sent via a diskette. E-mail, like Snail Mail (its atom-based counterpart), can travel a circuitous route, even be lost and delivered years later.

If one is on a local area network, the time lag might be milliseconds between the message being sent and received. Two individuals with dial-up telephone connections who infrequently check their e-mail might see months between the time the message is sent and the message is read. Asynchonicity is an important concept: digital communication allows us to break free of old time constraints and reshape the way we do things to fit our needs. For example, if you are hearing me present this talk, you needed to be in a particular place at a particular time (and pay a particular amount.) If you are reading this over the Internet, you chose the time and place and, perhaps the cost. Because of this asynchronicity, because of this store and forward capability, e-mail is remarkably adaptable. Especially in the developing world, the Internet wire can take any form. It can be an actual physical wire, a telephone line, modem, it can be satellite signals, radio transmissions, or a diskette or a hard drive being physically transferred from one location to another.

Another popular Internet service is FTP, File Transfer Protocol. This key service allows you to gain access to a remote computer and retrieve files from that computer's magnetic storage disks. An FTP server is a machine that allows other computers to gain access to its file system. The server is responsible for verifying the identity of the client and insuring they have access to only the intended files. In a sense, it takes your ticket and then directs you to the seat and the view that you purchased. The ability to copy a file from one computer to another being essential, FTP has been around since the beginning of the Internet.

In a sense, FTP is the grandfather of the World Wide Web. Let me explain why...

For decades FTP was not easy. Based on older, character-based operating systems, FTP required users to learn a whole slew of arcane commands. One worked from a command prompt (instead of pointing and clicking with a mouse.) As well, one needed to know the name of the file, its precise location, and the exact spelling of both. Needless to say, FTP was a frustrating experience that called for lots of patience

and extraordinarily accurate typing skills. It was used mostly by computer nerds and network administrators. Casual computer users were more likely to simply copy their file to a diskette and pop it into the mail or send it via Federal Express than wrestle with FTP. Fortunately for all of us, today there are programs with good graphical interfaces that make doing basic FTP much easier.
But let's take a look at what else has become of FTP...

The World Wide Web grew out of a series of innocuous little changes that meant little in the way of new technology, but changes in human behaviour that made a world of difference. Here's where it starts..
Long, long ago (OK, the 1980's..), some people had grown tired of setting up new user accounts on their systems every time they wanted someone to have access to their files. They decided, instead, to set up an area on their computer where they could make files available to anybody in the world. Because the FTP server software needed to have a pre-set ID to allow the user to log in, the name "Anonymous" was adopted and given the password of "guest." Once a few people demonstrated this trick, others started to follow and pretty soon it became a common practice across the Internet. (Although some systems might want you to type in the unique password just for the heck of it.)

These anonymous accounts grew out of, once again, a very human desire to collaborate and share; and a very practical need to make it easier for all. One thing that people did to make it easier for the non-nerds to find and transfer files from their computer was to devise a menu system. After lots of experimentation, a standard was agreed upon so that the first thing a user would transfer, when they came to an FTP site with this menu system, was the initial menu file, the index, which listed all the submenus and files available on the host computer. To change directories or download a file, the user simply pressed a number key that corresponded with the menu item number.

The best such system still in use today is called Gopher. A Gopher server will have a text-based but easily navigable interface. But Gopher, or Panda if you will, was a mid-point between the old fashioned text based FTP and what eventually became known as the World Wide Web.
HTTP, the HyperText Transfer Protocol, is the core Internet service that underlies the World Wide Web. In a sense, the World Wide Web is nothing but FTP with a highly graphical interface. It's a simple but elegant method for transferring files from a server computer to yours

that allows you to readily see what's inside those files. It is that old fuddy-duddy FTP with a pretty face.

What essentially happens during a HTTP/World Wide Web session is:

- Your computer contacts another computer, a World Wide Web server, and requests a file (INDEX.HTM is usually the "home page".)
- The World Wide Web server sends back the file, which
- contains both text information and HTML formatting codes After your computer receives this file, your browser software automatically composes the file and displays it on your screen for you

An HTML file is essentially a text file with some codes added to advise the recipient's World Wide Web browser on how to format and layout the text that's in the file. These codes, which are called "tags", make up a HyperText Markup Language (HTML), a standard set of codes that can be used to format text and place graphics within the text as well as create links to even more files on the World Wide Web. This latter tag is a special type of tag that gives the document its "hypertext" properties. These tags can be used to "link" text or images on your screen with other documents on the Internet. This link contains the address of the computer, the name of the directory, and the name of the file -- all the information one used to need to know in order to FTP a file. When you press on a link in your Web browser, you're indicating to your computer that you'd like it to go to the site indicated underneath the link and fetch the specified file. This is the essence of the World Wide Web.

It uses a facility we' ve had for thirty years -- the ability to transfer files from one computer to another over the Internet -- and gives it an entirely new life by making file transfer easy and painless for the average computer user. It represents more a change in human behaviour than a flashy new technology. It demonstrates what remarkable things can be accomplished by large groups of diverse individuals coming together to forge new patterns of social interaction and communication.

Here's something to consider. The World Wide Web is comprised of one core element: a person's willingness to share the files on their computer with somebody else. So far millions of individuals and organisations have chosen to do so. As you might imagine, the same hesitation you may be feeling at the thought of

sharing your computer files with someone else - millions of unfamiliar Internet users was felt throughout the universities and corporate boardrooms of America. This was a radical departure from business as usual and represented a dramatic leap into uncharted territory.

But today those connected to the Internet consider a corporation, university, or government organisation or country, in the current context of Nigeria -- which is not on the Internet, to be irrelevant. In the realms of information and communication, we in the wired world are moving from a paradigm of scarcity to one of abundance. Imagine visiting a government official with a complaint about an unfair law. Imagine that government official giving you, and thousands of others, complete access to his library -- pointing out where you can find a copy of the constitution, copies of all the decrees and legislation that led up to the law coming into being, copies of the deliberations that went into shaping the law, and a list with the names, addresses, and phone numbers of all the original writers of the law as well as those currently in office who might assist you in changing the law. In the world of paper documentation - what the digerati now call "dead trees and ink" -- this would be sheer fantasy. But in the digital domain, it is common practice.

Once something has been digitised one can make infinite perfect copies. Once that digitised item is placed on the Internet, millions can access it and make their own copies at their whim. And it doesn't cost the producer one Kobo more. While at one time we sorted through what little information we had and tried to determine what we could afford to make available to our students or the public, we are now faced with people having unfettered access to unimagined abundance.

This is the Information Age.

New information is increasing at such a rate that the average student in the year 2000 is being introduced to as much new data in a year as their grandparents encountered in a lifetime. Our knowledge base has doubled every seven years for the past several decades. Every day ten thousand new scientific articles are published worldwide. Every month established journals and popular publications disappear from print and take up residence on the Internet instead. In America we see the entire businesses abandoning storefronts and moving their sales and customer service on-line.

Given the rate at which technology is advancing these days, the average shelf life of a technical degree is a mere five years. So much greater emphasis is being placed on continuing education for working professionals and universities are using the Internet to deliver instruction on-demand at the worker's desktop or clinic.

This gives rise to two new popular concepts:
"life long learning," where the degree granting institution partners with its graduates to provide them with continuing education and access to resources for the duration of their careers; and
"just-in-time knowledge," where, instead of leaving the university with a head stuffed full of facts and figures expected to sustain them throughout their careers, students leaves the university with the skills to mine the digital resources on the Internet and the expectation that they will be able to find the information they need precisely when they need it.

As I've said, and hopefully demonstrated throughout my lecture, things are changing around the world towards a digital future. Lest you think you can lay low and avoid all this upheaval, let me say this: every day, more and more resources fall into the category of only being available on the net. It currently is not economically feasible to print much of that which used to be printed. People will naturally gravitate towards using services and purchasing goods on-line. This dynamic will only grow over time… possibly exponentially. Thus, simple competition will drive some institutions to the digital domain.

All the indicators point to an increasingly digital future in every domain of our lives. We are at the point where standards have been set and the track has been laid out. The starter's gun has fired and the racers have sprung out of their blocks. But this race is a marathon and a quick start does not guarantee a successful finish. There's still room for Nigeria in this enterprise and there's no reason to assume that she cannot win big. Nigerian institutions can no longer afford to resist the lure of the Internet. You can be sure that there are Nigerians overseas who will not consider returning home until they can connect to the Internet. I can tell you most certainly that there are many Western businesses and individuals that would not consider locating in Nigeria if they cannot connect to the Internet. And I'd be willing to bet you next month's pay cheque that many excellent Nigerians are being lured away by the promise of being able to work with the world's premier intellectual resource elsewhere when they could be doing so right here at home.

There is no shame in not being connected to the Internet for the past few years, but to continue in this vein is to operate under a self-imposed intellectual and academic poverty. All of this can be remedied with the resources at hand. The cost of a year's satellite connection is roughly the cost of a couple of Mercedes and thousands can share it. The technology to do so is so common that it is almost boring. It is simply a matter of building the political and fiscal will.

13.2 Tutor-Marked Assignments

1) write a concise abstract for the article.
2) give a detail history of how internet came into being taken what you read in this unit into consideration.
3) identify and describe the operations of the features of internet.

13.3 References

Gusen, J (1998). Computer Made Easy; Jos, Plateau State, Nigeria

McBridge, P (1997). The Internet for Wndows 95 Made Simple. Oxford Made Simple Books.

Ralston, A. (ed). (1976) Encyclopedia of Computer Science. New York. Van Nostrand Reinhold Company.

UNIT 14

E-MAIL SERVICES AND OTHER AREAS OF MODERN TECHNOLOGY

14.0 Introduction

This unit introduces you to the E-mail services. It starts off with a brief explanation of E-mail and its advantages. The later part unit deals with other areas of modern technology.

14.1 Objectives

By the end of this unit, you will be able to:

- Explain what E-mail is and how it works.
- Discuss the merit of E-mail in our society.
- Identify other forms of information technology such as the intelligent automobile, police information system etc.
- Discuss the problems associated with Internet.

14.2 Electronic Mail

This is a computer to computer exchange of message with person to person messaging, documents and sharing. It is a method of creating and sending messages electronically to one or more individuals. These messages are stored in the destination mailbox until the receiver is ready to read them. Both the sender and receiver do not necessarily need to be on the same network machine.

Advantages of E-mail include:

a. E-mail is very fast

b E-mail is entirely electronic and doesn't require that paper copies of the message be created unless the recipient desires a printed version.

c. E-mail is convenient

d Materials in E-mail can easily be copied from other documents to the clipboard and inserted as part of e-mail message.

14.3 Transport Industry

You cannot see, or smell nuclear radiation, but it's deadly. There are many health hazards that can be caused by the transport industry that it can reduce by using Transport Environmental Decision Support System (TEDSS) to assist in creating an evacuation plan in case of a nuclear power plan disaster there. For TEDSS to be effective, it has to use the following information:

(1) The behaviour of radioactive gasses, such as dispersion rates.
(2) Highway system characteristics, such as number of lanes.
(3) Population distributions, such as densities and the location of the people with disabilities.
(4) Current weather conditions, such as wind direction.
(5) Evacuation routes and paths from any origin to assigned shelters.
(6) Projected volumes of traffic on he highway system.
(7) Highways that may become severely blocked by radiation.
(8) Time that will have elapsed before the last vehicle clears the area, (Haag, Cummings and Dawkins, (1998:)

Activity 14.1

On your own make a list of the various ways in which Nigeria can benefit from advances in the Technology of the 21st Century.

14.4 Other areas of Modern Technology

14.4.1 The Intelligent Automobile

This involves monitoring engine performance of the air-fuel ratio, spark advance idle sped, oil transmission fluid, and coolant levels, entertainment systems and on-board diagnostic systems.

14.4.2 Other Advanced Applications of Modern Technology

These include electronic navigation system, keyless locking and communication systems. Physical distribution of reight to include computerized freight rates and payment systems such as rate analysis, automatic freight payment and report generation. Computerized shipment-tracking system to include monitors step-by-step progress of particular shipment assists in processing a particular shipment. Computerized mileage/route system to include mile-marker.

The rail and shipping industries to include: railroad applications such as automated car identification system. Centralized traffic control system and computer-aided dispatch system which can monitor the street lights, and traffic showing different colorful signals to motorists and pedestrians that green means go, red means stop and appear means get ready. Shipping applications to include design and manufacturing of ships, computer assisted navigation, computer monitoring of ship engines, cargo, fuel and supplies.

14.4.3 Police Information System

This is the heart of all police information network that can be used to prevent crime, it contains police information of a national basis to track records of conviction, records of stolen property, and other reports.

14.4.4 Problems of Internet

The Internet present many problems to the business users, largely stemming from the fact that most of the technology and functions are relatively immature. These problems range from:

* Security information on Internet Electronic links tends to be exposed to attacks from both thieves and vandals. Internet hackers have found ways to steal from both passwords as they pass through.
* Technology Problem. Lack of standards allowing incompatible ways exists to access the net, allowing specific users to perform certain function. Lack of standards also affects the ability of organization to establish a stable link to the Internet. Sending graphics on Internet is also a problem because of low speed. Phone network not reliable, speed of data transfer differ and slower than US.
* Legal Issues. Laws governing electronic commerce are mostly non-existent or are just being written. Legislatures, courts, and international agreements will have to settle such. Discriminate copy of documents without permission.
* Traditional Internet Culture. The Internet had its origins as a scientific and academic tool. As it grew, a strong anti-commercial culture grew with it. Cultural articularism, regionalism, social expectations, work hours, political laws, transborder data and privacy laws.
* Personnel. There are acute shortages of skilled consultants in Nigeria.

* Costs and tariffs.
* Regulatory constraints and standardization issues.

Activity 14.2
Describe some of the problems which internet present to its users.

14.5 Conclusion

In this unit you have learnt about Electronic Mail (E-mail) and its advantages; as well as applications of modern technology

14.6 Summary

All that you have studied so far are to help you understand the modern information technology which has made the world a global village.

14.7 Tutor-Marked Assignments

(i) You as a distance learner, explain how E-mail services could enhance your study.

14.8 References

Gusen J. (1998) Computer Made Easy: Jos Plateau State Nigeria

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UNIT 15

SCIENCE OF THE MILLENNIUM – HEALTH CARE

15.0 Introduction

To study Health Care, you should be able to explain what health is. Because of the importance of our lives, the issue of health care becomes more important. So, the need to have adequate knowledge of what constitutes proper health care services and the roles of science and technology in solving serious health problems are what the unit intends to address.

15.1 Course Unit Objectives

By the end of this unit, you will be able to:

- Discuss the effects of human activities on our health.
- Explain the need for better health care services.
- Identify areas of serious attention in health care.
- Suggest means of attending to "C" above.

15.2 The Meaning of Health Care

Human development has many goals, one of which is to protect human health in the face of rapid environmental change. Unfortunately, we often fail to attain this goal. These changes occurring in the biological and physical environment of the planet as a result of human activity certainly does have an enormous impact on human health. To some extent, these changes are unavoidable because in the past, we have seriously overloaded the environment and the consequences have not yet become fully apparent. For example, past emissions of CO_2 and other greenhouse gases and long lasting ozone depleting compounds in the stratosphere will continue to have effects for decades to come. Moreover, unexpected, rapidly occurring threats to health are more likely to emerge in future as a result of strains now placed on the ecological systems that sustain human life.

Health care is therefore a basic service essential in any effort to combat poverty. That is why people like Tore Godal (2000) believes that disease and their underlying causes can affect families in a

number of ways. These include reduction in productivity, impediment of education or retained high dependencies on family members. This could lead to adverse effects on economies of families. He then concluded that the right investment in health is at least as important as education.

It is these investments which are often subsidized with public funds worldwide that has led researchers to innovations on preventive health, public health and curative health care. This is also why Feachem (2000) thinks that human health has probably improved more over the past half century than over the previous three millennia. He went on to say that it is a stunning achievement - never to be repeated and it is hoped irreversible, despite the devastating impact HIV/AIDS is having worldwide. Some current areas of health care where science and technology by way of research and or its findings have made or are making breakthrough are highlighted below:

Activity 15.1

Mention the socio-economic implications of poor health care system in a nation.

15.2.1 Malaria

According to a bulletin of WHO, malaria is responsible for 4% of global deaths. Sub-Saharan Africa suffers most of the burden of mortality and morbidity from malaria accounting for over 85% of the disability-adjusted life years (DALYs) attributable to the disease. Thus, over half the children in developing countries suffer from anaemia, with malaria and iron deficiency being the main etiological factors. So far malaria control in Africa continues to rely on the adequate and prompt treatment of suspected cases, because primary prevention by means of prophylactic drugs or vector control is rare. Also, interruption of contact between humans and vectors through the use of insecticide-treated bed nets is a promising approach that is slowly being implemented.

Research results reported the inclusion of malaria chemoprophylaxis and routine iron supplementation delivered through EPI for pregnant women and young children as a means of improving the control of malaria and anaemia - the two major killers of infants in parts of sub-Saharan Africa. Still on malaria, fresh clues to treating malaria in pregnancy have been discovered by James Beeson and colleagues in Malawi, and U.K. By now, we know that malaria during pregnancy is

serious threat to mother and foetus. The woman faces a substantial risk of death and the foetus is at risk to intrauterine growth retardation and miscarriage. Beeson and the others gained important new insights into the way malaria parasites invade the placenta and how the invasion might be inhibited, by certain sugar rich molecules called polysaccharides and by treatment of the receptor with an enzyme - hyaluronidase.

This they say would lead to the possible development of new adhesion - blocking therapies on vaccines. In fact, SmithKline Beecham candidate prophylactic malaria vaccine has shown promising results in clinical tests conducted in collaboration with Walter Reed Army Institute and the London based Medical Research Council (MRC). Similarly, malaria is acquiring new names like “Chloroquine resistant malaria” “Airport malaria”, “Baggage malaria”, “Runway malaria”, etc. These have been diagnosed as imported malaria found in persons who travel in the vicinity of international airport at which flights carrying infected vectors have arrived. Many instances of airport malaria, several of them fatal have been recorded - the largest being in France primarily because of the many direct flights arriving from areas of Africa where the diseases is endemic. Consequently WHO recently recommended several ways for aircraft disinfection and periodic treatment of aircraft with residual spray and /or the application of a space spray before take-off from highly endemic areas.

It should interest us to know that the Anopheles mosquito which is referred to as the principal vector of the malaria parasite in Turkey is said to be resistant to twelve different types of insecticides. This was discovered by some doctors under the auspices of WHO and the University’s Research Fund in Turkey.

Activity 15.2

List the various types of malaria that can be contacted through International means

15.2.2 Rotavirus

Rotavirus is virus that commonly causes diarrhoea in children. Over Lundgren and others at the University Hospital Uppsala in Sweden have discovered how rotavirus wreaks havoc on the gut. Rotavirus causes some 600,000 deaths a year and about 125 million cases of

illness. Most of these deaths are in low-income countries. Death results not from infection per se but from dehydration caused by profuse diarrhoea, nausea and vomiting unless O.R.T. can be given. There are no drug treatments for rotavirus and currently no licensed vaccine following the withdrawal of the first of its kind last year. Now, these researchers have discovered how the virus triggers fluid loss from the intestines and in so doing, have identified new targets for drug development.

15.2.3 Vaccine-carrying Potatoes

Nutritious potatoes are being genetically engineered to carry vaccines against public health hazards; and for the first time, cooking has not inactivated a candidate vaccine. Developed by Dr. Charles J. Arnizen of Cornell University Institute for Plant Research in Ithaca (NY). He and his colleagues inserted into the vegetable, a gene that makes a harmless component of cholera toxin that induces a significant immune response in the recipient. With this new vaccine, they hope to prevent many of the estimated 5 million cases of cholera that occur annually throughout the world that cause so many infant deaths, leading to massive diarrhoea which causes life-threatening dehydration, children particularly can die quickly.

15.2.4 Osteoporosis

Osteoporosis occurs when the density of the bone becomes light because it has lost its mineral content. This is a global health problem that will take on increasing significance as people live longer and the world's population continues to increase. Current treatments have been restricted to lack of drugs capable of restoring bone mass to normal level. Grey Mundy and colleagues in the USA have discovered a potential new drug for its treatment. They are called Statins compound and are currently in use to lower bone growth in mouse bone cell culture and also in use to lower bone growth in mouse bone cell culture and also in rats and mice.

15.2.5 Making Muscle from Bone Marrow

Victims of traumatic injury and muscle wasting disorder, muscular dystrophy (MD) have a first ray of hope of some day building a new skeletal muscle. Some Italian researchers - Drs Fulvio Marilio and colleagues from H. San Rafferele Telethon Institute for Gene Therapy in Milan have discovered that bone marrow in mice contains

a population of primitive stem cells that specialize in forming a new muscle.

15.3 HIV/Care and Prevention Service

The havoc that AIDS and HIV transmission is wrecking in our world today does require an introduction but Marshal and Hunt (2000) by way of caution wrote that "As with other development al issues HIV is about people's control over their lives. Ultimately, it relies on people realizing that their future lies in their own hands".

By way of care, study in Thailand showed that short course Zidovudine treatment reduced mother-to-child transmission of HIV by approximately half among women who did not breast-feed. The intervention involved the administration of Zidovudine orally for 4 weeks including the day of delivery. Meanwhile negotiations are in progress to obtain a substantial reduction on price of the drug for this indication to make its use relatively cost effective, even in developing countries. However, Dr. D. Francis the Vax Gen president a pharmaceutical company based in San Francisco (CA) during the 12th World Aids Conference in Geneva in June 1998, said they had developed a new vaccine called AIDS vaccine started that summer in the US.

It was reported that 5,000 volunteers in more than 30 US cities are participating in a 3- year trial approved by Food and Drug Administration (FDA). The Vaccines were also to be tested on 2,500 volunteers in Thailand. The specified vaccine in one formulation was designed to protect against the strains of HIV found in America, Western Europe, and Australia and also to protect against typical strains of AIDS - causing virus found in Thailand, Japan, Korea, Taiwan and Indonesia.

Health they say is wealth and that is why there are huge investments in matters concerning health care worldwide. We hear reports that 369 biotechnology medicines are in testing while it is also on record that an American survey found 217 medicines and vaccines in development as Pharmaceutical Companies, continue to step up their efforts to develop medicines to meet special needs particularly of children.

Activity 15.3

What do you know about Zidovudine?

15.4 Genetic Finger Printing & DNA Profiling

Obtaining a copy of the gene required is the most difficult part of genetic engineering.
There are about 3000 million bases and 100,000 genes in the human genome. A typical gene is several thousand base pairs long.

In 1995, there was a case of three women who each claimed they gave birth to baby girls at a private Maternity Home in Lagos. Two of them were told their babies died during the birth process. But when a TV programme covered the story of a 65 year old woman who claimed to have given birth to a mirage baby at the same maternity Home, the two other women became suspicious. This led to a situation where each of the three women began to lay claim to the living child.

This situation generated public interest and after seven years of extensive investigation and court proceeding, a court verdict had to be given. The verdict would not have been possible without a conclusive scientific proof of who the real mother of the child was. To do that, DNA samples from the three women and their husbands had to be taken. Genetic fingerprinting and DNA profiling is used to settle complex problems that have to do with identifying persons.

DNA profiling is the more recent and sensitive version of genetic fingerprinting. Alac Jeffreys and his colleagues at the University of Leicester developed genetic fingerprinting in 1984. Its use became well known to the public during the criminal trial of O.J. Simpson in the USA in 1995.
There are about 100,000 genes in the human genome. It has also been discovered that there is a great deal of variations between individuals in the way short sequences of bases are repeated in the DNA. At every particular locus in the DNA, each individual has two kinds of these variations, one inherited from the father and the other one from the mother. Genetic fingerprinting is a process of analyzing the lengths of these variations of a given individual.

DNA fingerprinting was first used for forensic work in 1986 in the UK to resolve the puzzle of who raped and murdered a school girl in a village near Leicester. A total of 1500 men were tested and none of them had a matching DNA. The actual murderer was caught as a result of conversation overheard by chance in a pub. DNA fingerprinting of semen sample from the crime and a blood sample

from the suspect confirmed the guilt of the suspect. When between 20 and 30 bands are used in the analysis of the DNA of suspects, the change of two persons sharing the same band is 1 in 1 million! With a world population of 6.2 billion in (4 year 2000) DNA profiling is a reliable way of distinguishing between two or more individuals.

Activity 15.4

Mention some instances where Genetic Finger Printing could be of use in crime control.

15.5 Conclusion

In this unit you have studied issues relating to health care, viral and non-viral diseases and HIV care and prevention service. The genetic finger printing and DNA profiling are also discussed.

15.6 Summary

This unit has discussed some areas of health care where science and technology have played significant roles in providing solutions. These include the viral diseases such as malaria, rotavirus and HIV. And the genetic finger printing and DNA Profiling used for crime detection was also discussed.

15.7 Tutor – Marked Assignments

- Discus the steps to be taken to ensure proper health care for the student s under your care?
- Discuss some of the Federal Government supports for proper health care system for its citizens in Nigeria.

15.8 References

Feachem, R.G.A. (2000). Poverty and Inequity: a Proper Focus for the New Century.
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Godal, T. (2000). Immunization “is a key step toward overcoming Poverty.

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UNIT 16

HIV-AIDS VIRUS

16.0 Introduction

There has been a great hope on biomedical technology to bring solution to the menace of HIV infection by way of producing vaccine or cure for it. With tremendous increases in commitment and resources, millions of the populace are falling victim of this dread disease. Thus, the need for its inclusion in the teaching.

16.1 Objectives

By the end of this unit, you will be able to:

- Discuss the :(i) transmission of AIDS, (ii) process of infection (iii) prevention and treatment.
- Identify available drugs for treatment

16.2 AIDS -Acquired Immune Deficiency Syndrome

It is a disorder which damages the human body's immune system. It is caused by the HIV (Human Immuno-deficiency Virus).

16.2.1 Transmission of HIV

You have learnt about viruses. HIV is just an example of viruses. You learnt that HIV virus like any other virus cannot survive on its own, except in another cell or body fluid. HIV virus was discovered among homosexuals, it could also be transmitted in heterosexuals. The virus passes the unaffected person. Example is the semen, blood or for the homosexuals, anal intercourse. The linings of the anus are very fragile, the vessels break easily, and the semen therefore passes to the blood in the lining of the anus.

Many people share needle that is drug users or nurses who use the same needle for different people. AIDS can be contracted through needles.

Many people contract AIDS through blood transfusion. If donor's

blood is infected, the recipient contracts the disease. Close contact between infected and non-infected person, through open cuts, and open wounds is another avenue of transmission.

Activity 16.1

What are the full meaning HIV/AIDS?
Mothers pass on the virus to their babies through childbirth, through the placenta, or breastfeeding.

16.3 Process of HIV Infection

Taylor et al (1998) gave five stages of HIV infection in the body, i.e. after infection.

Stage I: After infection, most people remain symptom free for years, while some may develop symptom's like fever, reduction of T helper cells in the blood and skin rash. The body produces its own anti-bodies against HIV. This can be detected on examination. This stage is between two weeks to 3 months. The fact that some one went for a test and it is negative is not an absence of the virus. It may take between two to ten years before the disease is fully blown. When infection occurs, the body produces anti-HIV antibodies. It takes up to three months before antibodies are produced.

HIV-AIDS Five Final Stages

1 Presence of HIV antibodies in the blood but T. helper cell number in the blood is normal.
2 Presence of HIV antibodies in the blood, T helper cell number in the blood is normal but chronic lymphadenopathy detected.
3 HIV antibodies present, number of T helper cells in the blood decreases and chronic lymphadenopathy may be there.
4 HIV antibodies present, number of T helper cells in the blood decreases and delayed type of hypersensitivity reaction (DTH) is also suppressed.
5 HIV antibodies present, number of T helper cells in the body decreases, complete loss of delayed type of hypersensitivity (DTH) reaction and appearance of fungal infection in mouth.

Activity 16.2:

16.4 Treatment and Prevention of HIV-AIDS Virus

When one goes for test, essentially what is done is that a sample of blood is taken and mixed with HIV proteins already prepared for the purpose. The test is positive if the blood already has anti-HIV antibodies by binding to the viral proteins. Unlike bacteria, antibiotic cannot be used to treat HIV-AIDS due to the nature of the virus. What is the nature again? You were told that they live in cells of organisms not on their own. For now, scientists (doctors) try to relieve the symptom on sufferers.

Taylor et al gave three areas of research aimed at prevention and treatment. They are:

1. Restoring or improving the damaged immune system of victims.
2. Developing drugs that will stop the growth of the virus and also treat the other infections and symptoms that result from HIV infection.
3. Developing a vaccine against the virus. There are other infections (secondary) associated with HIV infection, table 21.3 (see attached).

16.5 Drugs

Many retroviral drugs have been developed. These are Azidothymidine (AZT), Zalcitabine Glycyrrhizin and Ribavirin. The success of these drugs is still being determined. The best way to prevent the disease is to look at how the disease can be contracted and avoid them.

16.6 Conclusion

In this unit, you have learnt about the nature of virus and the properties and characteristics, with particular reference to the HIV-AIDS virus. The process of infection and stages of development were also treated.

16.7 Summary

Virus is about 50 times smaller than bacteria; virus cannot carry out activities on its own like a cell. It lives in other living cells and thrives in such cells. It is non-cellular. Viruses do not have cell structure. They are difficult to culture even though they have been cultured in chick embryo. You have seen how the HIV virus can be transmitted. There is no

known method of treatment yet, even though some drugs have been developed and are being tried. The best method so far is prevention. Avoid all means of contracting the virus.

16.8 Tutor – Marked Assignments

- Mention two ways each by which HIV-AIDS can be prevented or treated. Suggest ways of caring for an HIV-AIDS patient.

- Describe various ways by which the knowledge of HIV-AIDS can be disseminate to all nooks and cranies of the nation.

16.9 References

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UNIT 17

SPACE EXPLORATION

17.1 Introduction

This unit is designed in such a way that a reading material is presented to assist you to further understand what you learnt in the previous unit. Carefully go through the material and attend to the activity below.

17.1 Objectives

By the end of this unit, you will be able to:

- Explain the technical application of the following terms in space exploration: (i) exploration, (ii) application and, (iii) research .
- Discuss the impact of research on space exploration.
- Analyse space exploration in the world today.

Activity 17.1

Read the article with the following questions as guide:

1. Who is the author of the article?
2. What is the main issue presented by the article?
3. How has the issue been viewed before this time?
4. What is the author saying is the contemporary view of the article?
5. What is the author's main contribution to the issue being discussed?
6. List major differences before and now with respect to trends in science education?
7. What are your own interpretations of what he/she is saying?
8. What are your own reservations?
9. Provide a guess as to what you think of where we are going with respect to this concept.

After going through it, attempt to answer the questions raised in the objectives for the unit. If you cannot do so effectively the first time, go through the article again until you are able to do so comfortably.

Space Exploration

Kuje Christopher

Three principal and overlapping areas of space activities include exploration, application and research.

Exploration

Exploration is the act of searching, the quest for discovery in outer space. For instance, on October 4, 1957, the Soviet Union astounded the whole world when it launched the 84 kilogram object into an orbit around the earth; moving at a speed of 28, 800 km per hour, sputnik 1 circled the earth in 1 hour 36.2 minutes. Its two radio operator's continuous signals that were strong enough to be picked up by a meteur radio operators. Sputnik 1 was the first of great number of unmanned vehicles that have been launched into space. Also the United States space craft called Apollo 11 with Neil A. Armstrong, Edwin E. Aldrin and Michael Collins where they spent 195 hours during flight and landed on the moon between 16th and 24th August 1969. It was the first manned landing on the moon.

Application

Application of space for man's use include meteorology, communication and geodesy.

Meteorology:

This involves the study of weather and some weather satellites have been developed for the past years. Weather satellites reporting cloud cover and storm patterns are of obvious day to day significance to the people of the world. These devices offer the advantage of showing cloud formations over large areas of the earth s surface by means of pictures taken with television cameras, and relayed by telemetering to the earth. The United States has launched many weather satellites into the space, so also the Soviet Union launched series of weather satellites into the space.

Communication.

This involves the transmission of information or messages between the outer space and the earth. Communication satellites afford the promise of extending, in effect, the available frequency spectrum by as much as several orders of magnitude. Communication as a result of highly complex and sophisticated weapons.

Moreover, space based-sensors for surveillance system generate a considerable amount of data. The transmission of these and other satellites for military purpose needs reliable and secure communication systems. Space has become an area of vital interest as some 80% of military communications are transmitted by satellites.
Among the communication satellites used in space by military include

i. Early warning satellites which they perform mainly for electronic reconnaissance function, particularly for monitoring telemetric signals emitted from missiles during their test flights.
ii. Electronic reconnaissance satellites and these are referred to as ear in space. They carry equipment designed to detect and monitor ratio signals generated by the opponent's military activities. These missiles or satellites also gather data on missile testing.
iii. Photographic reconnaissance satellites - detect, identify and pin point military targets. Some of these instruments can spot objects as small as 30cm in size. Both the USA and Soviet Union launch such satellites regularly and also peoples Republic of China. Of the military satellites launched by these nations, some 40% have been used for photographic reconnaissance purposes.
iv. Ocean - surveillance and oceanographic satellites. These detect back naval ships and determine sea condition which can for instance help in forecasting the weather or less determine sea condition which can for instance help in forecasting the weather or less innocently, in detecting submarines. Space based sensors include radar that can see through cloud and detect even small boats.

Geodesy: is primarily concerned with measuring the size and shape of the earth and deducing from these parameters some factors about the physical structure of the earth. Geodetic satellites have been developed for this purpose and they provide more accurate means for navigation and mapping of the earth.

Research: From unique information about the solid earth itself to new insights into extragalactic astronomy, space research affords innumerable opportunities, for advance in science.

Questions under investigation include

i. What has been learned of the upper atmosphere and near space so far?
ii. What does this Knowledge mean as a guide to further efforts?
iii What is the status of development of space system upon which future efforts depend?
iv What are the prospects of practical application of earth s
v. satellites?
vi. What is science deeply concerned of about the research prospects afforded by space crafts?
How can we best go about complicated business of properly and economically planning and conducting meaningful space activities?

Answers to such questions are easy but be pursed

Space Stations

Spaced stations are orbital space crafts. A space station must be placed in orbit around the earth or some other body such as the moon. This of course, makes a space station a kind of artificial satellites.

A space station is defined, built and maintained to accommodate an astronaut crew as well as non- astronaut passengers - Scientists engineers, communication specialist and others. This makes it a large manned artificial satellite.

But space stations are larger than the manned artificial satellites we know today.

They remain in orbit for a long time, they carry more passengers and they are more complex.

A highly complex space station may be expected to perform many different kinds of astronomical and astrophysical investigations. It might also be expected to serve as a facility where medical research, particularly research on the effects of space travel on man, can be conducted. It can also be used as space hospital for space travellers.

The space station might also serve as a space factory for manufacturing certain products on board. Some products can be space. The behaviours of certain materials in space could also be studied.

A section of the same space station could be given to biological studies. Another part of the station could house special cameras and other equipment to examine and monitor the land ocean below, study the earth's agricultural, mineral and other resources. Still other sensors could observe world wide weather pattern and atmosphere.

Space Science and Nuclear Technology

The area space science and technology has not been left out in the modern trend of scientific developments. The nuclear energy is the bedrock of nuclear technology, primarily responsible for production of power (electricity). Today however man has produced and is still producing lots of destructive arms and ammunitions. Examples include the Atomic bomb, Hydrogen bomb, missiles of all forms and so many others (Encyclopedia Americana).

In space science a lot more are being discovered. Presently the technology has advanced tremendously so much that unmanned space-crafts which are computer -controlled are in use, a lot of findings have been recorded. The space craft voyager 2 has left the solar system 12 years its lunch. A last close encounter showed clouds on blue and stormy Neptune, and suppressing ion triton, the moon with an ice-ceys of methane, and Volcanoes powered by nitrogen Eberhart (1989).

Knowledge of the Earth from Space

One of the areas of greatest potential yield of new knowledge is that of the exploration of the moon and planets as well as study their physical features, tectonic activities, magnetic fields and chemistries. There are many questions concerning the earth which satellites can help us to answer. They can enable us to determine more exactly the size and shape of the earth. Similarly the earth's electromagnetic field can be studied with end in mind of determining the earth's capacity and magnitude and origin of its electric charge.

Satellites can help us determine the resulting density, temperature, composition, the degree of molecular dissociation, the degree of ionization and excitation, all as functions of height, geographical position and time.

Finally, rockets and satellites can help us learn about the boundary region in which the earth's atmosphere blends into the near vacuum of outer space and all these are as a result of processes and products of science and technology. It seems likely that in the years ahead, we shall learn more about the earth by leaving it than by remaining on it.

17.2 Tutor – Marked Assignments

- Write a concise abstract for this article.
- Different between space science and nuclear technology.
- What is the meaning of geodesy?

17.3 References

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UNIT 18

ENVIRONMENTAL EDUCATION (EE)

18.0 Introduction

There is a growing concern the world over about the safety of the environment. These concerns are borne out of the fact that indiscriminate use of the benefits of technology is degrading the environment. Byproducts of exploration and human productive activities are creating all forms of health hazards. Sustainability is becoming a buzz word in every day language. It is therefore necessary that those who teach the sciences focus on the socio-cultural and environmental impact of what they teach.

18.1 Objectives

By the end of this section, you will be able to:

- Discuss the importance of environmental education.
- Relate sustainability to development in general.
- Explain how environmental education can be used to promote good ecological behaviour.

18.2 What is Environmental Education (EE)

Environmental Education (EE) refers to a multitude of processes and activities by which an understanding of the environment is developed and through which caring and committed concern for the environment is evolved. it is concerned with knowledge, emotions, feelings and attitudes about the environment. It aims at producing informed and responsible citizens capable of playing active role in matters concerning the environment in which they live as well as enhancing appropriate use of the environment. As most environment issues are multifaceted (social, economic and political), Environmental Economics is a multi-disciplinary field and therefore uses a multi-disciplinary approach.

In EE learners are equipped with the knowledge of ecosystem and current environmental problems and then are exposed to strategies for tackling such problems. The strategies include discussions, problem-solving, workshops, action research, decision making and explicit

constructive actions. EE adopts a holistic approach in that it involves all the clientele of the environment and disseminates information through formal and non-formal means. It spans all ages and all education levels.

The idea of Environmental Education action started since the inception of International Environmental Education Programme by UNESCO in 1975. During the 1977 Intergovernmental Conference held in Tbilisi U.S.S.R, EE was recommended and every country was advised to endeavour to incorporate EE into her educational programme continued co-operation with United Nations Environment Programme (UNEP) was proposed to supplement or extend activities of UNESCO's regular programme in EE particularly those involving research, experimentation, training of personnel, exchange of experiences and development of informal EE programmes, materials and publications.

Since 1977 many countries have embarked on EE programmes. This involves making deliberate attempt to include relevant environmental issues in educational programmes at all levels and various EE associations have been formed. Many countries incorporate issues in various curricula. Examples are Ethiopia, Burkina Faso, Indonesia, Latin America, India, Malaysia, Canada, Burundi, Korea and Japan to mention a few. Others, Bahrain, Kuwait, Qatar, Kenya, Burundi, Costa Rica have specific courses on EE at some educational levels.

The Faculty of education of Kuwait University offers EE course. Qatar University has course on EE called Man and Biosphere; in Bahrain it is called Population and Environmental Education. In Burundi primary school pupils have a specific course, Study of the Environment. The University of Costa Rica offers a semester-long course in EE conducted by the Faculty of Education as well as offers courses on environmental themes in Engineering, Law, Agronomy, Biology, Microbiology, Chemistry, Geology and Architecture. Numerous other examples abound.

Some countries have taken a step forward by including statements on EE in their constitution. For example, Polish 1980 Environmental Protection Law Article II states Schools at all levels are obliged to include environmental education in their curricula activities. The law further requires compulsory introduction of EE into all on-the-job training courses for workers. While EE issues are incorporated in various curricula at all levels, EE is further promoted

by the requirement of every graduating secondary and vocational student to write a project on environmental issue. Every year, the Ministry of Education and Nature Protection League organise a competition for the best project on protection and management of the environment. Consideration is also given to environmental training of biology and geography teachers who attend a one term course in Ecology and Environmental Education.

Activity 18. 1

List the Universities in Nigeria that runs Environmental Education programmes.

Kenya, the host country of United Nations Environment Programme (UNEP) leads other African countries in both planning and practice of EE. The Kenya Development Plan for 1979-83 specifically stated that:

Environmental consideration must be brought to the attention of every citizen. Hence EE will be introduced in the schools not as a separate discipline but as a dimension to be considered in various aspects of the curriculum.

Kenya educators have played significant part in developing environmentally conscious educational programme. Examples are The Science Education Programme for Africa (SEPA), 1974 Seminar on Environmental Education Methodology in East Africa. The Kenya Institute of Education prepares syllabuses and appropriate materials of incorporating EE into school curricula and subjects. At Kenyatta University, there is a special EE programme in the Faculty of Education. This programme has grown into a distinct unit, the Centre for Environmental Education.

In Nigeria, environmental topics are incorporated into school subjects such as geography and biology. Topics such as pollution, flooding and desertification are taught. It should nevertheless be pointed out that not up to fifty percent of Nigerian populace are exposed to formal education. Fewer still attain secondary education. Nigeria has not taken bold steps to ensure that EE is disseminated at all educational levels and within both formal and non-formal education as an opportunity for providing in-depth understanding of environmental problems in Nigeria and beyond, which affect Nigerians. For example, while many countries have strong and active Education, the Nigerian Association for Environmental Education was

initiated last year and is not yet active. Except for the University of Nigeria, Nsukka, no other University in Nigeria offers courses of EE for trainee teachers. The lack of explicit emphasis on EE in Nigeria might in part explain the nonchalant attitude of the youth and the general populace on issues of environmental concern. In places where EE programmes are developed, youths alongside with adults have participated actively in promoting environmental quality.

18.3 Youth's Environmental Action

In various countries of the world, the youth have been involved in environmental protection. There are hundreds of youth environmentalist groups all over the world. These youths have helped in improving their environment through enlightenment programmes, publication and practical conservation tasks. Some examples are India, Fiji, Thailand, Egypt, Eastern Europe, Costa Rica, Kenya, Malawi, Zambia, Cameroon, Sierra Leone, Malaysia, Sri Lanka, Scandinavian countries, Germany and Socialist countries. Some activities of these youth clubs are discussed below.

In India, the Kalpavriksha Youth organisation which was formed in 1979 by a group of students was concerned about the deterioration of the environment of Delhi and the inaction of decision makers many of whom expressed concern about the environment in seminar after seminar yet did nothing about it. This group in 1982 joined in a sustained nation-wide campaign against the draft Forest Bill 1980 which barred poor villagers from collecting forest products in any land declared as reserved. Due to sustained pressure, the Bill was withdrawn and new one drafted.

Gorakpur Environmental Action Group (GEAG) was founded in 1974 by few research students of Gorakpur University in Uttar Pradesh, one of the poorest areas in India. In 1982 GEAG involved students in this area in activities such as training courses, lectures and poster competitions on environmental issues. This resulted in formation of various Youth environmental organisations which were concerned with health, resources and need for environmental balance and sustainable use of natural resources. GEAG carried out projects and surveys in various industries, analysed effluents and brought results to the notice of authorities and the media. They stimulated the local people into protecting their environment.

The Fiji National Youth Council (FNYC) emphasizes holism of environmental action. The organisation stresses conservation in

consumer society and avoiding over consumption of natural resources. It promotes campaign on switching off the lights, avoiding electric fires, growing edible fruits in gardens and using public transport instead of buying a car. In Moscow, there exist several Student Nature Guards. This started at the University of Tartu in 1958. In 1960 ten students of the Faculty of Biology at the Moscow University formed a club directed against poaching. In 1974 the Youth Council for the Protection of nature was established at the Moscow State University to coordinate the groups which now are about 80 with about 500 memberships. The Nature GUARDS (Druzhinas) investigate and write reports on environmental issues such as nature resorts, recreation, parking spaces, pollution compounds and waste management.

In 1976 the Nature and Youth of Norway organised meeting with youth environmental organisations of United Kingdom and Germany to start an international project Acid Rain. This was necessitated by the need to increase awareness on effects of air pollution and to emphasize the need for international environmental protection. There were follow-up international campaigns in 1977, and in 1979 in which the International Youth federation for Environmental Studies and Conservation (IYF) became involved. In 1982, IYF and the NGI Secretariat on Acid Rain in Sweden published a special bulletin with a theme on Acid Rain. Since then, various international organisations have been organised on Acid Rain.

In Latin America, the concern of the Youth is conservation of the tropical forest. The Latin American Federation of Young Environmentalists are concerned with issues such as political ecology, tropical forest destruction, and the misuse of pesticides. The first Assembly was held in Honduras on July 6-14, 1981. Follow-up meetings have been held in Mexico 1982, Panama 1984, and Columbia 1985. These conferences were sponsored by UNESCO Man and Biosphere Programme, UNESCO Youth Division Rare Animal Relief Effort and the World Wildlife Fund. Several environmental groups have been formed throughout Latin America. An example is Ecotipo, a conservation group at the University in Argentina. Its activities include lectures on environmental legislation and protection, environmental impact analysis, production of audio-visual series about national parks and pollution problems which are shown to primary and secondary students, observation and discussion about collecting and processing rubbish in the environment.

Activity18.2

Name four Youth Environmental Groups and their missions that exist in the world

Africa Youths also participate in environmental protection. East Africa leads Africa in this regard. The East African Course on Environmental Conservation which was held in 1974 and the African Youth Leader training Course on Environmental Conservation Education in 1979 were both hosted by the Wildlife Clubs of Kenya. The Youth organisations of East Africa are primarily conservation clubs because East Africa recognises the importance of this resource.

The Malihai Club (Living natural wealth) of Tanzania has a strong national Youth organisation. The Wildlife Clubs of Kenya are the most prominent of all youth conservation groups in East Africa. It was founded in 1968 and involves thousands of Kenyans of all ages. Malawi has Wildlife Clubs run in 35 secondary schools and colleges. This club is coordinated by the National Environmental Office. In Sierra Leone, the Sierra Leone Environment and Nature Association (SLENCA) which involves the conservation of forest is essentially an afforestation club. It embarks on tree planting done by school children and young people who care for the trees till they survive and grow.

From the few examples of environmentalist youth organisations given above, it could be seen that each Youth Club addresses the problems and needs of its environment. While these organisations are national, they have full encouragement from the IYF (the only one global environmental organisation run for and by young people and which has an age limit of 30 years). UNEP and International Union for Conservation of Nature and Natural Resources (IUCN).

Concerning Nigeria, it has to be emphasized that while adults are busy forming their research oriented academic environmental groups youths who are the future leaders and adults are left behind. Numerous environmental problems which exist in Nigeria require attention of the youths at various levels. Examples are desertification, erosion, flooding, oil spillage, disposal of household and industrial wastes and pollution.

18.4 Suggestions

Environmental awareness cannot be adequately imbibed by Nigerians through once a month environmental clean-up. For the right and persistent attitude towards environmental protection to be cultivated, citizens must understand the ramifications of environmental problems and their consequences. Thoughts adequately structured will then culminate in a properly mediated action. The Federal Environment Protection Agency is the national body charged with the responsibility of promoting environmental quality. It should therefore adopt a holistic approach in playing this role.

Two suggestions are hereby made on what the agency could do in terms of enhancing environmental awareness. The first is that EE which is a foundation for appropriate environmental action should be deliberately incorporated into Nigerian Educational programmes. It is FEPA's responsibility to ensure that this is done. It is surprising to note that FEPA was not represented during the National Curriculum Review Conference which was held in Kaduna this year. FEPA should ensure that EE is built into the National Policy on Education for the Education Ministry to pay the required attention to it. It has to sensitize education ministries first to the need for EE through a national seminar and publications. Later, EE will eventually be disseminated to lower educational authorities. EE should also be incorporated into Adult Education and other non-formal educational programmes. All these should culminate in the second suggestion which is encouraging formation of youth environmental groups. FEPA should act as coordinator of these groups and link them up with UNEP and various other national and international environmentalist groups.

As Nigeria becomes more developed, future generations will have more serious environmental problems to tackle. Therefore, the future leaders should be prepared today for effective use of the environment for sustainable development by making them environmentally aware.

Activity 18.3

Identify any five National or NGO's on Environmental Education

18.5 Conclusion

In this unit, you have learnt the meaning of environmental education, the steps taken by some countries of the world on issues of EE, how

EE are incorporated into the School curriculum (especially in some African countries), various youths organization involvement in EE and suggestions towards enhancing environmental awareness in Nigeria.

18.6 Summary

The idea of EE action started with UNESCO in 1975. This was followed with the Tbilisi, U.S.S.R conference of 1977 where every country was advised to incorporate EE in their educational programme. Since then many countries have embarked on this programme. In Nigeria, environmental topics are incorporated in school subjects such as Geography and Biology. But of recent some tertiary institutions in the country have commenced running of both Diploma and Bachelor Degree programmes in EE. Various youth organizations across the globe have involved in EE issues. The formation of FEPA by the Federal Government of Nigeria and granting of certificate of operation to Non-Governmental Organisations (NGOs) are government supports to environmental issues.

18.7 Tutor-Marked Assignments

- What is the future of EE in Nigeria?
- Discuss the roles of the youth organizations in EE issues within and outside Nigeria?
- What will you consider as the factors facing the implementation of Tbilisi, U.S.S.R. Conference of 1977?

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UNIT 19

ENVIRONMENTAL EDUCATION: EDUCATION FOR AN ECOLOGICAL BEHAVIOUR

19.0 Introduction

This unit is designed in such a way that a reading article is presented to assist you to further understand what you learnt in the immediate past unit. Carefully go through the material and attend to the activity below.

19.1 Objectives

By the end of this unit, you will be able to:

- Demonstrate an understanding of environmental issues.
- List what should constitute an ecological education content.

Activity 19.1

Read the article with the following questions as guide:

1. Who is the author of the article?
2. What is the main issue presented by the article?
3. How has the issue been viewed before this time?
4. What is the author saying is the contemporary view of the article?
5. What is the author's main contribution to the issue being discussed?
6. List major differences before and now with respect to trends in science education?
7. What are your own interpretations of what he/she is saying?
8. What are your own reservations?
9. Provide a guess as to what you think of where we are going with respect to this concept.

After going through it, attempt to answer the questions raised in the objectives for the unit. If you cannot do so effectively the first time, go through the article again until you are able to do so comfortably.

Environmental Education: Education for an Ecological

Behaviour

Elly Reinders (National Institute for Curriculum Development, Enschede, Netherlands)

"What happens to the earth happens to the children of the earth. If a man spits on the ground he spits on himself. This we know: the earth belongs not to man, man belongs to the earth. This we know:
Everything is connected just as the blood that ties a family. All things are related..." Seattle.

Introduction

In 1986 a motorway was opened in the Netherlands. Not a spectacular event except that the motorway runs through Amelisweerd, a country estate of great natural-historical and scenic value. An action group entered into battle with the public authorities and even now it is a classic example of running a campaign against the destruction of
nature. Perhaps you have seen on television or in the newspaper the action leaders sitting in the trees to prevent them being cut. Anyhow, the problem of scarifying nature for motorways will be well known to most of you. The Indians of Seattle century are often cited as
examples of human beings who lived in harmony with nature. The motorway through Amelisweerd is an example of manipulating nature for the sake of the economic interest of man in our western society.

Should we liken the action group to Seattle's Indians? Do they regard the earth as their mother and the air as their father? Or do they use nature in another way to realise their social and political ideals?
Should environmental education guide our children to join an action group or to live as Indians? I think that we should look for solutions in accordance with our culture. This paper gives an idea about how environmental education can contribute to that other way of appreciating nature.

Ecological Thinking

Crisis in nature is caused by the attitude of western man to nature. That attitude is a result of our way of thinking, where economic profit dominates. Nature is the raw material for the production of consumer good and the environment is the dumping ground for the refuse of this process. To solve this crisis, we need to review our way of thinking about nature and environment. A way of thinking which nature and a healthy environment are seen as essential conditions of life. A way of thinking in which man regards himself as part of a system that has links with the past, extends into the future and to places far beyond

our own span of control. Human action should be defined by this notion. This way of thinking can be called ecological thinking. Does ecological thinking fit in our culture? Or is it as alien to us as wearing feathers or smoking the peace pipe?

Dutch farmers who have lived all their lives in close contact with nature can say things that point out that ecological thinking is not so strange in our culture. Working in their vegetable garden they told me: "I don't know why I am doing this, but I will leave this patch of ground in a better state than I found it". And: "To me soil is the same as an animal, you must take good care of it". And with the opening of the motorway through Amelisweerd the policemen who, years before, had to keep the action group away from the felling of the trees, said in an interview how emotional they felt at the sight of 600 mighty beeches falling down. But western man is so fixed upon satisfying short term needs that any interest in 600 beeches or a clean environment for our health or the future of our children is far beyond his immediate field of vision. Environmental education should re-establish the relation between our conduct towards nature and environment on one side and our health and future on the other. You cannot fit ecological thinking into present day education without any changes. Aims, concepts and student-activities must be adapted to achieve another attitude to nature. There is not much optimism as to the possibility of changing attitudes within the educational system.

Changing attitudes by education

Fleming's investigations proved that in their personal lives pupils did not use knowledge and insight gained at school. A change of attitude seems to be very hard to achieve. Moreover a change of attitude does not always lead to a permanent change in behaviour. So the prospects for environmental education are not very bright. But before we loose all hope, we should take into account the following factors:

1. Research into changing attitude and behaviour in education takes place, naturally within the existing educational system, which is not open to changes. Research-projects may stimulate pupils to change attitudes during one or two lessons, but in other classes or in the period of time after the project, these stimulations are nullified.
2. To change attitudes it is necessary to question the validity of norms and values. That means attention should be paid to the moral development of pupils. But in Dutch secondary education, and perhaps also in other countries, pupils are

confronted with the lowest stages of moral development, that is punishment and reward. A single project or theme in which pupils are stimulated to adopt a critical attitude, a personal opinion and a sense of responsibility will be considered an isolated incident by pupils related only to a certain subject or theme.

3. Another aspect is that our educational system and that of many other countries I presume, is subject-oriented. Even in topics strongly related to social phenomena every subject deals with itself and there is no link to everyday life. For pupils the usefulness of what they have learned stops when they close the school door behind them. A project that brings social aspects under discussion does not alter the process at the school door.

4. And last but not least: the social situation does not help. An environment-friendly attitude is not the easiest road to great social and personal success in society today. In education one often thinks that when the education itself is good enough the desired change will automatically take place. But to change your behaviour demands a lot of mental energy in and out of school. Pupils must be very motivated to be prepared to offer that energy.

Must we accept that changes of attitude and behaviour are not possible? Not if we look at the success of advertising. However advertising preaches day in day out that a particular behaviour improves future prospects, a better career, more success with partners, a better future for your children and a better old age for yourself. Environmental education should follow suit, pupils should hear daily that a healthy environment is important for their own health, for their happiness and for their future.

The content of environmental education

It is said that environmental education can only be incorporated in the final years of secondary education due to the complex concepts and skills involved. But research (Novak) shows that it is possible to teach complex notions to young pupils, if you use the right didactical methods. But moreover I wonder if the complexity of a concept depends largely upon the way in which we have always taught pupils from childhood to look at the part instead of the whole, to be analytical rather than integral? In Seattle's area, Indians did not know

the word ecosystem. They did not receive environmental education. However, they were familiar with the phenomenon ecosystem and dealt with it very well. The same goes for many older farmers. Likewise they did not know the word ecosystem and received no environmental education. Before the government took measures they also knew that too much dung on their fields is not good for nature.

The way they treat their vegetable garden shows a greater understanding of the ecosystem than the irresponsible manner in which they spread too much dung over their farmland. Ecosystem may be an abstract notion in the scientific sense, but it should be possible to revert it into an everyday phenomenon. What should pupils know about everyday phenomena to handle sensible? It is not necessary to know everything about the IMF and the balance of payments to handle money sensibly. But why should pupils then describe ecosystem in terms of energy-flow, circular courses etc? Reflection of ecosystems from system theoretical principles is only possible at the end of higher general secondary education and pre-university education, and that group is too small to solve the crisis in nature.

Environmental education should give pupils from childhood the awareness that environment is important, has a value, that one has to deal with it carefully, that one can only spend it once. Environment should receive the same importance as money. In what way should the existing education change to educate pupils in that awareness? The existing science education in the Netherlands, but I presume in other countries too, shows children the part instead of the whole. Plants are unravelled in parts that are logical in a biological sense. Root, stalk and stem are considered in turn one after another. The plant, as a total phenomenon, in its natural environment with the organism it is related to is overlooked.

In many Dutch classrooms, in secondary education pupils dissect a tulip. Why not: it is tangible, pupils are active with their hands and it has to do with every day life. Or hasn't it? For children flowers are not relevant as reproductive organs of plants. Tulips can be bought by the bunch in a flower shop, you give them to your mother on her birthday. They are one of the first signs of spring. They are a sign of happiness or sorrow. And an introduction if you visit someone. All these meaning of flowers determine the attitude of children far more than the biological meaning.

So when environmental education should lead to another behaviour with nature and environment it should also incorporate these meanings. Only then can pupils make the link between what they learned and their attitude and behaviour. They should understand entities, not only at the biological or scientific roles of the object but also how that object fits into the world of a child.

Appreciation of nature

For ecological thinking you need ecological feeling as well as ecological knowledge. Environment and the natural elements in it should have a value for the pupils. Environmental education should give the opportunity from childhood on how to build up a relationship with nature. Most children start with positive feelings about nature, but education makes little use of fact. In the Netherlands domestic animals such as rabbits, guinea pigs and hamsters disappeared out of the classroom because of allergies. But the pig group of domestic animals, like snails, worms, flies and spiders could replace them very well. An aquarium is a good example of an ecosystem, and there is a lot of life in the field near the school. Children don't need rare species. Fieldwork in many forms should be part of environmental education.

A longitudinal curriculum-strategy for environmental education

Education to ecological thinking will not succeed if it is only started in secondary education. It is process to which should be worked at structurally.

For ecological thinking it is necessary that:

- Environment and nature get a value of their own for children.
- Children learn to appreciate that environment and nature can have a different value for different people.
- Children acquire an insight in the development of natural systems in time and space
- Children acquire an insight in the relations between man and environment and the different ways to approach them.
- They learn to handle problems and dilemmas.
- They learn to develop views of their own and to make choices.

Environmental education should start early to realise these conditions for ecological thinking. If we train our children during primary education to look at parts, then environmental education in secondary education will be very difficult.

Primary education

Primary education can work at development of values, i.e. allowing children to experience their environment and the natural elements in it. By making them aware of what they do and what they think is nice and important to live in that environment. They become acquainted with other values that people can have for nature and its value for plants and animals. Primary education can introduce pupils to and become familiar with relations and developments in nature as phenomena. And with the part man played in creation of their environment. In short, environmental education in primary education should focus on value development, introduction and the pupils' familiarity with the environment.

Secondary Education

Secondary education should continue value development by working and learning in the environment and awakening feelings and interests in the pupils themselves. Secondary education should systematically work on knowledge and understanding of relations and development. In the lower classes problems and dilemmas can be presented as phenomena. In the higher classes a confrontation with problems and dilemma should lead to solutions, to choices and points of view. A more scientific approach of man - environment relationships is more appropriate. In short; environmental education in secondary education should focus on value development, development of knowledge and understanding, handling problems, dilemmas and making choices.

The above-described structure can lead to an integral environmental education, in which the conditions for ecological thinking are structurally achieved. It seems worth while to realise such an integration of environmental education in the existing school system, thus within the existing subjects. One can call this a longitudinal curriculum strategy for environmental education.
Is such a longitudinal strategy possible and necessary in the existing educational system?
A few decades ago, one Sputnik considerably strengthened the position of science education in the western world. Why shouldn't a global crisis in nature do the same? Besides a crisis there should also be a social movement. I think this movement exists. Education

should take its turn in making social phenomena and developments with regard to environment, understandable and manageable. That is possible within the existing subjects, if the contents are chosen because of their importance in personal and social life. The desired attitude should determine the choice of knowledge and skills. But why is it not sufficient to incorporate from time to time a theme such as acid rain or air pollution in the existing programme? Then the analysing and manipulative way of treating nature keeps the upper hand. That does not alter attitudes. Environmental education as an ever-present theme in different subjects gives pupils a more real and differentiated idea of life. It teaches pupils to cope with various views and equips better for life. Environmental education as an ever present theme should make a motorway through a nature reserve as strange as a motorway through Rembrandt's Nightwatch. Then we can speak of ecological thinking.

19.2 Tutor-Marked Assignments

- Develop a concise abstract for the article.
- What in your own opinion constitute ecological thinking?
- Use the extract from the above article to support the augment for inclusion of environmental education into the primary education curriculum

19.3 References

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UNIT 20

ENHANCING ENVIRONMENTAL PROTECTION IN NIGERIA THROUGH ENVIRONMENTAL EDUCATION

20.0 Introduction

This unit is designed in such a way that a reading article is presented to assist you to further understand what you learnt in the immediate past unit. Carefully go through the material and attend to the activity below.

20.1 Objectives

By the end of this unit, you will be able to:

- Explain how oil exploration activities are degrading the Nigerian environment.
- Discuss meaningful ways in which occupants of an environment can help in protecting their environment.
- Explain the role of environmental monitoring action groups in protecting the environment.

Activity 20.1

Read the article with the following questions as guide:

1. Who is the author of the article?
2. What is the main issue presented by the article?
3. How has the issue been viewed before this time?
4. What is the author saying is the contemporary view of the article?
5. What is the author's main contribution to the issue being discussed?
6. List major differences before and now with respect to trends in science education?
7. What are your own interpretations of what he/she is saying?
8. What are your own reservations?
9. Provide a guess as to what you think of where we are going with respect to this concept.

After going through it, attempt to answer the questions raised in the

objectives for the unit. If you cannot do so effectively the first time, go through the article again until you are able to do so comfortably.

Enhancing Environmental Protection in Nigeria through Environmental Education

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Abstract

This paper discusses issues on environmental degradation resulting from the oil industry and other development activities. It observes that poor attitude and ignorance are among the major factors. It arrives at the conclusion that the onus of protecting each environment lies primarily on the occupants of the particular environment. It proposes a holistic approach to environment protection in which all will be involved in environmental monitoring action. It uses examples from various countries to show that creation of awareness on environmental issues particularly among the youths can stimulate grassroots environmentalist groups and contribute in enhancing environmental conservation and protection. It finally calls on the Federal Environmental protection Agency (FEPA) of Nigeria to ensure that Environmental Education is given a place in the National Policy on Education which is being revised so that issues of environmental concern particularly in Nigeria will be incorporated into the relevant curricular for schools in future. The agency should also endeavour to encourage formation of youth environmental action groups in Nigeria as a means of facilitating environmentally aware future generations.

Introduction

The discovery of mineral oil in Nigeria transformed the economy of the country. By 1962, petroleum exports accounted for only 10% of the country's export earnings. At this period, agricultural products were the major foreign exchange earner. During this period the capital expenditure under the First National Development Plan (1962-1968) was about EQ \O (N, =) 2.2 billion. By 1973 oil contributed 82.7% of the country- foreign exchange earner and in 1990, 90%. The massive foreign exchange earnings have led to massive and rapid expansion in government expenditure, industrial, commercial, agricultural, infrastructural and educational development within the two decades. Despite these economic gains, it is important to note that development is meaningful only if it is sustainable.

Sustainable development1 simply implies development without destruction. It implies utilization of resources available at present without depriving future generations of facilities for effective living. The oil industry has been the backbone to rapid development in Nigeria. Nevertheless, the accompanying degradation of attitude and environment cannot lead to sustainable development. While the degrading impact of the oil industry on the environment is discussed below, it should be realised that the consequences observed are a result of degraded thoughts and attitudes manifesting on misuse of the physical environment.

The oil-producing communities primarily bear the consequence of the oil industry. Between 1976 and 1990 a total of 2796 oil spill incidents were reported. This involved an estimated 2,105,393 barrels of oil seeping through, floating on or devastating the environment. An example was the Funiwa - 5 explosions of 1980 in the Delta creeks of Port Harcourt which led to contamination of drinking water, mass destruction of marine life and vegetation. There are constant minor spills in oil producing areas of Bendel, Rivers, Akwa Ibom, Imo and Ondo States. These states suffer consequences of oil spills including death as a result of drinking of polluted water, oil spills halt economic activities such as fishing and farming. The long term effect of oil spillage includes traces of oil in surviving organisms and little environmental restoration several years after the spill. The dangers of transferred effect of oil spill from aquatic creatures to human beings should give Nigerians some concern particularly at this time when many Nigerians depend on frozen fish as their major source of protein. In Japan, in 1956 hundreds of inhabitants of the village on Minimata died or gave birth to deformed children because they ate fish which had accumulated mercury from polluted sea in their tissue.

Apart from oil spills causing pollution, effluent water from oil refineries have devastating effect on the environment. For example, the NNPC oil refinery in Kaduna discharges crude oil effluent into River Roni a tributary of River Kaduna. This effluent is alleged to contain dangerous metals. It has been reported that wells located near the oil refinery in Kaduna contain mixture of oil and water as a result of oil seepage. The villagers who have no other source of water supply are therefore in a dilemma.

Oil industry also contributes to air pollution. Hydrocarbons from fumes of oil stations and flaring gas not only contribute to greenhouse effect which has led to global warming with its

destabilising consequences on the ecosystem but has also led to acid rain which is observable in certain parts of oil producing communities in Nigeria. It has been reported that acid rain has corrosive effect on zinc roofs of some oil producing communities and therefore some people change their roofs twice in a year, while some have resorted to using thatched roof. The effect of acid rain on the yield of crops is obvious as it impairs photosynthesis.

Other consequences of the oil industry include deforestation and noise. The impact of deforestation in oil mining sites is worth mentioning. As soil is removed, soil erosion and flooding occur. Also each tree cut without being replaced contributes to accumulation of carbon dioxide in the atmosphere.

Noise or vibrations from drilling equipment is an environmental hazard which should be recognized. Dejardin documented that it has been established that prolonged noise over 85dB can cause hearing damage. It was reported that in 1989 October when ELF Producing Nigeria drilled its oil well OBN 97/5 located near Oboburu village in Ahoada Local Government Area, many villagers deserted their houses because the noise was unbearable. It was reported that the vibrations pulled down walls and ceilings of the community school. A frightening incident which occurred at an oil producing community in Nigeria which has not been proved to be as a result of mining activity is a slight tremor which lasted for forty-five seconds at about 6.30 a.m. on February 14, 1990.

Basic Causes of Increasing Environmental Degradation in Nigeria

Considering the basic causes of environmental degradation in Nigeria and the world, poor attitude (selfishness) and ignorance are seen as being among the major ones. Concerning selfishness, it is clear that the major principle pursued by every entrepreneur is profit maximization. Thus industrialists try all possible means to reduce costs. Some examples can be given. It was reported that four years after Muniwa oil spills some of the areas had not been cleaned. Several oil companies have been reported to have improper drainage to the detriment of the inhabitants. For example, ELF Producing Nigeria built a culvert to drain rain water from its oil well at Oboburu and in the process blocked the only existing pipe in the village causing submergence of several houses and the village market. Shell's poor drainage at Imirigi has also caused over flooding and destruction.

While spillages are not properly cleared, compensations are often under-paid and delayed despite the Petroleum Act Nos. 21 and

23 of 1969 of Nigeria which indicates that there should be fair and adequate payment of compensation. It could be argued that foot-dragging attitude of oil companies in clearing oil spills and in compensating for damages is because they feel that it is Nigeria government responsibility to repair ecological damage resulting from the oil industry as it takes the bulk (about 95 percent) of the oil revenue. Thus, the buck-passing which goes on between oil companies and Nigeria on the above issue affects destructive consequences of the oil industry while some live in abject misery amidst affluence and high technology. It seems that the Petroleum Act is not specific in operational terms on payment of compensation, hence oil producing communities do not have strong legal backing.

Oil spillage is an environmental hazard which could occur in any oil industry anywhere but unlike in Nigeria, the developed world is committed to the welfare of both the victims and the environment. In developed countries, both the government and individuals are aware of the need for maintaining equilibrium of the ecosystem and hence are concerned whenever this equilibrium is disrupted. The oil companies therefore try their best to maintain environment quality. An example could be given with the Oil spill in the Gulf of Alaska in 1989 involving an Exxon tanker. The clean up cost to Exxon was $1.28 billion dollars.

Exxon's commitment towards maintaining environmental quality was such that it was reported that even individual rocks showing traces of oil were wiped with absorbent pads. Otters, a key stone species which helped to maintain ecological balance as they feed on urines which feed on the kelp beds were saved. Exxon eventually saved about 230 otters at the cost of about $40,000 dollars each. For fishermen who did not catch as many fish as in the previous year Exxon paid the difference. Native villagers on the sound whose hunting and fishing were disrupted had free groceries supplied to them. Despite all the effort made by Exxon, in the end, 145 law suits were filed against it. In Nigeria, oil companies provide oil communities with drinking water in tanks whenever their water is polluted and give some compensation. Nevertheless, if there were full awareness of the amount of environmental despliation committed by the oil industry the demands, may be, could have been more stringent.

Concerning ignorance, the oil communities contribution in despoliation of their environment through sabotage which is said to contribute 2-5% of oil spillage in any area, is an act of ignorance.

While the basic purpose is to extort money from the oil companies, the harm done to their environment is irreparable.

Apart from environmental degradation caused by the oil industry the Nigerian environment is fast deteriorating due to improper disposal of household refuse and wastes from numerous industries in the country. The problem of managing household waste still persists despite the last Saturday-in-the month national environmental clean-up. The mixed wastes which are collected in a central dump emit horrible stench, block roads and drainage and pollute water sources. Numerous industries in the country, including battery manufacturing, steel, paints, plastics, chemicals, fertilizer, textile, breweries and cosmetics dispose poisonous wastes such as hydrogen sulphide, ammonia salts, phenols, chromium, copper, acids, lead, arsenic, mercury, zinc, cyanides, phosphates, dyes and caustic soda. These degrade the environment and are harmful to human beings. Other examples of environmental degradation which are often ignored is scarification of land caused by excavation of soil for road construction, pits left after open cast mining (examples, Limestone and tin ore). Other environmental pollutants result from the use of pesticides and insecticides.

Attitude and ignorance and some of the major factors of environmental degradation go beyond the oil industry. The numerous pits left after open cast mining in the Jos area which has claimed many lives, and the toxic waste dumped in Koko by an Italian company in 1988, all display attempts on the part of entrepreneurs to maximize profit. The 2,000 drums of toxic waste stored in Koko, alleged to contain polychlorinated biphenyls would have cost the company 1,500 - 2,000 per tonne to treat in Britain. The villagers at Koko accepting the toxic waste as fertilizer, applying the thick dark paste on their crops and even using the empty drums for storing water, were all acts of ignorance. Another display of ignorance is by inhabitants of Paka village, 16 kilometers from Kaduna metropolis where acid and caustic wastes discharged from the textile industry made River Kaduna sudsy and the villagers regard the sudsy water as a blessing and use it in washing their clothes and in bathing.

The fundamental causes of environmental degradation discussed above show that the onus lies on the individuals to protect their environment. Therefore, an environmentally aware populace is an essential prerequisite for attaining environmental protection. Environmentally aware citizens will not only refrain from destroying

their environment as in the case of sabotage by oil producing
communities in Nigeria but also will, with full knowledge and critical mind, be involved in effective monitoring to ensure effective use of the environment. Environmental Education is therefore a necessity in Nigeria.

20.2 Tutor-Marked Assignments

- Explain how you will assist an oil producing community on issues related to environmental degradation.
- Environmentally aware citizen is an essential prerequisite for attainment of environmental protection". Discuss.

UNIT 21

TOWARDS ENVIRONMENTALLY SUSTAINABLE DEVELOPMENT IN THE PETROLEUM INDUSTRY

21.0 Introduction

This unit is designed in such a way that a reading article is presented to assist to assist you to further understand what you learnt in the immediate past unit. Carefully go through the material and attend to the activity below.

21.1 Objectives

By the end of this unit, you will be able to:

- Analyse the general ecological impact of oil spillage in Nigeria.
- Discuss the regulations to control oil spillage and other environmental hazards in the oil industry.

Activity 21.1

Read the following article with the following questions as guide:

1. Who is the author of the article?
2. What is the main issue presented by the article?
3. How has the issue been viewed before this time?
4. What is the author saying is the contemporary view of the article?
5. What is the author's main contribution to the issue being discussed?
6. List major differences before and now with respect to trends in science education?
7. What are your own interpretations of what he/she is saying?
8. What are your own reservations?
9. Provide a guess as to what you think of where we are going with respect to this concept.

After going through it, attempt to answer the questions raised in the objectives for the unit. If you cannot do so effectively the first time, go through the article again until you are able to do so comfortably.

Towards Environmentally Sustainable Development in the Petroleum Industry

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The dilemma of development and environmental protection, otherwise known by the cliché Sustainable Development, is perhaps nowhere better exemplified than on the issue of the fossil fuel energy source called petroleum and the environment. Petroleum is the most valuable and versatile fossil fuel; but, world-wide, environmental lists are calling to question the capacity of the earth environment to cope with the overwhelming burden of pollution that is associated with the estimated twenty trillion dollar world economy run on fossil fuels.

In Nigeria, petroleum is the backbone of the economy, accounting for many years, over 90% of the foreign exchange earnings and over 70% of total Government revenue. It is also a pillar of our foreign diplomatic confidence, according us a pride of place in the comity of nations. However, upstream and downstream activities from exploration production through transportation, marketing and utilization of petroleum (whether oil or gas) leaves in its trail diverse environmental problems of varying degrees depending on form and cause.

Spills during exploration, production, transportation, hydrocarbon processing and marketing are a major hazard on the environment both in the short and long terms. Most oil pollution episodes are usually a result of improper disposal of drilling muds, shipping and terrestrial traffic accidents, oil well blowout, off-shore and on-shore production accidents, tank washing and oil ballast discharges, depot leakage and failure or rupture in oil pipelines, to mention a few. Within the past two decades, this country has recorded over 3,000 oil spill incidents with over 24 million barrels released into our territorial, coastal and off-shore marine environment. The most memorable case of large scale small-spill disaster is the Funiwa-oil well blowout in 1980 when over 400,000 barrels of oil were spilled.

Needless to recount are the various aspects of environmental degradation caused by oil spills. However, the general ecological impact of oil spills includes:

(i) Decrease of fisheries resources and damages to wildlife such as sea birds and marine mammals;

(ii) Human hazards through eating of contaminated sea food;
(iii) Decrease of aesthetic values due to unsightly slicks on oiled beaches;
(iv) Modification of the marine ecosystem through elimination of species, decrease in ecological diversity, biomass and productivity; and
(v) Modification of habitat leading to delay in recolonization and succession.

It is pertinent to mention that the mangrove swamp zones and the off-shore areas of the Niger Delta which consist of the country's most produce biological areas are the most vulnerable to spills. Another major source of environmental degradation in Nigeria is gas flaring. I recall that one scientist once estimated at a seminar in 1987 that the wasted heat and energy from flaring gas in 1986 was equivalent to all the electrical power generated from NEPA that year!

Combustion of refined petroleum products, an indispensable process in power generation for transportation and industrial processing, release gaseous emissions of varying composition and toxicity into the atmosphere where they affect plants and animals. They also cause irritation of lungs and pose serious threats to the health of people especially those prone to asthma, bronchitis and heart complications. In our cities, household petrochemical products such as polythene bags, plastic containers, styrofoam packages, and tyres are, by their nature, non-biodegradable and have become difficult municipal wastes. Perhaps the most disturbing is the issue of crankcase oil disposal from mechanic workshops, industries, power stations and Commercial Houses about 20 million gallons of crankcase oil and other potentially waster oils are released into the Nigerian environment annually. This is aesthetically unpleasant. It also prevents growth of flora and soil fauna and contaminates surface and underground water. Continuous handling of lubricants and other petroleum products without protective clothing and masks can cause skin diseases, respiratory problems and gastrointestinal disorders.

This trend should not continue. If we are to put the country on a path that is equitable, environmentally sound and hence sustainable, practical strategies must be developed and implemented. The need to address the dilemma of development and pollution in the petroleum sector through the establishment of consistent pragmatic policy strategies has been recognized in Nigeria by government, oil prospecting companies, researchers and the affected communities for

quite some time. However, the imitation of this Biennial Seminar Series in 1979 was the first time a constant forum was put in place to address the issue and share information both on the problems and the Best Available Technology to solve them. I wish to commend the foresight of the founding fathers of this Seminar series and also acknowledge the achievements made so far.

On the issue of oil spills, the first level response contingency plans of specific oil companies for minor oil spills as well as the cooperative contingency plan of the Clean Nigeria Association (CNA) for medium oil spills are commendable initiatives. However, their inadequacy to deal with major oil spills informed government to set up the International Committee for the Formulation and Emplacement of a National Oil Spill Contingency Plan. The plan, when finally released, will assist the Federal Environmental Protection Agency (FEPA) to fulfil the mandate of section 22 of Decree 58 of 1988 which requires the Agency to prescribe, among other things, specific methods and National Contingency Plan for the removal of hazardous and oil-related pollutants discharged into the Nigerian environment.

The heart-warming news to environmentalist is that given by the Honourable Minister of Petroleum and Mineral Resources at the 1991 Shell Health, Safety and Environment (HSE) Week with respect to gas flaring. In the words of the Honourable Minister, our Chairman today, Professor Jubril Aminu, the Ministry of Petroleum Resources intends to stop flaring of associated gas in all of Nigeria s oil field, and has gone ahead to initiate a number of agreements which would soon be signed for harnessing and supply of associated gas for large industries, power generation both as fuel and feed stock for downstream petrochemical industries like fertilizer etc, and of course Liquidified Natural Gas (LNG). This is welcome news to the Agency.

Perhaps one area that needs the most attention and accelerated action by FEPA is the issue of pollution and waste management in the oi industry. The relatively high lead content in our gasoline introduces lethal pollutant into the environment in an aerosol of both particulate lead and unburnt hydrocarbons, and has led several physicians and researchers to describe the hazards of lead pollution in horrific terms, suggesting that auto exhaust contributes significantly to the silent epidemic of lead toxicity. It is gratifying to note that the Ministry of Petroleum and Mineral Resources has been addressing the issue since 1989. This singular effort by the Ministry, I recall, was publicly

acknowledged by President Bush of the United States of America in April 1990, during the White House Conference on Scientific and Economic Research Related Global Change.

In dealing with the remaining but multi-dimensional areas of pollution and oil waste management, FEPA has adopted a phased-approach. First, it prescribed and established the National Guidelines and Standards for Pollution Control with particular reference to the manufacturing industries and those that use petroleum products. Second, it enacted two appropriate and binding regulations, which

(i) make it mandatory for industrial facilities to install antipollution equipment and
(ii) spell out generators liability, permissible limits, restrictions, strategies for waste reduction, industrial facility contingency plans etc. The third regulation on hazardous waste management has just been signed and will be released to the public very soon. It is now mandatory by law for all operators of facilities generating wastes, processor of wastes and consultants to obtain permits and licenses for their operations from FEPA.

Having put in place institutional framework for tackling pollution by industrial facilities, the next logical step is the issue of prescribing environmental guidelines and standards for various economic sectors as detailed in the National Policy on Environment. In this connection, I acknowledge the steps already taken by the Department of Petroleum Resources to establish a set of self-regulating guidelines by producing the Sectoral Guidelines for Operational Safety in the Petroleum Industry. The document has been submitted to the Federal Environmental Protection Agency. Although FEPA is yet to give its official comment, I am happy to say that the document will no doubt assist the oil companies to comply with the National Guidelines and Standards for Waste Management in the Oil Sector now under preparation by FEPA.

In accordance with all the information available, the National Guidelines and Standards will among other things:

(i) Ban the dumping of drilling muds and cuttings in dry land and onshore areas;
(ii) Stipulate provisions for cleaning the existing waste pits within specific deadline;
(iii) Give due regards to the stipulations of the London Dumping

Convention already ratified by Nigeria; and

(iv) Prescribe recycling of crankcase and other waste oils as the viable option to solving the problem of oil pollution in our cities.

The Draft of the National Guideline and Standards for Waste Management in the Oil Sector will be presented to you before the end of the Seminar. Mr. Chairman, Your Excellency, the Governor of Lagos State, Distinguished Ladies and Gentlemen, the environmental protection effort enumerated above is the joint achievement of all of us, particularly, government agencies, the oil companies, the Nigerian public as well as the international community. But our goal is far from being achieved. We need to remove the anxiety of the Nigerian Society with respect to their health, and the overwhelming degradation of their environment while they are striving to share in the blessings of petroleum as the backbone of our economy. This is the basic tenet of sustainable development.

The widespread awareness of the common ecological threats posed by the petroleum industry which has informed our present common concerns also requires that we resolve to take common actions. In this connection, our local actions are the most important to save our people and their offspring from these apparently local problems but which themselves are the cause of the now popular global environmental issues such as global warming, climate change, ozone layer depletion and loss of biodiversity.

In a few months time, the Untied Nations Conference on Environment and Development (UNCED) shall be holding in Rio De Janeiro, Brazil. Although, the Interministerial Committee set up by FEPA to articulate Nigerias position has been working very hard, and many Ministries and Agencies have actually sponsored representatives to attend all the technical Preparatory Committee Meeting (PRECOM), I still urge this seminar to assist in enriching Nigeria s position especially on such issues as Carbon Tax, bearing in mind our requirement for development, our membership of the OPEC as well as our environmental goals of resource management and pollution control.

I am aware that this seminar has the issue of Environmental Impact Assessment (EIA) as a major sub theme. FEP will be waiting for the outcome of deliberations on this sub theme to enrich its stock of information on Impact Assessment in the oil sector. However, the

issue of Environmental Performance Appraisal, commonly call AUDIT (which is a systematic examination of performance to ensure compliance with requirements) needs to be taken more seriously especially in association with their insurance policies. This is the only way that oil companies can ensure that when they buy new sites, they do not inherit invisible environmental problems such as groundwater pollution. Insurance policies may be a good security against risk but the best security against Environmental Pollution is a thorough EIA or AUDIT. Only recently, a court ruling, for a clean up in Colorado USA, awarded a two billion dollar ($2 billion) bill against a major oil company for groundwater pollution resulting from Arsenic on a site acquired without thorough auditing. None of the over 800 different insurance policies of the oil company covered this particular risk. Even here in Nigeria, community leaders from oil-prospecting areas bombard my office regularly seeking compensation. But the question that comes to my mind each time is how can the polluted environment itself be fully compensated? FEPA is currently working out modalities for evoking Section 21 of Decree 58 of 1988 which spells out spiller liability.

Distinguished ladies and gentlemen, the problems I enumerated earlier, that is, oil spills, gas flares, industrial and vehicular fumes, crankcase oil, plastic containers, polythene bags, etc, constitute our wastes that are littered around us. They remind us not so much of the extent of our wealth, but of the carelessness of our actions. Our lifestyles pose a risk not only to our own kind, but to the environment of generations yet unborn. How sustainable are current actions in the petroleum industry for the development of our country Nigeria? In the face of the new technologies currently available to reduce the waste of oil in the environment, we have no excuse not to update the policies and practices that have fouled our fragile ecosystem. This is the challenge before this forum. And if we must act, the time is NOW!
Dr. Evans O. A. Aina
Director/Chief Executive

21.2 Tutor- Marked Assignments

- Develop a concise abstract for the article
- Discuss the general ecological impact of oil spills on living organisms.

UNIT 22

DESERTIFICATION

22.0 Introduction

This unit is designed in such a way that a reading article is presented to assist you to further understand what you learnt in the immediate past unit. Carefully go through the material and attend to the activity below.

22.1 Objectives

By the end of this unit, you will be ale to:

- Describe the situation of the world environment, and your local environment.
- Explain how man has tampered with the environment.
- Differentiate between man-made environment and natural environment.
- List the areas of the environment that have been badly tampered with.
- Write short essays on afforestation, deforestation, desertification and landslide.

Activity 22.1

Read the article with the following questions as guide:

1. Who is the author of the article?
2. What is the main issue presented by the article?
3. How has the issue been viewed before this time?
4. What is the author saying is the contemporary view of the article?
5. What is the author's main contribution to the issue being discussed?
6. List major differences before and now with respect to trends in science education?
7. What are your own interpretations of what he/she is saying?
8. What are your own reservations?
9. Provide a guess as to what you think of where we are going with respect to this concept.

After going through it, attempt to answer the questions raised in the

objectives for the unit. If you cannot do so effectively the first time, go through the article again until you are able to do so comfortably.

Desertification
Joshua R. A

Introduction

Desertification is one of the most serious problems facing the world today. Large parts of the dry areas that cover more than one- third of the earth' land surface are being degraded with serious effects on the environment, food production and the lives of millions of people. As if this is not enough, intensive exploitation of forest productions and the abuse of vegetation cover also continue unabated in southern Nigeria which are increasingly susceptible to flood.

Desertification, characterized of soil and vegetative cover, can occur in dry area, not just on the fringes of natural deserts. It is a global phenomenon, affecting both development and developing nations. In savannah belt of Nigeria particularly in areas like Borno, Kano, Katsina and Sokoto States the menace and threat of encroachment is ever increasing.

What Is Desertification?

Desertification is the degradation of land dry areas, some key definitions of desertification, briefly describes the general distribution of dry lands and reason for their occurrence, distinguishes between desertification and natural desert, and introduces the two main physical characteristics of desertification- the degradation of soil and vegetation. Desertification is not the desert expansion of population imagination, instead it is essentially a subtle, dispersed and continuous process which mainly occurs far away from desert fertile land into desert only taking place in extreme cases.

Definition

UNCOD define desertification as "the diminution or destruction of the biological potential of the land and can lead ultimately to desert-like conditions".
Dregne 1985 referred to desertification as "impoverishment of terrestrial ecosystem under the impact of man... the process of decertification in these ecosystems that can be measured by reduced

productivity of desirable plants, undesirable alterations in the biomass and the diversity of the micro and macro fauna and flora, accelerated soil deterioration, and increased hazards for human occupancy.

Characteristics of Desertification

The two main characteristics of desertification are the degradation of soil and the degradation of vegetation. Degradation of vegetation occurs in the early stage of the desertification process. When deforestation makes soil more susceptible to wind and water erosion, the vegetation cover of an area may be said to be degraded when it becomes inferior to:-

(a) What the land could be expected to support taking into account, the climate, site conditions and historical experience.

(2)What the area needs for the purpose of the environmental protection.

Degradation of soil occurs in four ways: water erosion, wind erosion and compaction and water logging, salinization and alkalinization.

Causes of Desertification

What causes soil and vegetation in dry lands to become degraded can be seen in two (2) main ways; the DIRECT and INDIRECT ways. Seen in this way, DROUGHT is an "indirect" cause of desertification because it exacerbates POOR LAND USE which is the "direct" cause of desertification.

Drought

Drought is extended periods of below average annual rainfall. They are not unique to dry lands, although in these areas a drought can have devastating social, economic and environment environmental consequences. Nevertheless, the occurrence of drought is a normal part of life in dry areas and farmers have traditionally planned their operations accordingly. When drought becomes longer or more sever than usual, problems arise, and humans and animals may die from lack of food or water. This was the case ,for example in the year between1968 and 1972 when the amount of rainfall received in Sahel was, on average only half of the long-term mean annual rainfall for the period of 1908 and 1956. (Lamb, 1979).

Poor Land Use

UNCOD identified four main types of decertification; over cultivation, over grazing, deforestation and mismanagement of irrigated crop land and water resources. Over cultivation, occurs when farmers try to crop the land more intensively than permitted by it's fertility, and fail to compensate for the export of nutrients in the crop by using artificial fertilizer or fallowing the land so that it's fertility can regenerate naturally. Over grazing, initially, the nomads were blamed for causing the Sahel disaster by keeping too many animals. Overgrazing is indeed a major cause of desertification, and range lands account for almost 90% of decertified lands (Mabbut, 1984). Overgrazing results when livestock density becomes excessive and too many animals are grazed on the same area of range land, leading to the degradation of vegetation and the compaction and erosion and soil, poor irrigation and management.

Despite, the theoretical advantages of irrigation, for instance seen to be the logical way to solve the food problems on dry land areas and threat of crop failure during the drought is therefore removed, the reality is very different and the poor management of many irrigation projects usually causes productivity to fall after few years of operation. If allowed to continue this can lead to soil salinization, alkalinization and water logging which will eventually make the land unproductive. Irrigation is paradoxically, therefore a cause of desertification as well as being cure.

Deforestation

The outright clearance of wood lands to provide extra crop land and range land is an important cause of deforestation in the dry lands. Deforestation is the first step along road desertification. Dry areas where vegetation is relatively sparse, trees and open wood lands play a vital role in stabilizing soil and water and giving shade to people and animals. When the trees are removed, crop lands and range become more exposed to the elements, unprotected soil is baked by the sun and eroded by the winds and rain, the whole area becomes more arid, and towns and villages are exposed to frequent dust storms.

Desertification in Nigeria

Desertification is one of the chronic ecological problems in Northern part of Nigeria. The menace and desert encroachment is on the increase than had been earlier thought off. The true indicator that

desert is already in Nigeria in the case of sand dunes invading some farm lands and villages and extreme northern parts of Borno State. Other places are at Gidan Kaura Village and villages near Kyadawa in Gada district of Gwadabawa Local Government in Sokoto State.

Alarm of desert encroachment raised by Stabling in 1930's created some concern in the colonial administration which made a number of the boarder Emirate embark on tree planting to stop the encroachment of Sahara desert as far back as the 1940's the effort can be seen today in many towns and villages in these areas today owe their shade, shelter and comfort to trees planted then.

Activities of man have enhanced the rate of desert encroachment. A natural vegetation cover which has been seriously tempered with pave way for effective wind erosion. By and large with the growing population of booth man and animal, indiscriminate felling of few trees that are available, bush burning, bush clearing for farming and over grazing change the picture of the ecosystem in Sudan/ Sahel region to a more or less semi-arid zone like the result of these processes is to leave the soil at the mercy of the harmattan wind and rain storm to exercise their erosive power and leave behind the product of sand dunes. These sand dunes normally engulf fertile land areas (Fadamas).

Control of Desert Encroachment

The need to control the advancing desert encroachment is becoming more necessary now, as desertification, said to be moving at the present rate of 2-8 kilometer from north toward south of Nigeria, if not checked will one day take over the Savannah region.
The threat of desert encroachment in northern part of Nigeria was realised as early as in1967, and serious effort was made to check it by. Introducing:

- Shelter belt planting as soil conservation.
- Trees planting campaigns, organized with hope of creating adequate vegetational cover of trees to protect and improve the farm land to restore the normal Savannah environment.
- Afforestation programmes should be vigorously intensified, particularly to species found suitable in the shelter wood programme.

Shelter belt planting as soil conservation, are extremely effectively check to moving process of desertification, southward, the coastal

region. To make it more effective, planting campaigns to create vegetational cover and tree planting as wind break should be fast growing pioneer, tree species with dense canopy, adaptable to local conditions and resistant to pest and diseases. The species found to be suitable in the shelter wood programme includes:- *Azadiracha india, Acacia nitotica, Acacia albida* and *Eucalyptus camadulensis* and *Eucalptus* species.

Merits of Forestry

Forestry involves the production of numerous diverse goods and services which satisfies fundamental requirements of human population (Sartorius and Henle 1968). Apart from the production of wood, pulp and other 'by products' by the forest lands which prevent erosion of all forms;

Oguntola (1977) reported that forest conservation aids climatic, hydrological, air quality, and aesthetic repopulation .These are measurable quantities, with present and future potentials for the improvement of the urban and rural living environment. The environment enjoys AIR QUALITY REGULATION, as forest (or tree around us) filter sound, smell and dust within the environment and exercise useful, though unquantifiable influences air, noise water, soil, etc. It regulates industrial waste and environmental pollution which are toxic to plants and animals and which constitutes health hazards to man and his environment. Man inhales oxygen and exhales carbon dioxide which are taken in by plants which later remit oxygen for use by man.

Conclusion

To check the menace caused by the ecological crisis, the following points are recommended:

1.Techniques of land use planning and management based on ecologically sound methods should be introduced into areas affected or likely to be affected by desertification.

2.Public participation should be made an integral part of action to prevent and combat desertification packages and the full use of extension services are headed to increase general public awareness of the problem, public discussions should be maximized by making use of mass media and encouraging the expansion and strengthening of community organizations.

3.People should be aware of the vital and important roles of forestry in environmental purification.

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Deforestation

A problem connected with over population is deforestation. Trees are cut down by man for such reasons as clearing land for cultivation, and as a source of energy. In fact, in Uganda, 96% of all fuel used is wood and charcoal, and 50,000 hectares of forest land is cut each year. Machna et al (1989) reported in the African farmer; there are other cases of tree cutting for roofing, furniture making and paper making and so on. In Uganda, Kenya he reported that the inhabitants are devising fuel efficient stoves to reduce the amount of wood consumed.

There have been tree planting campaigns organized by local, states and Federal Government in an attempt to restore the amount of trees destroyed for one reason or the other. Eckholm, (1977) feels that whatever the success of tree planting projects, the wider substitution of other energy sources where wood is now being used would if feasible contribute greatly to a solution of the firewood. Such alternatives as Kerosene or natural gas were beginning to be spread from Urban to rural areas eventually rendering firewood nearly obsolete, but artificial scarcities and price hike of these commodities has altered the energy use trends as from the early 70s. The joy and hope of foresters and Ecologists for a rapid reduction of pressures on receding wood lands was dashed overnight in December 1973 when OPEC announced new prices of fuel.

Other alternatives to wood could be Solar energy this is laudable, but it is in its infancy in most developing nations, and so it is expensive beyond the reach of the masses and besides there are no cheap storage

facilities devised.

Indian Scientists have made a break way by developing a sound device for breaking down manure and organic wastes into methane gas for cooking. He went on to say that about 8,000 biogas plants are now in use in India without change in prices, and this is hoped will infiltrate the rural communities where the fuel problems are growing. Other alternatives are hydro-electricity, but these are too expensive for the rural man. In fact, the tariff on electricity is so high that even the rural dwellers are resorting to using their lamps.

Since the alternative, to wood are not feasible, we can heed to Bhudah's teaching, that afforestation programs should be stepped up more than most bureaucrats have ever contemplated, and the suicidal deforestation should be stopped now in Africa, Asia and Latin America. The attitudes of some people to deforestation is disturbing like Mr. Diallo a farmer who said that, farmers who do not buy their wood wonder why it is necessary to stop using products that do not cost anything and is gathered by hand, a report from Machna (1990) in the African Farmer Reinforcing this idea of Mr. Diallo, some scientists, Chisatologists, geophysicists and ecologists etc agree that in arid zones reforestation cannot have any significant effect on the regional climate, so that planting of solid strips of trees across desert hedges without subsequent management organization is purely mythical and doomed to a costly failure.

One of the main reasons of deforestation is so that enough land is left for cultivation, and since according to some literature, population increase has been a major factor in over population of cultivable, land, I rather feel that the mismanagement of land such as using machineries which turn down the top fertile soil inwards, making the soil too soft and paving way for erosion, the use of inorganic fertilizer indiscriminately without consulting soil surveyors who could determine both the type of fertilizer and the type of crop that can be grown on what type of soil. With proper management of the land and the traditional use of organic fertilizer, and the choosing of the high yield crop for the right piece of land, population will be insignificant factor in the process of desertification of arid and semi arid lands due to over cultivation.

The growth of population is directly proportional to the growth of livestock. The demand for protein is so high that there is an equal increase in life stock on limited land resulting in a progressive

reduction in vegetation cover and increase in soil erosion, due to trampling, sealing and increased run off, higher water tables salinity, all mechanism which feed the process of desertification. Indiscriminate movement of livestock should not be allowed, instead livestock should be limited to ranches where they will be fed by fodder grown around the ranches. In this case they will play a dual role of providing protein and organic fertilizers from their dung. The population of livestock could be reduced and replaced by some other species that are less destructive. The scientific committee on problems of the environment (Scoope) feels that we do not have enough protein, so the production of livestock should be stepped up by a wiser use of microbial and animal diversity.

It went on to suggest that:
We are to rationalize the consumption of animal matter in comparison with plants, because in the case of food production, it is less efficient in the production of energy and stressful in terms of environmental impact, there are however, some parts of the world that are unsuited for cultivation in which an animal crop is the best form of land use.

We can expand the range of species that are cropped and particularly utilize species that are not attractive.

Animals like the dog which some religions frown at, could make a good source of protein others could be lizards, grass hoppers and so on and so forth.

Of recent, research findings have shown that some large wild ungulates are capable of producing meat using unimproved natural vegetation on the same kind of scale as improved domestic stock; it went on to say that methods of extracting lead protein from range of plants has opened up the possibility of cropping wild self sustaining vegetation without management efforts of intensive cultivation though energy costs are high.

Many activities have been very lucrative before the discovery of oil and other economically viable sources of foreign exchange. It was the mainstay of agriculturally cultivable land with little or no efforts to restore productivity regardless of legislative compelling of the mining companies. According to the Reporter of 25, August 1990, soil survey reports will help to determine the type of soil to be used for reclaiming land and the type of trees to be planted in order to restore

the productivity of the soil.

Some scientists believe that desertification is caused by climatic changes I quote for the first time in twenty years 1972 was a year of anomalous weather including a major drought in Soviet Union. In fact, they went on to say that desertification seems to be more in areas where there is enough water. If the major cause of desertification is due to climatic changes, whether naturally or due indirectly to mans activities, such activities as deforestation, diversion of rivers, changes in agricultural or forestry practices, changes in the number and or sizes of condensation nuclie (biogenic nuclie) emitted to the atmosphere affecting cloud formation and dissipation or the release of Krypton - 85 changing the electrical properties of the atmosphere which in future could affect thunderstorm.

The problems on how to solve it. The solution to the problems lies on the fact that man s destruction of the forest or vegetation should stop. Some scientists suggest some technological fixes such as Climate and weather modifications. These Schemes may raise false expectations and mask the underlying problems as well as creating new ones, while the search for technological fixes for increasing the utility of Marginal lands continue, human mismanagement of the relatively more productive lands is in the long run removing potentially good land from use rather than awaiting the development of a new technological fix, attention should be turned to the improvement of poor land mismanagement practices, and it will be easier and less costly to stop the deterioration and erosion for example than it would be to rejuvenate the land before it has deteriorated beyond critical level.

We can critically look at how the Russians have systematically overcome the desert in their country. The desert in the USSR covers about 300, million hectares of land within Kazakhstan, Uzbekistan and Turkmenistan. It spreads over 3,200km from East to West and 2,500 km from North to South. The Russians had to intensively study the area and performing a lot of experiments on the desert, and they came out with unified classification of desert types, based on one principal natural and or economic feature or on several interconnected features. They used both ground methods and remote sensing on a large scale. This method contirbutes to qualify, while reducing time and expenses for example, study of spectral reflectance of some desert land scape features and suitable seasonal periods aerial photography. Photo interpretations keys of all desert types have been compiled. The Russians also looked at the water supply in the desert - the only source of local water, for example is fresh underground water and run

off water. With high technology equipment, they could deliver water to considerable areas through drilling and pumping and reliable power supply. Water is supplied to towns, mining areas and industrial centres. The scientists have calculated that during a year of average annual precipitation, the deserts in Central Asia and South Kazakh receive four times as much water in form in rainfall as flows in the Anudary River thus rainwater is harvested in the deserts Babyeu (1977) pp 207 reported.

Run off water is stored in natural underground strata called underground storage lakes. This guarantees an economically reasonable year round supply of fresh water for cattle in the most remote pasture lands. They also use storage basins made of asphalt and cement. These are light weight, heat- resistant antifilter materials which are being considered to form a strong water tight surface cover for such basins synthetic films or liquid emulsion used to construct water storage basins.

Natural annual run off water could be mixed with Mineral water to supply flocks of sheep. The USSR succeeded in using such undergrad Mineral drainage as well as sea water for irrigation. Irrigation with Mineral water with salinity of up to 5-6g/litre allows a variety of crops for example sorghum, maize, sun flowers, Sudan grass and rice to be cultivated with good yields on reasonable economic basis. Mineral water used is inexhaustible with reliable technical equipment used in industries and settlements.

The Russians also constructed mobile stills of converting capacity of a 5-25m_3 per 24 hours salinity of 5-8g/litre. The problem is the stills accumulate scales and not very useful in the deserts.

Water is also supplied by helicopter, motor vehicles to places where there are no fresh underground water or no water storage basins.

They also desaline saline water by freezing in desert regions of the northern region where air temperature drops below zero degrees centigrade.

Near Oasis sandy areas could be used for Oasis agriculture.
The Scientists at the desert institute of the Turkman Academy of Sciences in Ashkhabad have determined that by applying normal dosages of Organic Mineral fertilizer to grayish desert soils and by watering with an average of 500m3/ha, high yields can be achieved

for Sorghum, Orange, Corn and water melon pumpkin.

22.2 Conclusion and Recommendations

The Russians are rated as one of the most technologically developed people and they have been able to control the effects of technology technologically, but most of the deserts are found in the developing world where coping strategies are yet to be fully developed.

There are many who believe that technological advancement or technological transfer will resolve many of our environmental problems, many others believe that technological solution must be scientifically assessed before their application for their social as well as physical implications. Rather then waiting to develop new technology fixes, it is strongly suggested that land mismanagement practices used by the inhabitants of an area should be discouraged because it will be easier and less costly to stop the deterioration before the land is lost to desertification and erosion for example than it would be to rejuvenate the land once it has deteriorated beyond critical level.

Population increase according to Helen Ware (1977) is not the main factor in desert encroachment, other factors play vital role in desertification. We have enough land to take care of the food requirement of the world, but we have used technology wrongly for example ploughing of land using tractors does not only destroy the land by burying the top soil and rendering the land infertile, but also destroy the shrubs and their roots making the ground bare and erosion sets in. There are varieties of plants and animal species that could be used which are too attractive and wild plants that could be utilized and their protein extracted. Recent research on a variety of beans called winged beans psophocarpus tetragonolobus has been found to be highly productive and a potential money maker. The leaves are rich in Vitamin A duplicate Soya beans in nutritional value, make its own fertilizer, grows in small space for example one hectare of winged beans produces nourishment equal to six hectares of most other crops.

We could make use of other food strains with the following properties:

- More tolerance to drought
- Increase efficient use of water
- Efficient use of solar energy
- More tolerance to saline soils
- Adaptability to a shortened growing season

Lastly, the decision makers and politicians should in making their polices and taking decisions should be able to distinguish between what is desirable and what is possible and what is desirable and what is essential.

22.3 Tutor-Marked Assignment

- Develop a concise abstract for this article
- Explain how you will talk to groups of people in a particular community on how to deal with issue of desert encroachment.
- Describe the following terms with necessary examples
  (i) Desertification
  (ii) Deforestation
  (iii) Afforestation

UNIT 23

ISSUES IN SCIENCE AND TECHNOLOGY

22.0 Introduction

In this unit, you will learn those things that constitute misuse of science and technology.

23.1 Objectives

By the end of this unit, you will be able to:

- List areas where scientist, technologists and the people in the community around you have misused science and technology knowledge.
- Discuss intelligently, issues that affect the society like:
- Computer Worms and viruses
- Evaluate the consequences of uncritical use of the benefits of technology.

23.2 What is Misuse of Science and Technology Knowledge?

Man's deliberate acts in the attempt to exploit natural resources may in turn give rise to an unpleasant situation. Misuse of the knowledge of science and technology can be witnessed as follows:

23.3 Mining Activities

An attempt to exploit mineral resources from the ground leads to remarked effects such as:

1)destruction of stable soil structure.

2)destruction of land flora and fauna which in turn tempers with topic levels in the feeding relationship between organisms.

3)create unnecessary ponds which serve as breeding environment for mosquito and deat traps for other terrestrial habitants (man, stray animals and wild life).

4)denature the environment making it unsuitable for agricultural activities.

23.4 Deforestation

Forest trees are fell down for furniture, housing, boat, canoes and bridges, all useful to man. The felling down of the forest trees exposes the soil surface to erosion, constitutes threats to wild life, makes the land vulnerable to deserts encroachment and creates atmospheric imbalance.

Activity 23.1
Differentiate between deforestation and afforestation.

23.5 Industrial activities

This leads to high accumulation of Carbon dioxide in the atmosphere, giving rise to green house effect. The end result is environment degradation or downward trend of the environment

The use of halogenated hydrocarbon pesticides can initiate liver cancer and also cause some birth defects. They are also reported to cause make sterility e.g. D.D.T (Dichlorodiphenyl trichloroethylene) interferes with ion transport in and out of nerve fibers resulting in tremors, convulsion and death.

The burning of fuel, bush, household waste, fumes from passing vehicles of decomposing organisms (bacteria) all coupled with deforestation result in the accumulation of carbon dioxide (CO_2) in the atmosphere. These lead to a phenomenon known as global warming, other call it thermal pollution. This is a major contemporary concern of scientist yet caused by them. It is believed that the higher the concentration of CO_2 in the atmosphere, the warmer the earth becomes. This creates a distortion of natural equilibrium between oxygen and carbon dioxide due to increasing population of man, animals and depletion of the forest.

The knowledge of science and technology can be misused due to greed and aggression. Some government agencies make genuine and adequate scientific and technological proposal for development. These are frustrated by some individuals either due to excessive greed or mismanagement of the funds needed for such projects. This is sad and spells disaster for the nation. Some individuals, nations, world powers, become aggressive due to the quest for political economy, power drunkenness e.t.c. rise against other nations (in war).In the event, sophisticated war techniques e.g. the use of bombs, nuclear and

biological weapon and other war machines, which are the products of science and technology, are used. The consequence of this is severe destruction of life, properties, vegetation and landmass including pollution of air and water. Some biological weapons are known to create sterility in human population, even the future generation.

Drugs are some of the products of science and technology. These are meant to be consumed under medication otherwise they are abused. When abused to extreme lead to degradation of the brain and eventual madness.

Irrigation schemes are constructed using the knowledge of science and technology. These irrigation schemes create a micro climate similar to that of the rainy season. Continuity in the life cycle of some pest and weeds become possible. The result of this is the abundance of such species, which in turn constitute great nuisance to man in agriculture. Also dams constructed for irrigation and other purpose serve as breeding environment for mosquitoes, fungal and growth. The dams could be death traps to wild life and human. When the dams burst, destruction caused to life and properties is alarming.
Inorganic fertilizers washed into streams and rivers increase salinity of such water bodies. This increases acidity and leads to death of aqua culture.
Over use of inorganic fertilizers destroy soil structure and scorching of plants.

Activity 23.2

What is the effect of irrigation scheme on the people living around such

area?

23.6 Conclusion

Science and technology are the basic tools or engines for development. No nation at all can develop without imbibing it as a matter of policy and practice.

26.7 Summary

In this unit you have learnt the meaning and different issues related to misuse of science and technology. In the next unit you will study waste recycling.

23.8 Tutor -Marked Assignments

- Look back to some activities embarked upon in your immediate environment/community and list those one you can consider as misuse of science and technology.
- List the products of Science and technology that are destructive to life.

23.9 References

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UNIT 24

WASTE RECYCLING

24.0 Introduction

In this unit you will learn the meaning of waste recycling. This unit also continues the discussion on process of recycling, advantage and problems of waste recycling

24.1 Objectives

By the end of this unit, you will be able to:

- Discuss the problem of waste management in urban and rural areas.
- List the various ways in which waste can be converted to wealth.
- Explain the problems associated with the process and methods of waste recycling.

24.2 The Meaning of Waste Recycling

You have learnt about urbanization and pollution. When the society is large, there is the tendency for the society to produce much byproduct. Byproducts include unwanted materials, like sewage, garbage, etc. To the society, they are waste. If you take for instance a can of garbage you will find that a typical garbage from your house contain: yam peel, leftover food, pieces of paper, broken glasses, orange peel, wraps from soap, dust particles, banana peel, mangoes, assorted rotten fruits etc. You even have polyvinyl products. All these things that we consider as waste contain valuable materials that can be reclaimed and re-ued. You must have taken canned soft drinks or any canned food. The can has been re-used. Such cans are got from scraps of metal. If all the refuse, tins, cans, plastic products we find littering the environment are re-claimed and re-used, we would have a better and cleaner environment.

Activity 24.1
Explain the term Waste recycles

24. 2 Process of Recycling

Let us look at our garbage bin again. If we pick out the egg shells, we can grind or pound them to powder and mix with the ashes from burning firewood. It serves as vim for scoring hard surfaces and the back of pots.

Locally, you can compress the dirt or waste in such a way that you have a hard or caked up material that can be used as sources of energy. Burn them in earthen oven for baking bread or for cooking. Used papers are now been recycled in Nigeria. In developed nations waste is biodegraded. In the process of biodegradation, gas methane which burns easily is produced. They have careful way of collecting the gas. The gas is used to produce electricity that serves the same locality. The trend in most developed nation is waste-energy incineration. In fact, industries to convert wastes are being developed.

Another method used in developed nations is sewage processing using decay microorganisms. Here the microorganisms present in water and soil are allowed to breakdown human wastes. Wastes thrown into rivers or streams cause trouble for organisms living in water. But with microorganisms, the process of decomposition is utilized. In the end methane is produced and a nutrient-rich dried sludge is produced. Some sludge come out as fertilizer, it depends on the constituents of the waste.

24.2.1 Advantages of Recycling Wastes

If you look around our environment, you will wish that something is done to heaps of refuse you see everywhere. If we develop a technology of reclaiming and re-using them we will have a healthier environment.

In the process of recycling wastes, the energy required is less than manufacturing new ones. Also the pollution is reduced. Energy saving is up to 50%. Making new products require time. Example in Europe to produce new tins (can), you need to mine the metal ones and then process them.
Many businesses are reducing packaging on products in order to save energy. In so doing, pollution from industries is reduced.

Recycling also beneficially reduces the total volume of waste requiring disposal.

In developing nations waste disposal has claimed lands that could be used for other things. If such wastes are reclaimed and re-used, problem of space will be minimal.

Sludge from decomposition have helped in soil fertility. They are used as fertilizers depending on the constituents of the waste.

Activity 24.2

What is the advantage of biodegradation?

24.2.2 Problems of Recycling Wastes

In developing nations its problem of technical-know-how and ignorance. In developed nations where the process has started on a comparatively large scale, the need is for effective separation of wastes. In Australia, there are bins provided for each kind of waste e.g. glasses bin, paper bin, and other bins. The process is often fruitless if some foreign body gets into a particular process. If a piece of Pyrex gets into a consignment of glass, it can render the recycled product worthless.

In Nigeria, the waste management system is inadequate to cope with the population especially in urban area. In rural areas, the problem is lack of knowledge of basic hygiene and sanitation so waste products are not properly disposed.

Activity 24.3

Name the types of bins provided for waste in Nigeria.

24.3 Conclusion:

In this unit you have learnt that waste recycling is the reclaiming and reuse of waste that contains valuable materials. The process of recycling as well as the advantages and problems of recycling was also discussed.

24.4 Summary

In this unit you learnt the meaning, process as well as advantages and problems of waste recycling. In the next unit you will study energy sources.

24.5 Tutor -Marked Assignment.

- Suppose you are invited by the Chairman of your Local Government Area to talk to the people in your Community on the topic “Waste to Wealth”. Explain how you will present your facts on this issue.

24.6 Reference

Onianwa, P. C (1990). Heavy Metal pollution around Solid Waste Incineration dumps in Ibadan City. Nigeria J.J. Science.

UNIT 25

ENERGY SOURCES

25.0 Introduction

This unit is designed in such a way that it contains both study unit on energy sources and reading article on solar energy presented to assist you to further understand the unit. Carefully go through the study unit and the material.

25.1 Objectives

By the end of this unit, you will be able to:

- Explain the possible uses of solar energy in Nigeria.
- Analyse the drawbacks of Hydro electric power generation.
- Discuss alternative sources of energy.
- Give five benefits of renewing energy.
- Justify why energy should be renewed.
- Systematically list how energy renewal can be done.
- Discuss the effect of energy renewal.
- Explain the concept of energy crisis.

25.2 Meaning Energy

What do you understand by energy, what is energy used for? Energy is power to do work. Energy is used to do many things. To cook your food, you need a source that provides energy like firewood. You need energy to move and carry out activities. In your own case, the energy you need is derived from the food you eat. You studied photosynthesis, a process whereby plants manufacture their own food in the presence of sunlight. Light energy is trapped in the process and energy is store in the food. During the breakdown process of the food in our body the energy is release and you have power to work or carry out different activities like breathing etc.

All human activities and chemical and physical processes in nature require energy. To boil a cup of water, energy is required. Energy is obtained from many sources for different chemical processes. You may not be aware of it but you use kerosene, firewood, electricity to cook in using these products energy is released. The products are therefore sources of energy. Coals, nuclear power, and other fossil fuels generate energy. When any of these burn to release energy, there

are usually byproducts like carbon dioxide, methane etc (depends on the kind of product). These byproducts cause pollution. The kind of pollution produced by these products is dangerous to health. You have heard about energy crisis. It is a crisis because of the kind of problems that arise from their use. Problems like using up all the available sources of energy e.g. coals. The byproducts are hazardous to health. There is fear of nuclear accident, apart from the fact that there is inherent danger in using nuclear energy. The waste constitutes problem of disposal. Because of all these problems; scientists are thinking about other sources of energy that will not bring problem like the ones mentioned above.

Activity 25.1
List ten sources of energy.

25.3 Alternative Sources of Energy

In developed world, 10% of their electrical energy is from nuclear power. The Chernobyl disaster of 1986 is an example of the problems that can occur as a result of using nuclear power and fossil fuel. In developing nations biomass (energy which includes wood, charcoal, crop residues, dung and other organic materials) is a source of energy apart from fossil fuel.

Biotechnology is being used to produce alternative sources of energy based on naturally produced organic materials. There are places in the world where industrial plants convert sugar, from cane, into ethanol (gasohol), which can be used to fuel cars. In North America cereals such as maize wheat and barley are fermented to produce a variety of products including fuel alcohol. Sugar beet widely grown in northern Europe could be processed for fuel alcohol, is potentially a cleaner source of energy than fossil fuels because it is sulfur-free.

Now emphasis is on solar energy, wind energy, hydro-energy, waves energy, biomass technologies, and geothermal energy. The advantage in these sources of energy is that they are renewable. Of recent, scientists are thinking of how they can trap the energy we release in form of belching, breathing etc and recycling. The advantages of the above renewable energy resources are enormous. For instance, they have less damaging environmental impact than fossil fuels and nuclear power.

Activity 25.2

Name the problem that can occur as a result of using nuclear power and fossil fuel.

As useful as they are, they have the problem of tapping them.

Example, waves energy, wind energy and sunshine are energy sources that are not stable, they are too dispersed to make it easy to generate large amounts of power. A day could be cloudy and you can not get enough of sunlight, the wind may not blow, and the sea may decide to be calm, i.e. no waves these make them unreliable sources of energy.

As unreliable as they are, renewable energy sources are ideally suited for supplying small-scale dispersed power needs. In Nigeria sunshine is not scarce, so sunshine energy will be of tremendous advantage.

Activity 25.3

Read the article with the following questions as guide:

1. Who is the author of the article?
2. What is the main issue presented by the article?
3. How has the issue been viewed before this time?
4. What is the author saying is the contemporary view of the article?
5. What is the author's main contribution to the issue being discussed?
6. List major differences before and now with respect to trends in science education?
7. What are your own interpretations of what he/she is saying?
8. What are your own reservations?
9. Provide a guess as to what you think of where we are going with respect to this concept.

After going through it, attempt to answer the questions raised in the objectives for the unit. If you cannot do so effectively the first time, go through the article again until you are able to do so comfortably.

Solar Energy: Relating Science and Technology to Society

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Introduction

The broad aims of education relate both to individuals and to society in general. At the level of the individual, education aims to prepare students to realize their full potential and to function and participate responsibly in society as citizens, workers, consumers, and family members. An educated person requires more than knowledge and skills in language, mathematics, science and so on; he or she must also have developed the skills necessary to function effectively in an increasing technological society. In this latter aspect, schools can greatly help meet this aim by ensuring that school curricula related to a changing societal context. One way in which this evolutionary aspect of curriculum has been addressed by science educators is to include an approach which relates science and technology to society. Through this approach science is presented not as a body of knowledge in an abstract, factual, formal setting but rather within a setting of significance to the students' everyday life.

The need for science curriculum changes incorporating Science, Technology and Society (STS) is evident in the perception by educators, government and the public that education in general and science education in particular have not in the past been relevant to the needs of the broad cross section of students. It is now being argued more forcefully that a science curriculum that is more personally and socially relevant would be more appropriate for secondary students, especially those who will be the future consumers of science rather than the future producers. In line with this viewpoint, the 1979 International Symposium on World Trends in Science Education (McFadden, 1980) addressed the introduction of science, technology, and society into science curricula as one major theme. In the USA, UK, Canada, Australia, and many other countries, major policy documents in science education have promoted the concept of STS (see for example, Association for Science Education, 1979 and 1981; Harms and Yager, 1981; Hufstedler and Langenburg, 1980). Likewise, many science educators (see for example, Bybee, 1982; Roby 1981; Solomon, 1982; and Ziman, 1982) have also advocated, and illustrated by example, the need for a science curriculum which integrates science, technology and its societal context.

Recently, McKavanagh and Maher (1982) and McKavanagh (1984) have highlighted the essential differences between a traditional science approach and an STS approach. In the latter, the science content at each stage is linked with societal and technological contexts. Science is presented as a human endeavour which develops through the efforts of people and which affects the lives of people. McKavanagh and Maher (1982, p. 71) state that "STS involves an organization of existing science content to bring forward a different emphasis and use different organizers of student learning. While we are aiming for similar understanding of science concepts as in conventional science, it is not the science concept organization which is immediately living. The science flows out of life-related contexts".

Some Australian Developments in STS

There is a growing awareness in Australia that knowledge about technology needs to be part of a person's education (Beare, 1984). This is reflected in the syllabi or guidelines for science teaching at secondary level in each state, each syllabus has themes concerned with the relationship and impact of technology on developments in science and their contribution and effect on society. Furthermore, science curricula have been developed on the basis of identifying objectives for their relevance to the needs and interests of students and to the integration of science, technology and society. The Victorian Physical Science curriculum (Wright, 1976), the Western Australian Physical Science Course (Education Department of WA, 1979) and the Science Technology & society Project in Queensland (Hall, Lowe, McKavanagh, McKenzie and Martin, 1983) are three examples.

The first two of these three examples constitute a whole course of study covering at least one school year. Other approaches involve the development of materials which can be used as a supplement to existing science courses. There are only a few instances of science curriculum materials in Australia which have been developed in this way.

Government concern regarding the impact of technology on society and its effect on national and state development is very evident. For example, there is now a National Technology strategy and in Western Australia the recent McGaw (1984) & Beazley (1984) reports list "science and technology" as one of seven broad areas of new and relevant curricula for schools. The curriculum area of science and technology is designed to "examine, making use of real world

examples, including technological examples, the manner in which science interacts with the culture it serves and by which it is reported" (Beazley, 1984, p.4). Such a goal is consistent with STS developments overseas.

An Approach to Integrate STS: Solar Energy

Energy is a topic of study at both the primary and secondary level throughout Australia. It is generally acknowledged by teachers that this is a difficult area to teach mainly because energy is a very abstract concept. An approach to teaching energy to children is to present concepts concerning energy in the context of real life situations and experiences. This has broadly been the approach used by the authors of this paper, but the approach has been taken one step further. Concepts related to energy are presented to students in the study of solar energy which is defined in its broadest sense to include direct forms of solar energy (solar radiation) and indirect forms (wind, waves and biomass).

Concepts are presented to students using an inter-disciplinary approach whereby solar energy is studied through aspects of science, social science, economics, and engineering. The materials for primary school are already available to schools in the form of a teacher text, Sunshine Science. The high school science text, Energy from the Sun, has already been extensively tried in schools in Western Australia and will be available in 1985. Both science curriculum materials described here have been developed as part of the Solar Energy Education Project (SEEP) at the Western Australian Institute of Technology. Since the inception of SEEP in 1981, the development of the curriculum has been funded by the Solar Energy Research Institute of Western Australia (SERIWA).

Much of the context of Energy from the Sun is linked with societal and technological contexts as described by McKavanagh and Maher (1982). Indeed, the major goals of the secondary text are: to teach basic concepts and principles relating to heat, light, and other forms of energy; to examine mankind's need for utilization of energy; to study technological changes and adaptations, and to consider the effects of knowledge and technology on society. The materials address the harnessing of solar energy but do so by considering energy supply and demand in general and the role that solar energy can play in Australia's energy scene today and in the future. Throughout the text, the reader is presented with technology for harnessing the Sun's

energy. At the same time, concepts comparable to those encountered in a regular science course are identified and illustrated. The general aim of the text is to describe technology, some of which the students may be aware in their everyday experiences, and to teach the science concepts and principles behind these technologies.

Some examples will help illustrate the STS approach taken in Energy from the Sun, the contents of which are shown in Figure 1. The first and sixth chapters have a broad social orientation. The first chapter deals with energy use in the world and Australia in particular; the sixth chapter deals with energy used for the future and the role that solar energy might play in that future. At all times an effort has been made to ensure that the reader does not become to believe in a "technological fix" for solving the world's energy problems. Rather, the role that technology can play, in this case harnessing the Sun's energy, is examined and at the same time the limitations of the practical world are described. These limitations include the status of the technology as well as cost-effective aspects of new technology compared to existing technology for harnessing energy supplies.

Each of the middle four chapters deals with one aspect of solar energy in terms of how it can be collected and used. Specifically these four chapters deal with heat, electricity, the wind and biomass. Each chapter describes how solar radiation can be collected and examines the underlying concepts and principles which enable this collection to take place. Each chapter also presents applications in the domestic and industrial sectors. For example, in the second chapter the use of solar energy to provide heat by means of solar hot water heaters is described. A variety of domestic and industrial applications are shown together with specific instances of their use.

Hydro Electric Power (HEP)

Have you ever considered the amount of energy electricity generates in the home, environment, industries etc. What is electricity? Why is it so powerful? Here we are talking about current electricity. There is also a kind of electricity called static electricity. Electricity flows through wires. It is a form of energy that can be related to heat and light. Electric current is a flow of electrons through a conductor like metals. What is the origin of that power that produces electricity?

Hydro-(water) power is the main source of renewable energy in the world. It is believed that hydro-power produces 500,000 MW world

wide, supplying about 23% of the world's electricity. In Nigeria the Kainji dam generates energy that produces electricity B used all over the country. The dam is affected by the amount of water in the dam. In Brazil the Itaipu dam produces electricity. Damming rivers create a lot of environmental problems. Some are:

- displacement of people as environmental refugees
- flooding of valuable farmland and forests (you must have heard of the flood in the year 2000 around the Kainji, where villages were swept away and farmlands affected)
- River flow is disrupted
- Soil erosion is on the increase
- It changes the humidity of the environment that in turn affects the organisms living in that area. Setting and acidification are problems that affect damming.

Activity 25.4

You will notice that some of the objectives have not been fully covered in this section. It is deliberate because energy issues are topical and relevant in Nigeria. On your own compile the various ways in which Nigerians have been coping with energy problems in the past ten years.

25.5 Tutor Marked Assignments.

- Write a concise abstract for the article presented in this unit
- Describe how the Australian teacher presents the concept of energy to the students in the classroom.
- Describe various alternative sources of energy that Nigerians can really upon.

UNIT 26

PROBLEMS OF A DEVELOPING NATION

26.0 Introduction

This unit is designed in such a way that a reading article is presented to assist you to further understand what you learnt in the immediate past unit. Carefully go through the material and attend to the activity below.

26.1 Objectives

By the end of this unit, you will be able to:

- Discuss the challenges faced by developing nations.
- Relate the problem of population growth and illiteracy with underdevelopment.
- Draw up a guideline on strategies that Nigerians can use to cope with technological problems arising from underdevelopment.
- Suggest how you as an individual can cope with the fast technological changes taking place around you.

Activity 26.1

Read the article with the following questions as guide:

1. Who is the author of the article?
2. What is the main issue presented by the article?

3. How has the issue been viewed before this time?
4. What is the author saying is the contemporary view of the article?
5. What is the author's main contribution to the issue being discussed?
6. List major differences before and now with respect to trends in science education?
7. What are your own interpretations of what he/she is saying?
8. What are your own reservations?
9. Provide a guess as to what you think of where we are going with respect to this concept.

After going through it, attempt to answer the questions raised in the objectives for the unit. If you cannot do so effectively the first time, go through the article again until you are able to do so comfortably.

Problems of a Developing Nation

Dadong Maurice M

Definition

Developing means advancing towards certain well defined general objective which correspond to the specific condition of man and society as found in the most advance societies of the modern world. Developing depends on what social goals are being advocated by the developing agency, government, analyst or advisers. In a social objective developing is a list of attribute which society is seeking to achieve or minimize and this include:

- Increase in ideal income per capital.
- Improvement in health and nutritional status.
- Educational achievement.
- Access to resources.
- A fairer distribution of income.
- Increase in basic freedom.

Therefore, a developing nation from an absolute term is that nation that is attaining an average or above average growth in terms of increase in per capital income, food production, technological advancement, basic freedom, science, industrialization, economic growth, population control, environmental control, good agricultural practices, employment, resource management etc.

However, research has shown that most of these developing nations like Latin America, Indonesia, Nigeria, Malaysia and Austria suffer or are facing problems related to the above mentioned.

The Problems of a Developing Nation.

Poor Technology: Developing nations like Nigeria is technologically dependent, that is, it relies on other countries to carry out its technological activities. Also most of these developing nations Indonesia, Malaysia, Latin America, are technologically dependent. This has resulted in the transfer of in appropriate technologies to the developing nations.

These Inappropriate Technologies can be seen in two ways:

The technologies which are transferred from advanced countries are generally capital-intensive, whereas the factor endowment pattern (or, crudely, the relative availability of capital and labour) in developing nations require labour-intensive techniques if there is to be full employment of resources, the transfer of wrong kind (i.e. capital-intensive) technology is seen as at least a proximate cause of unemployment and malnutrition of income in developing countries.

Secondly, technological dependence together with other factors results in the manufacture of inappropriate products in developing nations. The products which are manufactured in advanced countries results from a process of technical innovation. That is why they always reflect some trade marks or basic characteristics of the economic environment where they are made. These technologies are usually designed to meet the requirement of high income consumers (developing nations) who demand high quality goods. Nigeria for instance, in the previous years has been spending billions of naira in importing most of these machines, cars, weapons, and other sophisticated tools from technologically advanced countries like Japan, Britain, America, just because of its poor technological background.

Problems of Agriculture System/practices

Traditional agriculture and traditional manufacturing are common features of developing nations. In each instance, the basic

productive unit is the family. Capital is limited to simple human and animal powered implements with few or no moving parts as can be seen in most developing nations of Americas work is sequential with no division of labour for individual commodities, the individual producer carrying the product through every stage of production. This lack of specialization means that there are no significant coordinating activities technological knowledge and work competencies are transmitted by observation and learning by doing. All the inputs and the physical principles governing the transformation are manipulated by man.

Studies have shown that Africa estimated at 60% the population of the labour force engaged in subsistence agriculture. In Indonesia, it is estimated that 80% of the small holders are subsistence farmers. Even where agriculture production for direct consumption is widely prevalent, the communities thus engaged are by means of self-sufficient units. Though the buying power of rural population may increase, the standard of living does not necessarily rise along with it. Production of food stuff frequently drops with a change to the money. Economy, much of the money earned is spent on essential burgeoning a beer market in Africa and stark increase in alcoholism. In Mexico, for instance, in some areas agricultural produce goes through fifteen different hands till it finally reaches the urban consumer.

Problem of Industrialization

Developing countries in the initial stages of industrialization are characterized by inexperienced owners, few design skills and a very limited capability for machine building, because of the poor industrialization in most of the developing nations, they often rely on industries in advanced countries, for example, Nigeria is rich in oil but has no industry that can refine the crude oil to its final usage. It therefore usually take the crude oil to other countries for refining. Inexperienced owners of such materials are anyway poorly placed to discriminate between rival process technology and machinery systems. For instance, Nigeria cannot produce spare parts but can only buy the part of machines from highly industrialized countries and assemble it i.e., it can only assemble the parts to produce a simple Volkswagen, all are attributed to lack of planning and designing skills. In a developing nation, it is observed that the machines have to be imported, so has the process know-how and often also the capital for paying for at least the import content if not also the local cost component of the total project cost.

Unemployment

High unemployment has already become basic feature of developing countries like central and Eastern Europe. Research has shown that the restructuring process started in most of these countries only towards the end of 1960 and the beginning of 1991, and yet unemployment rates for the region above organization for economic cooperation and development average levels were registered as at the beginning of 1992.
Furthermore, the gap in unemployment rates between, on the other hand, organization for economic cooperation and development countries and on the other hand, central and eastern European countries are continuously. The high increase of unemployment in transition countries is confirmed by results from the labour forces surveys introduced in most countries of the region in 1992.

Developing nations like Austria and Norway experience relatively low unemployment rates. In Poland for instance, employment in the old non agricultural private sector increased by over 20% during the period 1990-92. This increase was not sufficient to absorb people laid off from the state sector, while remaining high, the rate of growth of private sector employment slowed down in 1992, despite the more favourable overall macro-economic environment.

Poverty

Most developing nations are not physically endowed with riches or wealth, the appearance of natural wealth is often misleading much of Africa is paired with a laterite soil of low fertility and shallow depth. Much of it is covered and it seems was always covered in historical times by fruitless bush and poorly timbered trees. Also much of it is pestered by tsetse fly inimical to beast and man. Initially, most of these developing countries had few good food plants, early farming was a dry rice and local yams in Western Africa and of millet and sorghum else where, but of little else until the coming of Indonesia banana and Asian yams in the 4th and 5th century and of American cassava, maize, sweet potatoes pawpaw, and pineapples in the 16th century. Also the position with cattle was somewhat better thanks to the spread of zebu and sanga breeds in the first millennium yet most of this area could not give raise to cattle because of tsetse fly.

As experienced this year in some part of Plateau (Nigeria), there was

widespread of an epidemic disease which claimed or killed millions of goats, and in fact some houses have no single goat left.

Environment Problem

The pursuits of affluence by developing countries are already threatening the ecosystem of the planet. This problem is usually centered on the atmosphere. Many people believe that within a few decades the release of carbon monoxide through the burning of fuels will raise the temperature of the atmosphere past the point where serious climatic effects will begin to occur. It is known that an upward or downward change in world temperature of only a degree or two could have serious disruptive effects on food production.

Another serious environmental concern is the destructive effects our agricultural practices have on our soils. Most developing nations do not recycle food wastes but throw them away (causing pollution problem in the rivers and oceans). Our agricultural methods exhaust the nutrients of the soils. Agricultural methods used by these developing countries involved the routine application of large quantities of pesticides and these have destructive effect on soil micro organism. Another environmental effect commonly faced by these developing countries are in the area of forest destruction which often result in extinction of both plants and animals species. Similarly, human activity are direct consequences our struggle for affluence and growth and our commitment to the economic system which require both for instance, Amasonic rain forest are being bulldozed to make cattle ranches and rice plantation to supply already rich American tables and to boost the Brazilian gross national products, all in the drive to get wealth.

26.2 Tutor-Marked Assignments.

- Develop a concise abstract for this article.
- Discuss the solutions to the problems of a developing nation.
- Describe those attributes which a developing society is seeking to achieve.

26.3 References

Charles Cooper (1973): Science, Technology and Development.

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