NATIONAL OPEN UNIVERSITY OF NIGERIA

SCHOOL OF EDUCATION

COURSE CODE: ECE 231

COURSE TITLE: SCIENCE IN EARLY YEARS

COURSE GUIDE

ECE 231 - SCIENCE IN EARLY YEARS

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INTRODUCTION

Science in Early years is a Two – Credit Unit course meant for the 200 Level students of BA(Ed) Early Childhood Education. The Course consists of three modules with each module having five units. The Course assists you, in knowing the development of science and technology right from the early human civilization till date. The intention is to make you familiar with the evolution of science right from the dark ages up to the present day.

This course guide tells you briefly what the course is all about, what course materials you will be using and how you can work your way through these materials. It suggest some general guidelines for the amount of time you are likely to spend on each unit of the course in order to complete it successfully. It also gives you some guidance on your Tutor Marked Assignment (TMA). Detailed information on TMA is found in the separate Assignment file. There are regular tutorial classes that are linked to the course. You are advised to attend these sessions. Detail of times and locations of tutorial will be made known to you later.

WHAT YOU WILL LEARN IN THIS COURSE

The overall aim of ECE 231 is to introduce the nature and philosophy of science and also to give a brief historical background of the development of science and technology right from the ancient times up till the present day. You will also learn about how the early human civilization of ancient cities like Egypt, Mesopotamia, Greek, Rome etc have contributed to the development of modern science. During this course, you will learn about the re-birth of science which the historian of science calls the Renaissance, scientific revolution and the industrial revolution of the 18^{th} century. Lastly you will see how science and technology has developed in the 19^{th}, 20^{th} and 21^{st} centuries.

COURSE AIMS:

The aim of the course can be summarized as follows:

- Introduce you to the Nature and Philosophy of science
- Give a brief historical background of science in early human civilization and their contributions to modern science
- Introduce you to the European renaissance and its impact on modern science
- Outline briefly the development of science right from the 16^{th} century to the present day.

COURSE OBJECTIVES

To achieve the aims set out above the course sets over all objectives. In addition, each unit also has specific objectives. The unit objectives are always included at the beginning of a unit. You should read them before you start working through the unit. You may wish to refer to them during your study of the units to check on your progress. You should also look at the unit objectives after completing a unit. Set below are the wider objectives of the course as a whole. By meeting these objectives, you should have achieved the aims of the course as a whole.

On successful completion of this course you should be able to:

1. Define science and differentiate it from technology

2. Differentiate between the products and the processes of science using specific examples
3. Enumerate the attitudes of science and the attribute of scientists.
4. Explain the contributions of ancient cities to the development of modern science
5. Explain the contributions of Islamic civilization to the development of modern science
6. Identify the impact of renaissance on modern science and technology
7. Appreciate the impact of scientific revolution of the 16^{th} and 17^{th} centuries to the development of modern science.
8. Make a list of some of the scientist of the 16^{th} and 17^{th} centuries and their contributions and achievements in science and technology
9. Outline the factors that led to industrial revolution and the scientific movement of the 18^{th} century.
10. Enumerate the major developments in science in the 19^{th} and 20^{th} centuries
11. Describe the nature of science in the 20^{th} and 21^{st} centuries.

WORKING THROUGH THIS COURSE

To complete this course, you are required to read the study units, set text book and other materials provided by NOUN including visit to the e-library. You will also need to find out more about the examples given to illustrate certain point in the course units. You will need to spend about three hours on each unit.

MODULE I: The Nature and Philosophy of Science

Unit 1 - Meaning and Importance of Science and Technology
Unit 2 - products and Process of Science
Unit 3 - Scientific attitudes and attributes of Science
Unit 4 - The Scientific Method
Unit 5 - The beginning of Human history and contributions of early Human civilization

MODULE II: Contributions of Early Human Civilization to the Development of Modern Science

Unit 6 - Science in the Ancient cities of Egypt and Mesopotamia
Unit 7 - Science in Ancient Greek and Rome
Unit 8 - Science in Ancient cities of China, Maya and Indus River Valley civilizations
Unit 9 - Islamic civilization and Science
Unit 10 - Science in the middle Ages

MODULE III: Scientific developments in the later years

Unit 11 - European Renaissance and its impact on Modern Science
Unit 12 - Science in Western Europe in the 16th and 17th Centuries
Unit 13 - Industrial Revolution and the Scientific Movement of the 18th and 19th centuries
Unit 14 - Scientific developments in the 19th century
Unit 15 - Major Scientific achievements in the 20th and 21st centuries

ECE 231 - SCIENCE IN EARLY YEARS
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2.0 Objectives
3.0 Main Content
3.1 Definition of Science and Technology
3.2 Differences between Science and Technology
3.3. Importance of Science and Technology
3.4 Reasons Why Science enjoys Prominent position in our society
4.0 Conclusion
5.0 Summary
6.0 Teacher Marked Assignments
7.0 References and Further Reading

Unit 2: Products and Processes of Science
Content

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2.0 Objectives
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5.0 Summary
6.0 Tutor Marked Assignment
7.0 References and Further Reading

Units 3: Scientific Attitudes and Attributes of Scientists
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3.2 Types of Scientific Attitudes
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6.0 Tutor Marked Assignment
7.0 Reference and Further reading

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3.2 Stages of Scientific Method
3.3 Hypothetical Illustration of Scientific Method
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4.0 Conclusion
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3.2 Achievement of Ancient Egyptian civilization
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4.0 Conclusion
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Content
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3.3 Achievements of Ancient Rome an Civilization
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7.0 References and Further Reading

Unit 8: Science in Ancient Cities of China, Maya and Indus River Valley
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2.0 Objectives
3.0 Main Content
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3.2 Achievements of Ancient Mayan Civilization
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4.0 Conclusion
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7.0 References and Further Reading

Unit 12: Scientific Developments in the 16th and 17th Centuries

Content

Unit 13: Industrial Revolution and the Scientific Movement of the 18th and 19th Centuries

Content

Unit 14: Scientific Developments in the 19th Centuries

Content

Unit 15 Major Scientific Achievements In the20th and 21st Centuries

Content

Working Through this Course

To complete this course, you are required to read the study units, read set of recommended books and other materials prescribed by your tutor. Each unit contains activities to enable you follow the trend of what you are reading and be sure you understand it. There is tutor - marked assignment 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 is 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 Assignment (TMA)

There are thirty tutor marked assignments in this course. You are encouraged to submit all the thirty except any counter d\directive from your tutor, in which the best require 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 tutorials provided in support of this course. You will be notified of the dates, times and location of the tutorials, together with the name and phone number of your tutor, as soon as your are allocated a tutorial group.

Your tutor will mark and comment on your assignments, keep close watch on your progress and on any difficulties you might encounter and provide assistance 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 the self-tests or exercises
3. You have a question or problems 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 your tutor and to ask questions which are answered instantly. You are free to raise any problem encountered in the course of your study. To examine 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

ECE 231 intends to introduce you to the brief of historical background of science right from the dark ages to the present day. Upon completing this course, you will be equipped with the knowledge of the historical development of science and you will be able to see how modern science has developed from the activities of the ancient cities and in their civilizations. You will as well be able to answer the following questions.

1. What is the difference between science and technology?
2. What are the products of Science?
3. What are the Processes of Science?
4. List some scientific attitudes
5. Mention some attributes of Scientists
6. What are the contributions of ancient cities (e.g. Egypt Mesopotamia, Greek Rome etc) to the development of Modern Science?
7. Describe the origin of Renaissance and its impact on Modern Science

8. Outline the factors that led to Industrial revolution in the 18th century
9. Identify the Major Scientific Developments in the 19th Century
10. Explain the nature of Science in 20th and 21st Centuries.

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MODULE 1: NATURE AND PHILOSOPH Y OF SCIENCE

INTRODUCTION

In this module you will be exposed to the nature of scientific enterprise and the philosophy of science. You will also learn the meaning of science and how it differs from the term technology. The major concern of this module is to acquaint you with the processes of science, products of science and the attitudes of science .All these will serve as background for subsequent modules. This module therefore is broken down into 5 units which are stated as follows:

Unit 1 - Meaning and Importance of Science and Technology

Unit 2 – Products and Processes of Science
Unit 3 - Scientific Attitudes and Attributes of Scientific
Unit 4 - The Scientific Methods
Unit 5 – The Beginning of Human History and contribution of Early Human Civilization

UNIT 1

Content

Introduction

The term science has been given several definitions by many scholars. In this unit, you will be introduced to the various definitions of science and you will also be able to define science based on your understanding of the word. You will also see how science has contributed to the over all development of mankind.

Objectives

By the end of this unit, you should be able to

* Give various definitions of science by different scholars.
* Explain the concept of science as you understand it
* State and explain the importance of science to mankind.

3.0 Main Content

3.1 Definition of Science

The word science was originally derived from the Latin expression “Scientia” which means “to know” or to have “knowledge”. Another latin verb “scio-ire-ivi-iture” which means “to know” to have skill in” or “to know how to’’ The Latin definition. seems to give more support to the definition of science. The above verb therefore describes science as a way of acquiring knowledge or skills. In the same vein, science is also related to the Greek word “Episteme” which when translated into English language become “knowledge”. These definitions therefore suggest that science is knowledge yielding enterprise.

On the basis of the above, science can be understood in two broad inter-related sense. First, it could be understood as the persistent desire of man to improve his strategic position in the world by means of dependable method for predicting and whenever possible controlling the events that occur in it. In this regard, scientific activity generally results in the present day production of gadgets and invention of weapons.

Secondly, science is an intellectual activity embarked upon by man in order to satisfy his insatiable desire to find out or investigate the natural phenomena. Since man is a rational animal, he is curious and always has a desire to know the world in which he lives, explains and understands it. These two factors constitute the basic motivations for any scientific activity

Self Assessment Exercise: Explain how the Latin describe science?

Other definitions of science

The meaning and definition of science varied as many as there are different science scholars. To a layman, science is often seen in terms of scientists who carry on the process of science or their work as applied in technology. Otuka (1983) is of the view that science is man's attempt to understand his environment. Otuka's opinion is in line with Ogunniyi (1986) who sees science as an attempt by human being to organize their experiences about nature into meaningful systems of explanations. Conant (1951) defines science as inter connected series of concepts and conceptual schemes that have developed as a result of experimentation and observation and are fruitful of further experimentation and observation Conants definition implies that science is not permanent but that the products of science are subject to change as soon as further experimentation and observations are made on them.

From the above definitions, science can be seen in three forms:

1. Science can be seen in terms of the products i.e. knowledge in form of concepts, laws, theories etc.

2. It can also be seen in terms of the processes or method of acquiring knowledge i.e. observing experimenting, measuring etc

3. It can also be seen in terms of attitudes of scientist and as a human enterprises where every one contributes fruitfully towards achieving stated goals.

Self Assessment Exercise

State any two definitions of science as given by different scholars

Definition of Technology

The term technology has its root from a combination of two Greek words "techne" and "logos". The word "techne" means art or craft while the word "logos" means word or speech. The combination of the two words means a discourse on the art and its application. Simply put, the word technology can be seen as the systematic study of techniques for making and doing things.

It is the practical application of the products of science for the benefit of mankind. The primary aim of technology is to make life comfortable for mankind. Technology has provided a lot of benefit to mankind. This can be seen in terms of increase in food supply through application of machinery power, fertilizers and pesticides, improved health services, communication transportation and so many others.

Self Assessment Exercise
How will you define the term technology in your own words?

3.2 Differences between Science and Technology?.
Ordinarylly, science attempts to give possible explanation to happenings in the universe. When scientist carry out their investigations about nature, they come out with theories, laws, ideas, principles etc which are called the products of science. Technology on the other hand is the practical application of the products of science for the benefit of mankind. Science produces the required knowledge and skills which technologies use in making their working tools. The industrial revolution of the 18th century and the socio-economic interchange from the industrial revolution has made science and technology to come closer.

Technology is the cause of happenings and not the explanation of the happening nor the explanation of the causes. It is only science that can explain the causes of events in the natural phenomena. For instance, technology devices motor cars but does not explain how and why motor car move. Technology devices a means of curing sickness but it does not explain the cause or the description of the illness.

Self Assessment Exercise
Briefly explain the main relationship between science and technology.

3.3 Importance of Science
Science today represents, for many, the paradigm of the progress of human knowledge and achievement.. The success of science were construed as a cumulative process of increasing knowledge and sequence of victories over ignorance and superstitions. In addition, science has made possible an impressive array of gadgets and usages today. The primary aim of science is to find out general explanation, understanding, prediction and control of natural events around us. Science is the most powerful means devised by the mind of man for arriving at truth in respect to matter and energy.

Self Assessment Exercise
Enumerate the importance of science to mankind.

Reasons why Science enjoys prominent position in our society.
Abdullahi (1975) identified three major reasons why science enjoys prominent positions in any society and all over the world. According to him:

i. No other subject has affec ted man so directly like science. This is evident in the products of technology in terms of gadgets, communication devices, weapons etc

ii. No other subjects have attention being paid to the methods of generating new knowledge and information like science.

iii. No other branch of knowledge expands so rapidly like science.

The position of Abdullahi as stated above implies that science and technology interact with the society to provide social changes and in fact they are the key elements for future social development of any nation. In addition, the greatness accorded a nation today; depends on her scientific and technological advancement. For instance, the United States of America, Britain, Russia and Japan, to mention but few are regarded as developed nations today because of their advancement in science and technology. Nigeria among other nations is regarded as a developing nation because of her backwardness in science and technology.

Other importance of science and technology can be summarized as follows:

a. Science has done so much to liberate mankind from bondage due to superstitions, idol worshiping, animism, and associated beliefs.

b. In terms of Agricultural practices, the knowledge and information from science have contributed to improved agricultural practices, pest and weed control, curbing the problems of soil erosion and modern ways of cultivation are some of the modern agricultural practices that have helped to improved crop yield.

c. Scientific and technological structures of a society have a strong influence on the economic development of that society. For instance, most of the technological development which resulted in important inventions such as steam engine, printing press and many others bring about economic revolution of a society.

d. Science and technology have helped man to beautify his environment and give possible explanation to things that happened in his environment.

e. Through science and technology, communication has improved and less risky form of transportation and services has been introduced.

f. Science and technology have made life comfortable for man and have improved man's standard of living.

g. In terms of medicine, science and technology have helped in increasing the lifespan of man. This can be seen in the discovery of surgery, preventive and curative drugs.

Self Assessment Exercise

State and explain other ways by which science is important to mankind.

3.0 Conclusion:

4.0 Science has been defined by various authors. To some, it is an organized body of knowledge and the processes of acquiring the knowledge. Others see science in terms of what scientist do in terms of its product and methods, while others see it in terms of its ethics and motives. Furthermore, the role of science and technology in the development of any nation cannot be over emphasized. From the discussion so far, it can be concluded that the strength of a nation today depends on its level of science and technological development. Science has brought a lot of influence on the economic aesthetic and culture of various society in the world all over.

5.0 Summary

In this unit, you have learnt the various definitions of science, starting from the Latin verb to the Greek word. You have also learnt about the relationship between science and technology and the importance of science to mankind. In the next unit, you will be introduced to the products and processes of science.

Tutor Marked Assignment

1. Why do you think science has enjoyed prominent position in the society more than any other discipline? Give reasons for your answer

2. Do you think the world would have been better without science and technology? Substantiate your position with relevant examples.

References and Further Reading

Abdullahi, A. (1982) Science Teaching in Nigeria Ilorin, Atoto Press

Conant J.B. (1955) Science and Common Sense, New Haven, Yale University press

Oguniyi, M.B. (1986) Teaching Science in Africa. Ibadan Salem Media.

Otuka, J.O.E (1983) Science Curriculum in Nigerian Secondary Schools, some cultural implications in curriculum development. Unpublished paper presented at the international symposium on time cultural implications of science Faculty of education ABU Zaria, Nigeria.

UNIT 2: RPODCUTS AND PROCESSES OF SCIENCE

Content

1.0 Introduction

In the last unit, we attempted to define science. We also saw how science differ from technology. Attempt was also made to see the main contribution of science and technology to the development and benefit of mankind. In this unit you will be introduced to the products of scientific enterprise and the tools which scientist use in carrying out investigations.

2.0 Objectives

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

1. Describe the products and processes of science differently
2. Give examples of the products of science
3. Mention and explain some processes of science

3.1 Products of Science.

When scientists carry out investigation of natural phenomena, they came out with their findings. These findings could be inform of ideas, principles laws, theories etc. These are known as the products of science. In other words, the products of science are the outcome of scientific investigations. The following products of science will be discussed fully ideas facts, principles, concepts laws and theories.

Scientific Ideas:

Ordinarily an idea is a conception or abstraction about something. A scientific idea is a mental image used by scientist to define their terms and test their hypotheses, which if meaningful, entail prediction. Ideas in science are usually formed to test a hypothesis which later leads to formation of concepts in science.

Self Assessment Exercise

Name one idea or conceive one idea based on your area of specialization.

Scientific Fact

A fact is something that can be shown to be true or to exist or to have happened. Scientific facts are based on the use of one or more sense organs to prove the existence of something. Scientific facts are not based on mere speculations but on observable or demons ratable events. E.g. the sun rises from the East and falls in the West.

Self Assessment Exercise

Mention one fact based on your area of specialization.

Scientific Principles

Scientific principles are fundamental truth upon which other truths are founded. In other words, scientific principles are made up of laws that form the basic theoretical structure of a concept. For instance, the basic theoretical structure of physical sciences can be found in Boyle's law and Newton's law of motion. A good example of a scientific principle is the principles of conservation of energy.

Self Assessment Exercise

Give one example of principle in your area of specialization.

Scientific Concepts:

A concept in science is an idea or a mental image formed by abstracting common features of a series of experiences. Concepts generally can be classified into two major groups. These are theoretical and empirical concepts. Theoretical concepts are concepts whose meaning are not derived from direct or indirect observation using sensory stimulation. Rather, they are subject to human ability to communicate the imagined idea. Examples include, electron, atom, gene, mass etc.

Empirical concepts on the other hand is the direct opposite of the theoretical concept. Empirical concepts are concepts derived from direct or indirect observation or experiences. This means that they are concepts that a scientist can use his sense organs to observe. Examples include colour, chromosomes, change of state, energy change etc.

Self Assessment Exercise

Mention some concepts from your area of specialization which are theoretical and those which are empirical.

Scientific Laws:

Scientific laws are generalized statement that have characterized general pattern or regularities in natural happenings. Laws when established usually stand for quite some time before it is changed. Examples of law in science include, first and second law of heredity postulated by Gregor Mendel, Boyle's Law, laws of thermodynamics etc .

Self Assessment Exercise
Make a list of other scientific laws you know or laws from your area of specialization

Scientific Theory.

A scientific theory is a statement put forward to explain the existence of one or several laws. For instance, in Dalton's atomic theory and kinetic theory of matter, several observed facts and a statement connecting the observed facts together were made. Therefore, a theory is put forward to explain the existence of Laws. Scientific theories are not permanent but changes with time as new facts are discovered. Other examples of theories include theory of natural selection, Big Bang theory etc.

Self Assessment Exercise
Explain in your own words what you understand by scientific theory.
Why are theories not permanent?

3.2 Processes of Science

Processes of science are the various tools that scientist use when carrying out their investigations or activities. There are many processes but ten major ones will be discussed. Those are

i. Observation
ii. Classification
iii. Inference
iv. Production
v. Measuring
vi. Communicating
vii. Making operational definition
viii. Formulating question and hypotheses
ix. Experimenting
x. Formulating Models.

Observation

This is the very first skill used by scientists in carrying out investigation of natural phenoma. Observation can be direct using all or any of the sense organs or it can be indirect when the senses are not adequate. This will then involve using machines or other aids to support what is being observed. Data collected as a result of observation could be used to take further action based on the precision of the senses used.

Self Assessment Exercise
Mention some of the sense organs that can be used for direct observation.

Classification:

This is the grouping or ordering of things or objects based on certain common characteristics. For instance, when objects and events are observed, they can be classified based on similarities; differences or any other selected properties.

Self Assessment Exercise
Mention the various ways by which objects and living things can be classified.

Inference
This refers to receiving an opinio n or decision that something is true or otherwise on the basis of information that has b een acquired through observation. Inference requires evaluation and judgment. It leads to prediction.

Self Assessment Exercise
What are the requirements of inference?

Prediction:
This is the act of saying that something will happened based on regularity of observation about an event or object. Prediction may later become true or not but it usually have a high level of certainty. For instance, having observed for several years that rain usually fall whenever there is cloud and high temperature it can then be predicted that rain will fall whenever there is high temperature coupled with cloud formation.

Self Assessment Exercise
Make a prediction about an event in Nature.

Measuring.
Measuring is concern with knowing the size or extent of something especially in comparison within a known standard. In science, measuring can be made directly or indirectly. Data collected from measuring can be used in communicating.

Self Assessment Exercise
Mention some of the instruments and units of measuring things.

Communicati ng.
The outcome of observation and measurement need to be recorded and kept for future use. Communication can be verbal or non verbal. The verbal communication occurs when scientist interact with one another in the course of their activities. Non verbal communication on the other hand involves writing, drawing, graphical representation to mention but few.

Self Assessment Exercise
Discuss some of the verbal and non verbal ways of communication in your area of specialization.

Making Operational Definition.
Operational definitions are made in order to simplify communication on phenomenal being investigated by scientists. It gives information needed to differentiate terms which are being defined from other similar phenomena.

Self Assessment Exercise
Attempt to define some words operationally from your area of specialization

Formulating hypotheses and questions

Formulating hypothesis and questions when a problem comes up, scientist usually ask questions as to the possible cause s of the problem. The questions lay the foundations for designing an experiment; identify the possible cause with a view to solving the problems. The questions asked may lead to intelligent guesses about the possible cause of the problem. These intelligent guesses are known as hypothesis.

Self Assessment Exercise
Attempt to pose a problem from your area of specialization and formulate question and hypothesis based on the problem.

Experimentation
This is the process of designing and gathering data to test the hypothesis formulated about a problem. Experimentation may involve all or some of the science processes. For instance, in an experiment, observations, classification, prediction etc are made.

Self Assessment Exercise
Design an experiment in your field of specialization and list out the science processes involved.

Formulating Model:
From the result of the test hypothesis in an experiment, a model can be formulated to further explain the problem being investigated from the result of the hypothesis in an experiment. The model can be empirical or theoretical.

Self Assessment Exercise
Formulate a model from your area of specialization

5.0 Conclusion

6.0 Both the product and processes of science discussed above constitute the nature of scientific enterprise; whenever scientists are carrying out their activities they must use the various processes of science to arrive at their findings which form the products of science.

7.0 Summary

In this unit, we have discussed the products and processes of scientific enterprise. We have also learnt that the product of science are the outcome of scientific investigations which could be in form of ideas, facts principles, laws and theories to mention but few. We have equally also learnt that the processes of science are the skills which scientist use in carrying out their activities. These skills include observation, classification predicting and experimenting . In the next unit, you will be introduced to the attitudes of science and the characteristics of scientists.

Tutor Marked Assignment

What do you understand by the term products and processes of science?

wo products and two processes of science using relevant specialization.

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UNIT 3: ATTITUDE AND ATTRIBUTES OF SCIENCE CONTENTS OF SCIENTISTS

Introduction

1.0 In Unit two, you have learnt about the nature and philosophy of science. This involve how scientist use various skills (i.e. processes) to carry out investigations and arrived at certain out come known as the products of science. Scientist in the course of carrying out their investigation in the laboratories need to develop, certain characteristics which include curiosity, honesty, open mindedness perseverance etc. these are called scientific Attitudes. In this unit, you will learn about some of the major attitudes that scientist need to imbibe in the course of their investigation. Also, you will learn about who a scientist is and some of the major characteristics of scientist.

Objectives

2.0 By the end of this unit. You should be able to:

Define scientific attitudes
List and explain some of the major scientific attitudes
Describe who a scientist is
Mention and explain some attributes of scientist

1.0 Main Content

3.1 Meaning of Scientific Attitudes

Scientific Attitudes can be described as that, which regulate behaviour of scientist when they are carrying out scientific activities in the laboratory. It is an internal state that moderates or influences the personal actions of scientist in the course of carrying out investigation in the laboratory.

Proshansky and Seidenberg in Emina (1986) are of the view that scientific attitudes can be considered to have cognitive, affective and behavioural components. The Cognitive components refers to ideals, beliefs and convictions about a situation. Affective components refers to feelings which are internal and personal. The behavioural components refers to visible physical response to a specific object or situation.

Self Assessment Exercise
Explain how Proshansky and Seidenberg describe scientific attitude

Types of scientific Attitudes
Koslow and Nay (1967) proposed eight attributes or types of scientific attitudes. These are listed as follows:

*Critical mindedness
*Suspended Judgement
*Respect for evidence
*Honesty
* Objectivity
* willingness change
* Open opinion mindedness
* Questioning

A brief explanation of each is made below,

Critical Mindedness:

This is the ability to develop the spirit of appraising something. It involves passing judgment on everything. As a scientist, it involves passing judgment on everything he comes across in the course of scientific investigation.

Objectivity
This means that scientist should be able to develop the ability to perceive or describe something without being influenced by personal emotions or prejudices. By being objective, scientist should be able to describe objects, events or things as they are.

Suspended Judgment
This means that, scientist should not come into conclusion about something he has not gotten all the evidence.

Willingness to Change Opinion
Knowledge in science is not permanent but keeps changing as new information are acquired. Therefore scientist should develop the habit of changing his opinion whenever there is a change in any findings.

Respect for Evidence

All scientist should always look for evidence and respect it. In the course of carrying out investigation, scientist should not base their conclusion on heresay..

Open Mindedness

This means that scientist should always be ready to share their findings with other scientist. They should allow their fellow scientist to see and criticize their work so as to improve on it.

Honesty:

Scientists should develop the spirit of presenting their finings as they are rather than manipulating. They should be honest in the course of carrying out their investigation.

Questioning:

Scientists should be curios by asking questions about events and happenings in their environment.

Other scientific attitudes apart from the above include humility and perseverance

Humility:

Scientists should develop the spirit of humbleness in the course of carrying out scientific activities. They should be cool headed and submissive especially to those above them.

Perseverance:

Scientists should develop the spirit of perseverance in the process of carrying out their activities especially when they are passing through experimental failures and frustrations. They should endure all difficulties.

Self Assessment Exercise

Give reasons for why scientist should develop the above mentioned attitudes in the course of carrying out investigations.

Who is a Scientist?

A scientist is someone who has scientific training or background. According to Ukoli (1985), a scientist is an individual who tries to establish the laws of nature in his various activities using the processes of science. Scientist – uses rational and logical reasoning to explain the natural phenomenal. He is always in the laboratory carrying out investigation about natural phenomena.

Self Assessment Exercise

Attempt a description of a scientist from your own point of view

Attributes of scientist.

1. Must develop scientific attitudes such as curiosity, open mindedness, honesty etc.
2. Must be emotionally sensitive in addition to the application of rational and logical approaches in the course of carrying out his investigation

3. Must be sensitive to "chance discovery" This is the possibility of making discovery by accident or by chance.
4. Must be kept abreast within relevant literature. This means that he is expected to possess sufficient wide range of relevant knowledge so as to be up to date.
5. Must be competent to design and test experiments. He must also develop ability to formulate hypotheses and design experiments to test the hypotheses
6. Must be ready to understand repeated failure and frustration as they came in the course of carrying out scientific activities.
7. Must be able to use appropriate language when reporting his findings.
8. Must familiarize himself with the lives and works of the past scientist. This is because they may serve as a source of inspiration to him,

Self Assessment Exercise

Discuss other attributes of scientist you know.

4.0 Conclusion

For anybody to be called a scientist, he must be able to imbibe the various attitudes of science and posses certain characteristic. This is the major difference between science discipline and other fields.

5.0 Summary

In this unit, you have learnt about some of the attitudes that scientist must develop to be able to carry out investigations effectively. In the next unit, you will be introduced to the method which scientist use in carrying out investigations. This is known as scientific method. You will also see the various steps involve in scientific method and the induction and deduction method of scientific investigation.

6.0 Tutor Marked Assignment

State and explain three attitudes of science you have learnt

What are the attributes of scientists

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UNIT 4: THE SCIENTIFIC METHOD
CONTENT

1.0 INTRODUCTION

In the previous unit, we have attempted to describe what scientific attitudes were. We were also able to mention and explain some of the characteristics of scientist. In this unit, you will be introduced to the concept of scientific method and the steps involved in using scientific method.

2.0 OBJECTIVES

By the end of this unit, you should be able to

- Describe scientific method
- differentiate between inductive and deductive method
- List the steps involved in scientific method
- Give an imaginary illustration of scientific method

3.0 MAIN CONTENT

Scientific method can be said to be a general principle which guide scientists, in the search for new knowledge. Attempts have been made to describe scientific methods in a series of steps but no single description has ever been satisfactory to all concerned. This is because scientist do similar things when in investigating but there are different approaches and different ways the evaluate what they find. The exact approach a scientist use depends on the individual doing the investigation as well as the particular field of science being studied. However, there are certain activities that seems to be common to scientists in different fields as they conduct scientific investigations.

Self Assessment Exercise
Attempt a description of scientific method in your own words.

Inductive and Deductive reasoning.
Apart from the scientific method, scientist also use two philosophic ways of reasoning in the course of carrying out investigation. These are inductive and deductive reasoning. The two method of reasoning were developed by the Greek philosophers. The theories of inductive and deductive reasoning laid the foundation for the scientific method.

Inductive method of reasoning was developed by Francis Bacon. It involves taking particular cases and using them to draw general conclusion. In other words, inductive method involves

moving from specific to general. In this methods, scientist collect bits of information through a gradual process of investigation and forming them into theories. Deductive method on the other hand is the process of inferring new facts from something already known. Deductive reasoning has to do with using the logic of a theory to generate propositions that can then be tested. Deductive reasoning was developed by the ancient Greek philosopher Aristotle

Self Assessment Exercise
Mention the names of the scholars that developed Inductive and deductive Reaosning.

Stages of Scientific method
There are six major stages involve in scientific method. These are listed below and a brief discussion on them made.

Step 1: Observation
Step 2: Statement of the Problem
Step 3: Formulating Hypotheses
Step 4: Conducting experiments on the basis of hypothesis
Step 5: Collection and Analysis of Data
Step6: Drawing conclusion and Formulation of Theories.

Step 1: **Observation**
Here scientist ask questions out of curiosity about their natural environment. In the process of asking questions they observe. Observation could be direct or indirect. Direct observations involve the use of all the sense organs while indirect observation involve the use of other scientific aids such as microscope, telescope etc. Most observations made by scientist often lead to identification of problem and this forms the basis of stage two..

Step 2: **Statement of the Problem**
As a result of observation made, scientist identify problems and state the problem in a researchable form. The statement of the problem could be as a result of series of observations made either directly or indirectly.

Step 3: **Formulating hypothesis**
This stage involves formulating hypothesis based on the problem stated in step two. This means that scientist make intelligent guesses pertaining the possible causes of the problem stated in step two. The formulation of hypothesis often lead to conducting experiments on the basis of the hypothesis and this form the forth step below.

Step 4: **Conducting experiment**
In this stage, experiments are carried out to test the hypothesis formulated in step three. The experiment could be conducted in the laboratory or outside the laboratory depending on the nature of the problem stated. As experiments are conducted, data will be collected and analysis of the data will be will be carried out. This forms the basis for the fifth step below.

Step 5: **Collection and Analysis of Data**

the collection and analysis of data. As the experiment is riments is recorded.. The data recorded could be in form of rial representation. At the end of the experiment, the data ll form the basis of the final stage which is the conclusion and formulation of theory.

Step 6: **Conclusion and Formulation of Theory**
On the basis of the data collected in stage five, conclusions are made and laws and theories are formulated.

3.3 A Hypothetical illustration of scientific method.

In a biological garden where Albino rats are raised, it was observed (observation) by the curator that some of the animals are dying on a daily basis. This poses a serious problem to the curator. The curator of the rat started making intelligent guesses (Hypothesis) about the possible cause of the death of the rats. For instance some of the possible guesses made could be:

a. Could it be due to infection by disease
b. Could it be due to bad food or water
c. Could it be due to action of predators
d. Could it be due to harsh weather condition.

All the above questions are intelligent guesses which are also known as hypotheses. On the basis of the hypotheses, experiments are conducted. This means that experiments will be carried out to test each of the hypothesis. For instance, to determine whether the cause of the death is due to infection by disease, the animals (rats) will be taken to a vet nary pathology laboratory for a test. Each of the hypothesis will be tested and eliminated. In the course of carrying out the experiment, data will be collected (connection of data) based on what is observed during the experiment. The data collected will be analyzed either in graphical pictorial or in figure forms. Based on the data analyzed a conclusion will be reached as to what is responsible for the death of the rats. Based on the conclusion, a theory will be formed to explain the cause of the deaths of Albino Rats.

Self Assessment Exercise
Describe an imaginary problem in your area of specialization and explain how you will use scientific method in solving it.

3.4 Limitation of scientific method.

It should be noted that scientific method has its own limitations. Below are some of the major limitations.

1. Scientific method can only be applied to questions that have factual basis. Questions concerning morals, value judgement social issues and attitudes can not be solved using scientific method.

2. Scientific methods cannot be used to solve all the problems of man, for instance the problem of famine, drug abuse and pollution are human caused problems and must be resolved by man. Science may provide some tools for social planners, politicians and ethical thinkers but science does not have nor does it attempt to produce all the answers to the problems of human race.

3. Scientific method is not 100% reliable as it is subject to experimental errors.

Self Assessment Exercise
Mention and explain other limitations of scientific method not mentioned above.

CONCLUSION
In conclusion, it should be noted that scientific method should only serve as a guide to researchers when they are carrying out their investigations. The steps stated about should not be strictly adhered to, rather it should only serve as a guide.

SUMMARY
In this unit, you have learnt about what scientific method is all about and the steps involved in the use of scientific method. In the next unit you will be introduced to the beginning of human history and civilization.

Tutor Marked Assignment
State the major differences between inductive and deductive method
What are the limitations of scientific methods?

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UNIT 5 : The Beginning of Human History and Civilization

Content

Introduction

In unit four, attempt was made to define and describe the steps involved in scientific method. The limitations of using scientific method were also highlighted. In this unit, you will learn about the beginning of Human history and civilization and you will also see how the ancient civilization has contributed to the development of modern science.

Objectives

By the end of this unit you should be able to

1. Describe the nature and origin of man
2. Explain the theory of evolution
3. Relate how early human civilization has led to the development of modern science and technology.

3.1 Origin of Life

Many scientist have given possible explanation to the origin of life on earth. Most of the theories are of the view that the first living things on earth emanated from non living matter. According to this theory elements and compounds were the only matter present when the earth was formed and that a form of energy such as lightning caused simple molecules to combine.

This led to a larger and more complex molecules which were the type present in living things today.

In 1953, an American scientist Stanley Miller performed an experiment based on the theory that the early atmosphere of the earth was much different than it is today. According to him, the early atmosphere probably was made of many gasses such as methane, ammonia and hydrogen. Matter was also present. In Miller's experiment, these gases combined to form Amino Acids, when electric discharges passed through them. These Amino Acids formed the building blocks of protein which is the basic material of living organism today.

Amino acids contains Carbon, Hydrogen, Nitrogen and Oxygen. The first Amino acids, combined to form proteins and these proteins then combined to form larger and more complex compounds. These compounds had the ability to reproduce themselves such that exact copies of the protein resulted.

According to this theory, the first simple forms of life began in the oceans in form of one – celled organisms, from which more complete forms of life developed

Theory of Evolution

The first person to make a comprehensive theory of evolution was the French Scientist- Lamark. He tried to derive the whole variety of living things by descent from simpler forms of life. He proposed that all living matter had an inner tendency to evolve from the simpler creatures to the more complex ones. Lamark accounted for this by supposing that simple creatures were being made afresh all the time by spontaneous generation from non living matter. The diversity noticed in living things today was due to the fact that each creature was striving to adapt itself to its special mode of life.

Other scientist that further proved and refined Lamarks theory were Charles Lyell, John Ray Linneaus and Charles Darwin. It was Charles Darwin that really worked extensively on the theory of evolution and even proved it in his book titled "The origin of Species". In this book Darwin reviews the evidence for inherited variations in domestic animals and the way in which selection could give rise to varieties, which could be inherited and passed to offspring. He also talked on the theory of Natural selection in his book.

In 1858, Alfred Wallace, a British biologist in his investigation came to the same conclusion with that of Charles Darwins. Both Darwin and Wallace in their separate investigations came to the following conclusions :

1. That different species of plants and animals were related
2. that new species were appearing from the old one
3. that other species were disappearing as a result of natural selection

Self Assessment Exercise

Mention the scientist that are involved in the theory of evolution

What are the conclusion jointly reac hed on the theory of evolution by Charles Darwin and Wallace?

3.3 Origin of Man

Charles Darwin believed that the origin of man is equally in his theory of evolution. The origin of man is described by Charles Darwin in his book – "the Descent of Man" – This theory stated that man had developed from some lower animals. Darwin supported this assertion with available data which pointed out that the living mammals of any specific area were closely related to the fossilized remains of extinct species which had been discovered there. He concluded therefore that since the two living primate most closely resemble man (i.e. Chimpazee and Gorilla) and are both found in Africa, it would be reasonable to suppose that man's birth place would eventually be discovered on the African continent.

Another school of thought traced the origin of man to the theory of creation. This theory states that man was specially created by Almighty God and endowed from the very beginning with all the physical and mental attributes of modern man in His own image.

Self Assessment Exercise
Discuss the origin of man from the evolution theory of creation.

3.4 The beginning of early human civilization.

The science of which histories are written is usually that of the West and the origin of this Western Science lies deep in the remote human past and in several civilizations.

Civilization simply means the social process by which societies achieve an advanced stage of development and organization. A civilized society is a society in an advanced state of social development with complex legal political and religious organizations.

In a nut shell, it is an advanced state of intellectual, cultural and material development, in human society marked by progress in the arts and science.

It should be noted that the present ways of comprehending the natural world by scientist is a recent development. The ancient civilization achieved highly developed techniques in term of their perception of the universe, religion and legal system in the complete absence of a conception of science as it now understood.

Conclusion

In conclusion, the achievement of the ancient civilization served as the foundation for the development of modern science and technology. Prominent among the ancient civilization include Mesopotamia, Egypt, Greek, China , Maya and Indus River Valley to mention but few. The achievement of some of these ancient cities will be discussed in the next unit.

Summary.

In this unit, you have learnt about the origin of living things, evolution theory and the origin of mankind. You have also learnt about the meaning of civilization. In the next unit, you will see how civilization in the ancient cities of Egypt and Mesopotamia has contributed to the development of modern science.

Tutor Marked Assignment

1. Discuss how the theories of evolution and that of creation can be used to explain the origin of man
2. State the major conclusions reached by Charles Darwin and Wallace in their separate experiments on the origin of species

References and further Reading:

Bakker, G and Clark L. (1988) Explanation In An Introduction to the Philosophy of Science. Mountain View, California Mayfield Publishing Company.

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Unit 6: Science in the Ancient Cities of Egypt and Mesopotamia

1.0 Introduction

Ancient Egypt and Mesopotamia were among the ancient civilizations that contributed to the development of modern science. Their civilization was due to the availability of the River Nile in Egypt and River Tigris and Euphrates in Mesopotamia. These rivers encouraged the inhabitants to settle near the rivers and practice Agriculture. In this unit, you will learn about the achievements of the two cities.

2.0 Objectives

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

1. Describe the ancient Egyptian civilization
2. Itemize the achievements of Egyptian civilization and relate it to the development of science and technology.
3. Describe Mesopotamia civilization

4. Make a list of the achiev ements of Mesopotamia civilization and relate it to the development of modern science.

3.0 Main Content

3.1 Description of Ancient Egyptian Civilization

Ancient Egypt was one of the longest lived civilization of the ancient world. The ancient cities of Egypt were isolated and bounded by other natural factors which combined to give rise to a great civilization in the region. Nomadic people may have been attracted to that area because of the hospitable climate and environment. Other factory that made ancient Egypt to be successful include the following:

1. Egypt had a relatively cloudless sky where the sun almost shone, thus, consistently providing heat and light
2. The Nile River served as a water highway for the people and a constant source of life thus giving water and sustenance to all plant and animals.

3.1 The natural barriers provided good protection and security from invaders. For instance, the Egyptian desert was to the West, the seas to the North and East and the River Nile's rapids and valleys to the South.

The natural barriers made ancient Egypt to be conservative and independent.

Self Assessment Exercise
Discuss the major Natural factors that contributed to the success of Ancient Egyptian civilization.

3.2 Contributions of Ancient Egypt –

* They built magnificent building, using timbers and stones and this made their houses to be very strong. They were also experts in some cutting, sculpture and painting. They built great store tombs in form of pyramid. A good example of such pyramid is the Great pyramid of Giza and that of Khufu.

  Their style of building, sculpture and painting laid the foundation for modern architectural design of building, sculptures and paintings.

* **Astronomy:**
  The ancient Egyptians were very good in astronomy. They devised a way of knowing the direction of the four, cardinal points in the universe. These are the North, West, East and South. Their calendar had 29 and 30 days with a total of 365 days in a year. They measure the hours of the day by sun dials or the cardinal points. Calendar and measurement of time that are used today were ideas from the astronomy of ancient Egypt.

* **Mathematics:**

They were good in counting addition, subtraction, multiplication and division thus, laying the foundation for modern "BODMAS" i.e. Bracket of Division, multiplication, Addition and Subtraction.

* **Medicine**
  In terms of medicine, the Egyptians belief in life after death hence they embalm and preserve human body through the practice of mummification. In the practice of mummification the brain will be removed and thoroughly washed in herbs and wine. The body cavities will then be filled with perfume and sweet smelling resins. (an excretory product of plant). The ancient Egyptian practice of mummification made them to be conversant with the human body and surgical operation process.

* **Agriculture**
  They were good in irrigation and Animal rearing. Ancient Egyptians practiced irrigation at all times including gardening. The abundance of the Nile and the Egyptians careful management of the necessary dykes and irrigation system guaranteed a flourishing agricultural society.

  Finally, as one of the world's earliest major and long lived civilizations, ancient Egyptians left a legacy of important innovations, discoveries and contributions that have lead to the foundation of modern science and that have affected humankind over the millennia.

Self Assessment Exercise
What was Egyptian perception about life after death?

Ancient Mesopotamia Civilization
Mesopotamia is coined from a Greek word meaning a land between two Rivers. Today ancient Mesopotamia is located in the area of modern Iraq and Eastern Syria between River Tigris and Euphrates.

3.4 : Achievement of Ancient Mesopotamia Civilization

* **Agriculture**
  In terms of agriculture the river valley and plains of Mesopotamia is very rich for agriculture especially fishing and irrigation. This attracted people to settle in the ancient city and develop on their own. They built canals and practice extensive irrigation.

* **Writing**
  The growing administrative needs stimulated the invention of a form of writing known as "Cuneiform" which is a mode of writing utilizing wedge shaped strokes inscribed mainly on clays, stones, metal wax and other hard materials. There were about 200 signs with each representing a number of words having similar sounds.

Medicine

Their early medicine manifested itself in a combined form of magic and science. They believe that all ailments were caused by the gods and so they consulted their gods before they administer any drug. The y also use herbs gotten from roots leaves and fruits of plants for treatment of diseases. However, there was no major surgical operations as there were no specialist.

Classification of Animals

Because of the presence of the two rivers, there were many animals and plants this made them to classify the existing animals into fish, serpent, birds and four legged animals. Also, hundreds of different animals and about 250 varieties of plants were found and classified.

Map Making

They were the first to introduce the idea of map making:

Building

1. They used sundry bricks hardened by fire in building their houses
2. They build their temples known as ziggurats using sundry bricks
3. They were involved in trading by barter
4. They developed first class system of weight and measurements
5. In the field of mathematics, they adapted twelve instead of ten as their counting unit. They also practice fractions, values of square and cubes.

Self Assessment Exercise

What are the factors that made Mesopotamia to be successful in Agriculture.

Conclusion

The above contributions of Egypt and Mesopotamis laid the foundation for the development of modern science and technology.

Summary

In this unit, you have learnt about how ancient Egypt and Mesopotamia have developed and how their civilization has led to the development of modern science and technology. In the next unit, you will learn about the achievement of Ancient Greek and Rome.

6.0 Teacher marked Assignment

1. Explain the factors that led to the development of ancient Egypt.
2. Relate the achievement of ancient Mesopotamian civilization to the development of modern science and technology

7.0 Reference and Further Reading

Barker G, and Clark C. (1998) Explanation: An Introduction to the Philosophy of Science Mountain View, California, Mayfied Publishing Company.

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UNIT 7
SCIENCE IN ANCIENT GREEK AND ROME

1.0 Introduction:

In the last unit, we studied the development of two Ancient cities. These were Egypt and Mesopotamia. We were also able to discuss the contribution of each of the cities to the development of modern science and technology. In this unit, we shall discuss the development of ancient Greek and Rome. We shall also discuss their various achievement and how these achievements have served as a foundation to the development of modern science and technology.

Objectives:

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

1. Describe development of ancient Greek and Rome
2. State and explain the contributions and achievements of each of the ancient cities.
3. Relate the achievements of each of the cities to the development of modern science and technology.

Main Content

3.1 Description of Ancient Greek civilization .

The beginning of western science have traditionally been located among the philosophers of Greek states on the coast and Island of the Eastern Mediterranean, as far back as in the 6th and 5th centuries B.C. The early Greek philosophers were cosmologists who guess freely about the ul timate constituent of the universe. Among the ancient Greeks philosopher were Thales, Enpedocles, Pythagoras, Aristotle, Plato and Socrates . One peculiar characteristics of these ancient philosophers is that they were more speculative than being empirical. This means that they give common sense explanations about events in the universe rather than using scientific equipment in their explanation. Let us discuss few of their speculative views of the universe.

* Thales

He was considered as one of the seven wise men of Greece. According to him the original principles of all things is water. He is also said to have introduced geometry in Greece. He also became famous for his knowledge of astronomy.

* Empedocles:

According to Empedocles, all things in the universe are composed of four primal elements. These are: earth, air, fire and water. He also asserted that there are two active opposing forces which act on these forces combining and separating them into infinitely varied forms. These according to him are “love” and “hate”. The four elements are bound together by the principle of love while hate separate the elements to be apart.

* Pythagoras:

He was a Greek philosopher and a mathematician. He founded a movement with religious, political and philosophical aims known as Pythagoreanism. Pythagoras wanted to discover the master key to universal harmony both natural and social, and the personality of numbers which he construed as an ordered array of dots. Pythagoras was not only an influential thinker, but also a complete personality whose doctrines addressed the spiritual as well as the scientific.

* Parmenides

He maintained that the universe is an indivisible unchanging, spherical entity and that all reference to change or diversity is erroneous; According to him, all that exists has no beginning and has no end and is not subject to change over time.

* Plato

He was a great metaphysician, mathematician, astrophysicist and political theorists. He loved mathematics and saw in it the key to a rational method of scientific inquiry. He argues that geometry prepares the mind for the discovery of real ideas which can be perceived only through imagination. For Plato, genuine scientific knowledge is possible through the intellectual apprehension of the ideal entities in the world of forms.

* Aristotle:

He was a student of Plato and one of the world's first, and greatest scholars. He created a biological science and a taxonomy similar to those in use today Aristotle also made important contributions to logic, physics and political theory.

Other prominent Greek, Philosophers include Alexander the great, Euclid, Archimedes, Appolonius and Hipparctus among others.

Self Assessment Exercise

Mention any three Greek Philosophers and discuss their major contributions to the development of science.

3.2 **Contributions of Ancient Greek to the Development of** Modern science

The following are some of the achievement of the ancient Greek civilizations.

* **Mathematics:**

The Greeks taught the world about mathematicians Euclid was a famous mathematician who invented a complete system of geometry which is still studied in schools all over the world to day. The same thing applies to Pythagoras theorems.

* **Philosophy**

The Greek philosophy taught us to be inquisitive about our environment. It taught us to ask why things happen and how things should be done.

* **Science:**

The Greek began many of the branches of science that we study today. Aristotle wrote books on biology, zoology, physiology and Botany. Archimedes was the greatest physicist of the ancient world while Theophrastus is regarded as the father of Botany

* **Medicine**

Hippocratus is regarded as the father of medicine and modern medical doctors still honour his ideas today as it is expressed in the Hippocratic oath. The Greeks were the first to debunk the belief that sicknesses were caused by supernatural causes, rather, that sickness were caused by diseases.

* **The Greek Language:**

The Greek Language has had great influence on other European languages used in science and other disciplines today. For instance, words like philosophy, biology, geography, zoology etc were all derived from Greek language.

In fact, the contribution of Greek to modern civilization and particularly in science and technology cannot be over emphasized.

Self Assessment Exercise

Why is Hippocratus regarded as the father of modern medicine?

3.3 Achievement of Ancient Rome to civilization

The Roman civilization is a sophisticated and apparently modern in its personalities and politics. It is very solid in jurisprudence and law. It is also very progressive in the technologies of warfare and public hygiene but failed to produce many noticeable scientists like the Greeks. This is because the Romans considered science as fit only for casual speculations on the one hand, and practical techniques on the other hand.

The Romans discussed scientific matters seriously only in connection with philosophies that were basically ethical. They belief in the pursuit of happiness. This is enshrined in their philosophical belief known as Epicureanism. One of the possible explanation responsible for failure of science scholars in Rome could be slave trade which lead to stifling and shifting of Romans for industrial innovation in Europe. It has also been speculated that perhaps the social structure of Rome which did not allow for the necessary social mobility necessary for scientific progress might be responsible for their low achievement in science.

The remains of vast building projects including roads and bridges, temples and theatres as well as entire towns in the North African desert, still mark Rome's former domination. Their 'Latin" language is used today in many words in science and technology today.

Finally, the Roman empire became the channel through which the cultures and religions of many peoples were combined and transmitted via medieval and renaissance Europe to the modern world.

Self Assessment Exercise

What are the two major areas or field that the Romans were well known for.

Conclusion

It can be seen from the above that the Greek and Roman civilization had laid the basic foundation upon which modern science developed. However, it should be note that despite the giant strides achieved in the field of science by the Greeks, they had no precise instrument, for testing their theories, they only base all their works on speculations

5.0 Summary

In this unit, you have learnt about the development and contributions of both the ancient Greek and Roman civilizations. In the next unit you will learn about the achievements of ancient China Maya and Indus River Valley civilizations.

Tutor Marked Assignment

1. State and Explain the major contribution of Greek civilization to the development of modern science and technology

2. What are the main achievement of ancient roman civilization

7.0 Reference and Further reading

Butterfield, H (1975) : The Origins of Modern Science New Yoke, Free Press.
Stephen Toulmin (1983): The philosophy of Science, London, Hutchinson University, Press.

UNIT 8

Science in Ancient Cities of China Maya and Indus River Valley Civilization

1.0 Introduction

In Unit 7, we discussed about the ancient cities of Greek and Rome. We also talked about their achievement and how these achievements have laid the foundation for modern science and technology. In this unit, we shall move further to discuss other ancient cities. These are China, Maya and Indus River Valley. We will also discuss how their civilization has contributed to the development of modern science and technology.

2.0 Objectives

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

1. Describe ancient cities of China, Maya and Indus River Valley.
2. State and Explain the contributions of each of the ancient cities to the development of modern science and technology

Description of Ancient China and its Contributions to Modern Science and Techology

China traces its origins as a discr ete political and cultural unit to ancient times. Like the Egyptians, the Chinese also deve loped as an independent civilized community in the far East. This is because they were isolated from the rest of the world.

* *Way of Writing*

It was easy to disseminate information about their own brand of science through their way of writing. They wrote on pieces of bone or tortoise shell and later changed to bronzed vessels.

* *Chinese Science*

Chinese Science does not have underlying theory guiding their planetary motion, mathematics or alchemy. Rather most of what they did was in their bid to solve practical problem confronting them.

* *Mathematics*

They use small rods to count their numbers. For instance one rod stands for one, and two rods stand for two and it continue like that. The counting was done on counting boards and can be used for addition, subtraction, multiplication and division. They also devised a way of counting large numbers.

* *Astronomy*

They kept tract of the solar system by observing the heavens and the planet. They devised a calendar which had 365 ¼ days. They also kept records of significant astronomical events such as the eclipses. Comets and earth quakes.

* *Pure Sciences*

In pure science, the Chinese were more practical then theoretical. For instance in physics, they devised methods of practical measurements such as metric system, weights and balances. They studied optics, shadows and discovered that light traveled in straight lines. They also invented magnetic compass. In Chemistry, they discovered several chemicals which they thought could make them immortal. They use a chemical that today looks like mercuric sulphide on the body of the dead person which made the body so elastic as if it was buried recently. They also devised special chemical apparatus in the form of stoves, furnaces, vessels etc.

In Biology, the Chinese kept all sorts of animals and insects in their homes. They bred crickets for sports, kept bees for medicinal purposes, dogs for security and some insects for protection of crops. They also studied plants to know their different species and their environment in which they flourished best.

* *Medicine*

Chinese medicine was very popular through the practice of acupuncture. Acupuncture is a process by which the natural responses of the body system were stimulated to the circulatory system, nerves, veins and arteries. They diagnosis patients by checking his heart

rate, breath. Colour of the tong ue. These methods are in use by modern medical doctors today.

Self Assessment Exercise

Describe briefly Chinese way of counting numbers

Achievement of Ancient Mayan Civilization

Ancient Maya is today located in Middle America and in the Western mountains of South America. The people known as the Maya lived in the region that is now Eastern and Southern Mexico, Guatemalael- Salvador and Western Hondouras.

* *Architecture:*
  Their power in architecture could be seen from the way they build. They built massive store, pyramid, temples and sculpture. They used cemented rubble bricks and thick plasters in their building.
* *Astronomy*
  The Mayan conception of the universe was primitive and superstitious. They believed that the universe contain four directions and thirteen layers. The Earth was seen as the back of a giants Lizard or crocodile lying in vast pond within water lilies and fish. They had a calendar which had 365 days consisting of 18 months of 21 days each.

* *Mathematics*
  The Mayan counted their numbers in the units of twenty with each number going by a special name. For instance, the number 41 was calculated as two score and one and 51, as two score and eleven. There was no formal mathematics.

* Writing
  The Maya developed a complex system of hieroglyphic writing to read any astronomical observations and calendrical calculations but also historical information's. Scribes are carved on stone, altars, wooden lintels, roofs beams and in books made of bark paper.

Self Assessment Exercise

Describe the nature of Architecture in ancient Mayan civilization.

3.4. Achievement of Indus River Valley Civilization

This is one of the largest ancient civilization similar to ancient Egypt and Mesopotamia. The remains of settlement belonging to this culture has been found throughout the Indus River Valley in Pakistan and Western Indua. The civilization was covered by a single Bronze Age Culture.

* *Craft Specialization*
  They were very good in pottery. Ceramic toys, beads, metal ornaments and stamp seals.

* *Indus Valley*

This used to be very fertile and rich in agriculture but later complex ecological change occurred in the Indus Valley area, forcing abandonment of many settlements and altering the basic characteristics of the settlement.

* Harappa was a city in the Indus civilization that was very popular and it still remains a living town today.

* Material culture and the skeleton from the Harappa cemetery and other sites testify to a continual intermingling of communities from both the West and the East

* The major achievement of the Indus River valley civilization was in brick making and the industries of pottery and metal production which help to develop their culture. They were also good in town planning and the establishment of uniform standards of weights and measures.

Self Assessment Exercise
What is the importance of Indus Valley to their civilization

4.0 Conclusion

From what we have discussed above, you would have discovered that the ancient cities of China, Maya and Indus River Valley have contributed directly or indirectly to the growth and development of modern science and technology.

5.0 Summary

In this unit, you have learnt about a brief historical background of three ancient cities. These are China, Maya and Indus Valley. You have also seen how these civilizations have aided the development of science and technology in modern time. In the next unit you will learn about Islamic civilization and how it has aided the development of modern science and technology.

6.0 Tutor Marked Assignment

1. Describe briefly the major features of ancient China, Maya and Indus River Valley Civilization
2. How did the civilization of ancient China, Maya and Indus river Valley aided the development of modern science and technology.

7.0 References and Further Studies

Butterfield, H. (1975): The origins of Modern Science, New York, Free Press
Bakker, Co. and Clark, L (1988) Explanation: An Introduction to the Philosophy of Science Mountain View, California, May field Publishing Company.

Unit 9: Islamic Civilization and Science

Content

1.0 Introduction

In the last unit, we learnt about how three ancient cities (i.e. China, Maya and Indus River Valley) civilizations developed. We also learnt about how the civilization of these cities have aided the growth and development of modern science and technology. In this unit, we shall look at Islamic civilization and how it has aided the development of modern science and technology.

Objectives

By the end of this unit, you should be able to

1. State the contributions of Islamic civilization to the development of modern science and technology.
2. Make a list of the major Islamic scientist and what they are credited for.

3.1 Background to Islamic Civilization

Literature has shown that Islamic culture is very relevant to European science. Besides Islamic religion is also related to Judaism and Christianity. There was also active cultural intermingling between Arabic speaking countries and Latin. Drawing from the traditions of Greek, science, through Christian scholars at Syria, the early Arab leaders at Bagdad in

the 9th century had the bulk of the Greek science translated into Arabic and their scholars advanced further especially in mathematics, astronomy, optics chemistry, Biology and medicine. Let us now look at some of the contribution of Islamic scholars to the development of science and technology.

3.2 Contribution of Islamic Civilization to Science

* *Mathematics*

Arab mathematician Muhameed Al- Khwarizmi introduced Hindu – Arabic numerals to Europe. Hindu- Arabic numerals include "zero" which was not known in Europe at that time. Al-kwarizmi also wrote on algebra, a name derived from Arabic word "Al-Jabr". He was also the person that introduced Algorith, which forms the backbone for our modern day computing.

* *Astronomy*

The Arab scholars through their effective observational skills gave names to many of the brightest stars. Some of these names include – Aldebaran, Altair and Denab. All these names are used today by modern Astronomist.

* *Chemistry*

Arab scientist developed methods of manufacturing metallic alloys and method of testing the quality and purity of metals. Arab chemists left their marks in some names used in chemistry today. Such names include Alkali, alchemy, which are both Arabic in origin.

* *Physics*

The Arab scholars were also vast in physics. One of the famous Egyptian physicist Alhasan published a book that dealt with the principles of lenses, mirrors and other devices used in optics.

* *Medicine*

Translation from Greek were instrumental in the development of Arabic system of medicine throughout the Arab speaking world. They introduce numerous chemical treating substances for treatment of the sick. They were also good in the fields of ophthalmology and public hygiene.

Prominent among the Arabian physicians are Al- Razi who was the first to identify small pox and measles, Avenzoar, who was the first to describe the parasite that causes the disease scabies. Malmonides wrote books on diet and hygiene, Al-Quarashi wrote commenting on the writing of Hippocrates on diet and diseases.

Self Assessment Exercise

Discuss the role of Muhammed Al-Khwarizmi in the history of Islamic civilization.

4.0 Conclusion

In this unit you have learnt about Islamic civilization and how some Islamic scholars have contributed to the development of modern science and technology. This is peculiar in mathematics, astronomy, chemistry, physics and medicine. You will also agree that some of the discoveries made by Islamic scholars are used by modern scientist up till today.

5.0 Summary

From the previous units, you have learnt about the contributions of ancient cities including Islamic civilization to the development of modern science and technology. In the next unit, we shall discuss science in the dark and middle ages.

6.0 Teacher Marked Assignments:

1. Discuss the contribution of Islamic scholars to Mathematics, Astronomy and Medicine
2. With the aid of specific examples what are the contributions of Islamic scholars to the development of modern science and technology.

7.0 References and Further Reading

Butterfield, H. (1975): The Origin of Modern Science. New York, Free Press.
Bakker, G and Clark, L (1988) Explanations: An Introduction to the Philosophy of Science Mountain View, California, Mayfied Publishing Company.

Unit 10: Science In The Middle Ages

Content

1.0 Introduction

In the previous unit, you have seen how Islamic civilization has contributed to the development of modern science and technology. In this unit we will look into science in the middle ages and the factors responsible for the backwardness of science and technology in the middle ages.

2.0 Objectives

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

1. Briefly discuss science in the dark ages
2. Mention and Discuss the main features of science in the middle ages
3. Explain reasons why science was backward in the middle ages

Review of Science in the Dark Age

The next half millennium in Europe, up to the year1000A.D is often referred to as the Dark Ages by the historians of science. Below are the major events that happened.

1. Literary Culture in the Rome –dominated western Europe were almost declining
2. In contrast with the above the eastern empire under the reign of Constantinopele hosted a civilized society though they did not produce much new scientist
3. There were no many scientist even in Europe but philosophers that only speculates .
4. It is a period of ignorance because no meaningful learning was achieved during this period.

Self Assessment Exercise

What is the nature of science in the dark ages?

Science in the Middle Ages

In the early part of the 11th century A.D most learned men knew and understood bits of ancient science but later, a little progress was noticeable.

The 12th century witnessed the beginning of re-birth in science. This is when treaties and books were written on natural philosophy. The books also tend to sensitized the public on the need to embrace science.

The 13th century witnessed the great age of scholastic learning and the founding of great monastries and universities. At this period in question learning was centred on the monastries and not on the universities and religion tend to obstruct the road to scientific progress.

In the middle of the 13th century, Europe witnessed traumatic economic and social disasters in the forms of general financial collapse. This incidence further made science to be inactive and little interest was placed on experimentation. Natural philosophy and particular facts were studied mainly in connection with problem relating to religion and philosophical speculations. Historians of science has described the middle age as a period peculiar with dogmatism superstition and magic.

Throughout the middle ages, formal attempts to understand the physical world were developed especially in the arts and medical faculties of the medieval universities. Most of the speculations made by the Greek philosophers were revisited. The works of Greek Philosopher like Aristotle that had the most immediate impact began to dominate western philosophical thought. There was little or no practical study or experimentation within the medieval university but the Bible and Roman Law were the two popular courses.

The tendency to avoid practical subjects was reinforced by Aristotle's teachings on how natural philosophy should be conducted and the correct way of determining the truth of things. He rejected the use of mathematics in natural philosophy. This was because we belief that mathematics being entirely abstract, could not contribute to the explanation of

natural world. Although, geometry and arithmetic were taught in the university system, they were always regarded as inferior to natural philosophy.

Self Assessment Exercise

Discuss the major contribution of 13th century to the development of modern science.

Factors Responsible for the backwardness in science in the middle ages.

1. Medieval Mathematics were confined to simple computations and mathematics was not regarded as a compliment of science not knowing that mathematics can be used to take advance problems in science, including astronomy.
2. Absence of Scientific incentives
3. Great emphasis on theology and faith i.e Bible and Roman Law
4. Technical methods were treated as secret and with mysteries hence, there was no spirit of open mindedness. Knowledge gainfully employed acquired in industrial practice were not dismantled to other.

During the late middle ages, there was a positive change in the intellectual climate. It was discovered that theology and religion could no longer solve man's problem. Secondly, there were divisions among the churches. Disagreements appeared at the very centres of medieval learning's, philosophical controversies seemed to shake the very foundations of dogma, there was intellectual curiosity, willingness to re-open questions which appeared closed before and to seek answers from every source capable of giving them and this was the beginning of re-birth in science which the historians of science calls "renaissance"

Self Assessment Exercise

What was the major positive change in intellectual climate that occurred in the late middle ages.

Conclusion

The medieval period for all its contributions to science was a period of "go-Slow" for science. Theologians and Islamic philosophers used Greek Philosophers speculations to justify their positions.

5.0 Summary

You have learnt from this unit the main features of science in the middle ages. You have also learnt about reasons why science was background to the middle ages and how development in the mid and late 13th centuries prepared for the re-birth of science which is called the renaissance. In our next unit, we shall discuss in detail renaissance and its impact on modern science and technology.

6.0 Teacher Marked Assignment

1. Describe briefly the nature of science in the dark ages
2. Enumerate and explain the major factors that led to backwardness of science in the middle ages.

7.0 References and Further Reading

Butterfield, H. (1975): The O rigin of Modern Science. New York, Free Press.
Hoover, K.R. (1984): The Elements of Social Scientific Thinking, New York, St. Martin Press.

UNIT 11 European Renaissance and the Birth of Modern Science

Content

1.0 Introduction

In the last unit, we discussed about science in the middle ages. In the course of our discussion we saw how formal attempt to understand science started gradually and by the middle of 13th century, a lot of people started embracing science. In this unit we shall continue with how science became fully embraced by the society. This started in Italy in 14th century and got to its peak in the 16th century. The historians of science calls the period the age of re-birth of science otherwise called the Renaissance.

2.0 Objectives

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

1. Define the term Renaissance
2. Identify the factors that led to renaissance
3. Explain the contribution of renaissance to the development of modern science and technology.

Main Content

Meaning and origin of Renaissance

The term renaissance is a French word meaning "rebirth". It refers to historic era which is a cultural movement that encompasses a rebellion of learning based on intellectual transformation. Renaissance can be viewed as a bridge between the middle ages and the modern era. It was a cultural movement that affected European intellectual life. It began in Italy and spread gradually to Europe. Renaissance attempted to improve and perfect the way intellectuals of the middle ages approached religion. It also affected other intellectual inquiries such as literature, philosophy, arts, politics and science. Renaissance thinkers sought out learning from ancient texts typically written in Latin or Greek.

Renaissance was a period of revival in classical learning in Europe which was brought about partly by contact with other civilization, especially Islamic civilization in Spain and Palestine and partly by the development of Urban centres with literate upper classes. The period was characterized mainly by the founding of universities and scholars in scholastic learning some of the scholars of this period included St. Thomas Aquinas, a theologian and the experimentally – minded Roger Bacon.

Self Assessment Exercise
Explain in your own words what you understand by the term renaissance

Characteristics of Renaissance

There are four major characteristics of Renaissance:

1. Emphasis was laid on the study of ancient texts in the original form and appraisal was made on them through combination of reasoning and empirical science.
2. The development of highly realistic perspective in artistic technique. This can be seen in terms of painting and architecture
3. It was a period of revival in classical learning in Europe which was brought about partly by contact with other civilization especially Islamic civilization in Spain and Palestine and partly by the development of urban centres with literate upper classes.
4. Founding of universities and a surge in scholastic learning and values.
5. Great intellectual excitement among scholars who were convinced that they were living in a new age which promised to be ever more glorious that the great days of Greece and Rome
6. Greater ease of communication.
7. Invention of Printing which makes publication easy
8. Invention of gun powder to replace swords and shields used in the Medieval period's. The gun powder helped in offence and defence against enemies.

Self Assessment Exercise
Explain the "Great Intellectual Excitement" that occurred during renaissance.

Implications of Renaissance to the development of modern science.

The rebirth of learning led to the development of national languages. For instance, an Italian poet Dante, in his work "Divine Comedy" was written in Italian which was the language of the

common people in Italy and could be understood by them. It was not written in Latin as it used to be in the medieval period.

Renaissance has exposed men to the spirit of inquiry and criticism and to further research. Which constitute some of the characteristics of modern science and technology

It was during renaissance that meaningful study on medical science started. Men and animal bodies were dissected and previous theories about the human body were debunked.

The invention of printing has also ease publication of scholarstic works. This has made it possible to have access to published works which in turn facilitated learning. The invention of gun powder also led to the establishment of national armies which helped to strengthen the position of the monarchies and the interest of the state. The renaissance also manifested itself in the field of science. Researches were made about the animal kingdom, plant structure and vegetable life. The new scientific knowledge required that scientist should use experiment in establishing any new discovery. It was from this period that science as we know it today began to take proper shape.

There was the development of chemicals to supplement the use of herbal drugs in curing sickness. Distillation technique and practical apparatus for use in experiments were improved.

Important contributions were made on the theory of diseases and treatment of different ailments were developed.

In physics renaissance has also made advances. The main works in physics covered terrestrial magnetism, optics and mechanics Mathematics served all disciplines as it was used to give precision and quantitative results.

There was also the introduction of the Indian Arabic numerals including zero. Many mathematics books were written.

Important discoveries were also made in the field of astronomy. For instance, it was proved that the sun was the center of the universe rather than the earth as it was believed in the medical period.

Finally, the renaissance has provided the gate way for the word to discover itself. Man began to sail away from his own country and to discover new lands which he had read about from the study of works left behind by early geographic of Greek and Arab origin. Instruments such as the compass, quadrant and sextant Were used by sailors in open sea

Self Assessment Exercise
What is the importance of printing in the rebirth of modern science?.

3.0 Conclusion

It can be concluded that intellectual and scholarstic learning flowered in centres like Oxford Cologne, Paris and Rome. Renaissance was a gradual movement and it provided a very

important impetus to scientific thinking and knowledge. On the whole, it laid the foundations for modern science and technology.

4.0 Summary

In this unit, we have learnt about the meaning and characteristic of renaissance. We have also learnt about the implications of renaissance to the development of modern science and technology. In the next unit, we shall talk about the development of science in Europe in the 16th and 17th centuries.

5.0 Tutor Marked of Assessment

1. List and Explain the characteristics of renaissance
2. What are the implications of renaissance to the development of science and technology

6.0 Reference and Further Reading

Butterfield, H (1965) : The Origin of Modern Science New York, free Press

Burhard, J (1974): The Civilization of the Renaissance, London, penguin Publishers

Kuhns, S.T (1996): The Structure of Scientific Revolutions. Chicago . The University of Chicago Press.

Unit 12: Scientific Development In the 16th and 17th Centuries

Content

1.0 Introduction

In the previous unit, we studied the meaning and origin of renaissance. We also looked at the characteristics and implications of renaissance to the development of modern science and technology. In this unit, we shall talk about how science were developed in Europe in the 16th and 17th centuries. We will also look at the factors that led to revolutionary upsurge in science in Europe in the 16th and 17th century. Finally we shall look into some of the 16th and 17th century scientists and what they have discovered.

2.0 Objectives

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

1. Describe the development of science in Europe in the 16th and 17th centuries
2. Discuss the factors that led to revolutionary upsurge the Europe in the 16th and 17th centuries
3. Make a list of some of the scientist of the 16th and 17th centuries and what they are credited for.

3.1 Beginning of Scientific Revolution in 16th and 17th Centuries.

The scientific revolutions which is also called renaissance, positively affected the rapid development of science in Europe in the 16th and 17th centuries. It provided the intellectual basis for modern western technology particularly in Europe. The period witnessed a drastic emergence of able bodied men of science who can be regarded as genius. These men of science made new discoveries in almost all aspects of science and technology. Significant transformations were made in the field of astronomy, physics and mathematics. Also witnessed in these centuries was the use of scientific apparatus and instruments to carry out scientific investigations.

The change from only thinking and speculations about things to investigating them experimentally with special apparatus is one of the chief changes that gave rise to modern science. Today, most of the apparatus in a physics laboratory has been specially designed and made for scientific purposes. This was not the case in the early days of the scientific revolution. During these centuries too, it was possible and convenient to borrow, scientific instruments from other walks of life although emphasis was laid on designing scientific instruments for specific purposes. It can be said that the 16th and 17th centuries witnessed the development of scientific instruments. This made it possible for industries to develop rapidly in the 16th centuries especially minning. Minning was a rapidly growing industry and mines were getting bigger and deeper.

It should also be noted that in the 16th and 17th centuries, scientific instruments were used on a really big scale for the first time in history and the use of them suddenly opened up vast new field of discovery. The development of instrument, also played a major part in establishing the experimental method which is a major characteristics of modern science. Below are some of the factors that aided the rapid development of science in the 16th and 17th centuries.

Self Assessment Exercise
What can you say to be the major achievement of the 16th and 17th centuries

Factors that led to the revolutionary upsurge in science in the 16th and 17th centuries.

1. Quick cultural political; and economic changes taking place and the receptive of new ideas by the society
2. Formation of societies and organizations to promote, publicise and encourage science Examples of such society include the English Royal Society and French Academy of Science
3. Emergence of abled and devouted men of science. Examples of such men include Tycho Brahe, Robert Boyle, Galileo Galilee, Johanes Kepler etc.
4. Use of well formulated problems and the pursuit of answers to such problem
5. Use of improved experimental instruments such as telescope microscope, etc
6. Marriage of mathematics with science which made precision in science to be possible
7. Free communication among scientists. This include healthy rivalry and argument among scientist without bitterness and confrontation
8. Invention of printing which makes communication possible

Self Assessment Exercise

Mention any two scientific societies formed in the 16th and 17th centuries.

SOME OF THE 16TH AND 17TH CENTURY SCIENTIST AND THEIR ACHIEVEMENTS

Tycho Brahe

He developed precision instruments in form of sexant and quadrants which he used in observing the heavenly bodies. He used these instrument to disprove Aristotles view about comets that comets were celestial objects and not meteologiccal phenomenon that were capable of causing disease and epidemics as postulated by Aristotle.

Johannes Kepler

He confirm the Copernican theory by showing that the planet mars orbited round the sun. He was also able to prove that the ratio between the time taken by each planet to complete one orbit and its distance from the sun is the same on all the planets.

Galileo Galilei

He was regarded as the founder of the science of dynamics. He was the first to establish the law of falling bodies. He showed that there was no measurable difference between the rate of fall of objects in a vacuum. He also showed that the acceleration of falling bodies is always the same throughout the fall.

Isaac Newton

He discovered the law of gravity and postulated laws of motion. According to him, every planet, at every moment has an acceleration towards the sun which varies inversely with the square of the distance from the sun.

William Harvey

He came up with a satisfactory explanation of circulatory system in the human body.

Albert Einstein

He discovered the quantum nature of light and provided a description of molecular motion. He also introduced the special theory of relativity.

Nicolaus Copernicus

He propounded heliocentric theory which states that the sun is in the centre of the universe and that every other planet revolve round the sun.

Marie Curie

She discovered radio activity and she was the first woman to win Nobel prize

Archimedes

Known for applying science to every day life. He developed practical inventions such as levers and screws.

William Gilbert

He discovered the nature of electricity and Magnetism

Blaise Pascal

He invented the first mechanical adding machine and formulated one of the Basic theorems of projective geometry.

Other scientist that also contributed to the scientific revolution during the 16th and 17th century include Rene Descartes, Napier John to mention but few.

Self Assessment Exercise

i. Who discovered the Law of Gravity
ii. Name the first Woman to Nobel Prize in Science

4.0 Conclusion

In conclusion, it should be noted that during this period, different nations all over the world began to invest in science. This led to the establishment of scientific academies, and by the formation of scientific societies which sponsored the publication of important discoveries made by members and distribution of such copies to similar groups throughout Europe and other areas.

5.0 Summary

In this unit, you have learnt about scientific revelation in Europe in the 16th and 17th centuries. You have also learnt about the factors that led to revolutionary upsurge in science in the centuries in question. You have also seen some of the scientists of those centuries and their achievement. In the next unit, you will see how the scientific revolution of the 16th and 17th centuries has led to industrial revolution in the 18th century in Britain.

6.0 Tutor Marked Assignment

1. Briefly describe the nature of scientific revolution in the 16th and17th centuries
2. What are the factors that led to the revolutionary upsurge in science in the 16th and 17th centuries in Europe.

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7.0 References and Further Reading

Hoover, R.K (1984): The Elements of Social Scientific Thinking New York: St Martins Press Inc.

Harre Rom (183) Great Scientific Experiments England. Oxford University Press.

Kuhn Thomas (1996) : The Structure of Scientific revolution. Chicago University Press.

Unit 13: Industrial Revolution and the Scientific Movement of the 18th and 19th Centuries

Content:

2.0 Introduction

In unit 12, we have seen how scientific revolution has led to the production of abled bodied men of science and the production of scientific instrument, tools and machines. In this unit you will be exposed to how the scientific revolution of the 16th and 17th centuries has led to a boost in the production and use of machines in Britain and other European countries in the 18th century. There was widespread replacement of manual labor to the use of machines in factories. This is what is known as industrial revolution. In this unit, we shall see the factors that aided the industrial revolution and the impacts of the revolution on the society.

3.0 Objectives

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

1. Describe the term industrial revolution
2. Enumerate the factors that led to industrial revolution in Britain
3. Explain the impact of the revolution on the society.

Meaning and Origin of Industrial Revolution

Simply put, industrial revolution is the change from the use of hands in producing goods to the use of machine. In another word: It is the change from the cottage system of industry known in the medieval period to the factory system of industry. The revolution came about as a result of application of science for practical purposes. Several machines were invented in Britain and this helped Britain to become the birth place of the industrial revolution. Goods that had traditionally been made in the home or in small workshops began to be manufactured in the factory.

Production of goods and technical efficiency grew dramatically, in part through the systematic application of scientific and practical knowledge to the manufacturing process. The revolution began in Great Britain during the last half of the 18th century, it later spread to regions of Europe and to the United States of America during the following centuries. The industrial revolution is called a Revolution because it changed the European society both significantly and rapidly Europe metamorphosed from rural life to urban life and human labour was gradually replaced, by mechanical labour.

Self Assessment Exercise

Describe in your own words what you understand by Industrial Revolution.

3.2. **Factors that Aided Industrial Revolution in Britain.**

The major factor that enabled industrial revelation to take place was the invention of steam Engine by Thomas Newcomer which was improved upon by James Watt. The steam engine was used to run factories, turn drills, drive ships and pull cars along a track. It was a cheaper and more dependable form of energy. The invention of steam engine led to the invention that were made in the spinning and weaving industries.

Another factor that helped in making Britain the birthplace of the industrial revolution was the population. There was a geometric increase in population due to movement of people from rural areas to the cities as a result of improvements in agriculture. Introduction of machinery thus forced many rural dwellers off the land into the cities to work in the factories.

Also, the new factory owners were able to obtain necessary capital to operate their factories through short term loans from banks with low interest rate. This served as encouragement for more people to establish factories.

There was also the availability of raw materials to feed the factories. These include coal, iron, ore, and wool from the home market, cotton from India and other agricultural and mineral resources from Africa.

In terms of Transportation, Britain had some natural advantages. Since Britain is a relatively small country no place in Britain is more than one hundred miles from the sea. Besides, there were many navigable rivers which made it possible to use water to transport both its raw materials and finished goods to European markets and the whole world.

On the part of the British government, there were no internal custom duties in Britain for the industries and duties on imported raw materials were very low. All these made manufactured goods to be cheaper and affordable.

Self Assessment Exercise
How did the invention of Steam Engine aided Industrial Revolution in Europe?

Impact of Industrial Revolution

The revolution has affected all countries and states in the world today. From Great Britain, it has spread to other European countries and beyond. First to France and later to Germany, the United states of America and Japan. The revolution is now transforming other parts of Asia, Africa and Latin America.

The Industrial Revolution has brought changes in tools and weapons, transport and communications, mining, textiles, agriculture, social life to mention but few.

The major significant achievement of the revolution was the mass production of cheap goods. This has increased the wealth of all Nations and it has improved the standard of living of the people. It has also improved health care system, agriculture, improved means of transport and communication and in short man has successes in building a new society and civilization as a result of industrial revolution.

The Industrial Revolution also brought in the stratification of the British society, into two classes. These are the factors owners also known as the capitalist and factory employees or workers who worked to get wages. The capitalist owned the means of production and determine the politics of the time. The workers merely sold their labour in order to survive.

Self Assessment Exercise
What do you consider to be the major impact of industrial revolution.

3.4 Limitations of Industrial Revelation

One of the major limitations of industrial revolution is the exploitation of the lower class or the workers. Conflicts between the workers and the capitalists often lead to strike actions and lockouts.

Other negative consequences of the revolution include pollution of both land water and air which has led to loss of habitat for both plants and animals.

Drastic population growth following industrialization has contributed to the decline of natural habitats and resources.

Conclusion

While the renaissance could be said to be theoretical in nature, the industrial revolution came about as a result of the application of science for useful practical purposes. The revolution started in the 18th century, rolled through the 19th century and exerted wider and greater effect extending year after year by much invention into the 21st century. Although the impact of the revolution will continue for as long as human society exist, but its effects have been of a mixed blessing to mankind.

Tutor Marked Assignment: What is the major limitation of industrial revolution

5.0 Summary

In this unit, we have discussed the meaning of Industrial Revolution and the factors that aided the revolution in Britain. We have also seen the positive and negative impacts of the revolution. In the next unit, we shall discuss the major achievements of science in the 19th century.

6.0 Tutor Marked Assignment

1. Mention and Explain the factors that aided industrial revolution in great Britain

2. Will you consider Industrial Revolution as a blessing or a curse? Support your stand with relevant explanation and Examples

7.0 References and Further Reading

Hoover, R.K (1984): The Elements of Social Scientific Thinking New York: St martins Press Inc.

Harre Rom (1983) : Great Scientific Experiments England: Oxford University press

Burhard, J (1974): The Civilization of the Renaissance, London, Penguin Publishers.

Unit 14: Scientific Developments in the 19th Century

1.0 Introduction

In the last unit, we discussed about the Industrial Revolution, factors that aided it and its impact on the society and on the development of modern science and technology. In this unit, we shall talk on major scientific developments in the 19th century.

2.0 Objectives

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

1. Enumerate the major scientific achievements of the 19th century
2. State some scientist of the 19th century and name what they are credited for

3.1 Background Information on Scientific Developments in the 19th Century.

It should be noted that since the inception of renaissance in the 16th century there were drastic developments in science and technology all over the world. The scientific revolution of the 16th and 17th centuries were as a result of renaissance.

The same thing happens to the industrial revolution of the 18th century in Britain. Just in the same vein, the 19th centu ry appears as a golden age for science. This is because science at that time has spread to every where all over the world and so many inquiries and discoveries were made. These discoveries were made in the pure science, disciplines- such as physics, chemistry, Biology, Mathematics among others.

Mathematics and experiments were combined in physics. Controlled experiments in biology received a new lease of life. Many new Universities were established and the old ones reformed where research and teachings were encouraged. More scientific societies were formed, researches were published in journals and science became professionalized and recognized all over the world.

3.2. Major Discovery in the Pure Sciences.

Discoveries in Physics

Eminent 19th century physicist include Hans Christian Oersted, Michael Faraday, Herman Von Helmholtz and James Clerk Maxwell. These men in their various ways, contributed to the theory of energy conversion and conservation working within the context of Newtonian theory. However, electromagnetic theory, towards the end of the 19th century, began to question the validity of Newtonian physics. Electric motors and generators were also discovered during this century. Radio and X-Ray waves were also discovered.

Self Assessment Exercise

Mention two Physicist Of the 19th century.

Discoveries in Chemistry

The 19th century chemistry, built on the foundations of the chemical substance nomenclature founded by Lavoisier. Aslo, elaborated was Dalton's atomic theory which states that all materials are made up of small indivisible and indestructible particles called atoms. Modern periodic table of element was developed by Dimitri Mendelee, A Russian.

Substances were also classified as elements and compounds. Discoveries were made on the properties of other unknown elements. As chemistry continue to make progress, chemists were able to uncover the true structure of organic substances. It was at this time that chemistry moved closer to unity with physics and achieved an increased power in industrial application. Other 19th century discoveries in chemistry included the world's first synthetic fertilizer. Thomas Edison devised the carbon – granule microphone which greatly improved the recently invented telephone.

Self Assessment Exercise

State Daltons Atomic Theory

Discoveries In Biology

The study of micro organism became increasingly important in the 19th century Louis Pasteur discovered that some micro organisms are involved in causing disease. He

discovered immunization as a ways of preventing disease. He also invented the process of pasteurization, to help prevent the spread of disease through milk and other food. In this century too, Gregor Mendel an Australian monk laid the foundation of genetics, the study of heredity.

Charles Darwin postulated the theory of Evolution by Natural Selection. Theodore Schwann discovered the cellular structure of living organism

Self Assessment Exercise
What is the major achievement in Biology in the 19th century.

Discoveries in Earth Science and Astronomy.
Attempt was made to determine the age of the Earth and this raised some controversies among the scientist. In Astronomy, with great improvement on optical instruments, it was possible for important discoveries to be made. In the Solar System. For instance, Asteroid, one of the many small or rocky planetoids that are members of the solar system was discovered. Some planets were also discovered e.g. Neptune was discovered by a German Astronomer Johann Galle.

Self Assessment Exercise
Who discovered Neptune in the 19th century.

3.2 Reasons Why Science Excelled in the 19th Century.

Three major factors were responsible for the general praise for science in the 19th century.

1. The ancient tradition of respect for learning as a contribution to civilization has made science to be embraced in the 19th century.
2. The fact that science can now be applied to Industries which led to industrial revolution in Britain was an eye opener for investing in science
3. Conception of natural science as a weapon against religious dogma and popular superstition made science to be more recognized and embraced

4.0 conclusion:

It can be deduced from the above discussion that with knowledge in all branches of science accumulating rapidly scientist began to specialize in particular fields in the 19th century. It can then be concluded that from the 19th century onward, research began to uncover principles that unite the universe as a whole.

5.0 Summary

In this unit, we have discovered how science excelled in the 19th century. We have also seen how science began to specialize into various discipline such as physics chemistry, biology and Astronomy. We have also discussed some scientist of the 19th century and their major achievement. In the next unit which is the last unit for this course, we will look into the major scientific achievement in the 20th and 21st centuries.

6.0 Tutor Marked Assignment

1. Discuss with the help of specific examples the major scientific achievements in Biology, Chemistry, Physics and Astronomy in the 19th Century.
2. What are the factors that made science to be embraced in the 19th century.

7.0 References and Further Reading.

Haire Rom (1983): Great Scientific Experiments England: Oxford University press

Burhard, J. (1974): The Civilization of the Renaissance, London: Penguin Publishers.

Unit 15: Major Scientific Achievements in the 20th and 21st Centuries.

1.0 Introduction

In the previous unit, we have learnt about the major scientific achievements of the 19th century. We have also seen how science began to specialize and discoveries made in Biology, Physics, Chemistry and Astronomy. In this final unit, we shall talk about the major scientific achievements of the 20th and 21st centuries. We shall also talk about science Today.

2.0 Objectives

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

1. List and Explain the major scientific achievements in the 20th century
2. List and Explain the major scientific achievements in the 21st century
3. Briefly explain nature of science Today.

Major Scientific Achievements in the 20th Century

The 20th century was a continuation of the development in the 19th century. Science became highly professionalized. Investigations were concentrated purely on laboratory experiments with the use of scientific methods. This formed the basis of modern science.

The 20th century scientists achieved spectacular advances in the fields of genetics, medicine, social science, technology and physics.

Physics

Albert Einstein postulated the theory of Relativity to resolve certain theoretical and experimental anomalies in Newtonian physics Einstein also successfully used quanta to explain photoelectric effect, which is the release of electrons when metals are bombarded by light.

In the first half of the 20th century, scientists completely transformed the study of physics. Physics determined the internal structures of the atom. It was discovered that mass could actually bend space and time, and found that the smallest known units of mass and energy behaved as both waves and as particles.

Genetics

Gregor Mendel's work in genetics was revisited in the 20th century. Biologist have now become convinced that genes are located in chromosomes, the thread like structure that contain proteins and deoxyribonucleic acid (DNA). It was at this century also that James Watson and Francis Crick established the structured of DNA in 1953. British developmental biologist Lewis Wolpert is known for his pioneering work on the development of the embryo.

Medical Science

The major achievement in this field is that a Dutch physician Christian Eijkman showed that diseases can be caused not only by micro organism but by deficiency of certain substances now called vitamins Paul Ehrlich introduced the world's first bactericide a chemical designed to kill. Specific kinds of bacteria without killing the patients cells Sir Alexander Fleming discovered penicillin in 1928. By the middle of the 20th century, Medical scientists ere ahead on way to treating, preventing and cure of many disease that have affected human being. Also the diagnosis of disease has been modernized by the use of new imaging techniques. Improved drugs and development of new tools have made surgical operations easy and possible.

Social Sciences

Social sciences received a very great attention in the 20th century. An Australian physician Sigmund Freud founded the practice of psychoanalysis, a name applied to a specific method of investigating, unconscious mental process. There was also dramatic discoveries in the field of anthropology.

Technology

Significant discoveries were made in the field of communications especially in the discovery of radio signal, television and transistor which is an electronic device used to control or

amplify an electrical current. During the 1950s and early 1960s mini computers were developed using transistors. By 1971, the first micro processor, a computer on a chip was invented when combined with other specialized chips, micro processor, becomes the central arithmetic and logic unit of a computer. During the early 1950s, public interest in space exploiration developed. The Soviet Union launched the first Suputnik Satelite in 1957. the first man landed on the moon on July 20th, 1969.

From the beginning of this course, you have seen how science has passed through revolutionary changes from the dark ages through the medieval ages uptil the modern age; which is the 21st century. From the previous units, it can be deduced that the development of science has led to revolutionary changes in thinking and behaviour. The continuous advancement of scientific knowledge greatly influenced our daily lives such that man can hardly survive without science. Science today has greatly influenced the present social economic and political outlook of every society.

Science today is a continuation of Renaissance because new innovations and discoveries in science were being made today through the use of a well defined scientific method and the use of the process of science in carrying out investigations.

Modern science seems to carry out investigation on almost all aspect of Nature. This is possible with the invention of more sophisticated scientific apparatus and evolution of dedicated men of science.

Another interesting feature of science today is the marriage of mathematics to science. The mathematical relationship between measured quantities, which seemed so exciting when first discovered, become exercises and examples in applied mathematics. Scientist working in industries use these facts to work out processes and give us new products new varieties of plants and more useful breeds of animals for the benefit of mankind.

It is interesting today to note that the rapid development science has made cannot be over emphasized. No historical events of the past has influenced the world and the lives of men as has the rapid progress of science in the last century. While these material changes are taking place, and producing profound effects on the minds of men, the advancement of knowledge is changing our philosophy.

No nation today can achieve the first rank position without a most elaborate system whereby science is applied intensively to all problems of defense, industry, health, agriculture among others.

However, it is unfortunate that today, science which has so much increased the intellectual structure of man is now being used for unwholesome destruction of man and as a weapon of oppression by the supper power countries. Modern methods of communication and transportation arising in particular from the very scientific effects devoted to aircraft design and radio, have made war between nations inevitably become total war, involving the whole world.

4.0 Conclusion

It can be concluded as a matter of facts that the rapid development that science and technology are making in the lives of ma ….. is so tremendous and fascinating that modern man may regret why they were born so soon. It should however be noted that the products of science and technology if not misused, are the greatest power that man can use in promoting inter –national peace and understanding.

5.0 Summary

In this unit, you have learnt the scientific achievement of the 20th century as it affect the pure sciences such as physics, chemistry, biology, Earth sciences and Astronomy. You have also learnt about the major characteristics of science today. It is hoped that the knowledge you have gained from this material will enable you to trace the development of science from early years till the present century.

6.0Tutor Marked Assignment

1. Discuss briefly the Nature of Science in the 20th century
2Explain the major developments of Science Today.

References and Further Reading.

Hoover, R.K 91984): The Elements of Social Scientific Thinking. New York

Burhard J. (1974): The civilization of the Renaissance London, penguin Publishers.