INTRODUCTION TO GEOGRAPHY

LESSON 1

Objectives
At the end students should be able to:
I. Give the meaning of geography by (a) Interpreting the word geography & (b) defining geography as a course of study
II. Describe the scope of geography by identifying (a) the contextual scope (b) the spatial scope & (c) the temporal scope
III. State the value of geography to the students by mentioning (a) personal benefits (b) career benefits & (c) societal benefits

Meaning of Geography
The meaning of geography can be seen from the interpretation of the name and its subject matter as a discipline.

(a) Interpreting the word geography: The name geography is derived from two Greek words ‘geo’ and ‘graphus’. ‘Geo’ is interpreted as ‘earth’ while ‘graphus’ is ‘description’. Literally, geography means ‘description of the earth’.

(b) Defining geography as a course of study: Geography as a field of study is concerned with (i) how things are distributed on the earth surface (ii) processes or interactions that led to such distribution pattern and (iii) searches and plan for how best man can maximally utilize the space they occupy at a minimum cost, and at sustain basis. It can therefore be defined as the study of distribution patterns, the processes or interactions that are responsible for them, with the view of planning sustainable development.

Scope of Geography
The scope of geography can be discussed in three broad ways. This can be seen from the items that geographers are concerned with, the area and time coverage.

(a) Content Scope: The entire content of the earth can be divided into natural and man-made (cultural) features. These are classified as physical and human geography respectively. Table 1 presents elements of physical and human geography:

Table 1: Elements of Physical & Human Geography

<table>
<thead>
<tr>
<th>Physical Geographic Elements</th>
<th>Human Geographic Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landforms</td>
<td>People/Population</td>
</tr>
<tr>
<td>Weather/Climate</td>
<td>Housing/Settlement</td>
</tr>
<tr>
<td>Rocks/Minerals</td>
<td>Agriculture</td>
</tr>
<tr>
<td>Water resources /drainages</td>
<td>Industry/Amenities</td>
</tr>
<tr>
<td>Soil</td>
<td>Transportation/Communication</td>
</tr>
<tr>
<td>Plants (flora)</td>
<td>Trade/Tourism</td>
</tr>
<tr>
<td>Animals (fauna)</td>
<td>Health</td>
</tr>
</tbody>
</table>

(b) Spatial Scope: Geographers study the entire earth space but may choose to study it in bits. Depending on the size of the space chosen there are three traditional spatial scales in geographical studies. These are

(i) local or small scale e.g. geography of your immediate locality, your local government, or your state.
(ii) regional or continental scale e.g. geography of the Niger-Delta, Nigeria, West Africa, Africa; tropical regions etc.
(iii) global or international scale e.g. world geography

(c) Temporal Scope: It took a given space of time for every feature of the earth to develop. Traditionally we have three temporal scales in geographical studies. These are:

(i) micro or small temporal scale e.g. maybe a period of less than 10 years, 20 years, etc.
(ii) meso or medium temporal scale e.g. 30-35 years, maybe to 100 years
(iii) macro or large temporal scale e.g. maybe above 100 years

Value of Geography
The benefit of geography to a students can be seen from three angles. These are personal, career, and societal benefits.

(a) Personal benefits
i. Geography touches every aspect of the material
world, as such gives students an idea of how the material world operates
ii. With geography’s liberal education, the student is endowed with the power of observation, memory, imagination, reasoning, and of good judgment.
iii. Geography assists students to make sense of an increasingly complex world and develop tolerance to differences in our global society.
iv. Geography paints practical and give reality picture to the student on the theories studied in other sciences, humanities and arts.
v. Students can research on any issue bordering society e.g. HIV/AIDS, security; provided they can be geo-referenced.

**(b) Career benefits**

i. With the “geographic eye” businesses are sited at locations that would yield maximum benefits with little or no negative consequences. Not only that, geography also equipped the students creative and entrepreneurial skills in running businesses.

ii. An understanding of geography is fundamental to the architectural designing and construction of sustainable engineering structures like roads, bridges, dams, housing etc.

iii. A student with knowledge of geography can gain employment in both public and private organizations like in civil service, banks and consultancy service; and in the military and paramilitary agencies like the army, navy, air force, police, civil defense, immigration, fire and prison services.

iv. A student with knowledge of geography can specialized and become professional surveyor, architect, planner, environmentalist, meteorologist, pilot, sailor, photogrammetrist, estate manager, cartographer, geologist, archivist, administrator, criminologist, teacher, etc.

**(c) Societal benefits**

i. With geography’s holistic approach, students get to understand the important issues facing our community, our country, and the world, and better prepared to contribute solution.

ii. Understanding the geography of an area provides useful information for the scientific study of crime and security.

iii. The fundamental basis for preventive medicine is in the understanding of geography of emergence and spread of diseases. And the distribution of pharmaceutical drugs manufacturing herbs and organisms treating diseases is geographic.

iv. Understanding of the diffusion and distribution of pollutants in water, soil/land, air as well as noise is the basis for efficient environmental management.

V. The knowledge Geography is fundamental in the understanding of causes, effects and solution to contemporary problems like global warming and climate change.

**Evaluation**

1. Give the meaning of geography by (a) interpreting the word geography (b) defining geography as a course of study

2 Describe the scope of geography by identifying (a) the contextual scope (b) the spatial scope & (c) the temporal scope

III. State the importance of geography to the students by mentioning THREE each (a) personal benefits (b) career benefits (c) societal benefits

**LESSON 2**

**Objectives**
At the end students should be able to:

I. Define local geography

II. Identify what geographers look out for when studying the geography of a place

III. Identify the methods and tools employ by geographers in the study of a place (a) data sources (b) data gathering tools (c) data presentation tools

**LOCAL GEOGRAPHY**

Our immediate surrounding constitutes our local geography. Your village or the town, the local government or the state or region in which you live is your local geography. As a rule we must understand the geography of our immediate locality before proceeding into knowing those of other places. Local geography can therefore be defined as the study of our immediate environments.

**CORE GEOGRAPHIC THEMES**

When studying the geography of a place there are seven core themes that geographers look out for. These are:
1. **Location:** Every geographic enquiry starts with a location (i.e. the spot where the phenomena or event is taking place). This can be determine by reading their longitude and latitude.

2. **Direction:** The direction of one point from another in geography is read through the cardinal principles of north, south, east and west (for four cardinal points). The orientation is naturally taken from the rising sun of the East or the setting sun in the west, from which other cardinal points can be referenced.

3. **Distance:** We may want information on the distance between two locations on the earth surface (horizontal distance), or the height of a place above or below sea levels (vertical distance). In determining geographic distance imperial units such as miles or kilometers for widely separated locales, feet or meters for more closely spaced points are used.

4. **Place:** A geographic place is an area or region of the earth or the entire earth surface. Geographers view the world from spatial perspective i.e. the distribution of earth features over place.

5. **Time:** A given time is required for a distance between two locations to be covered. Similarly, every geographic phenomena, events or changes in them occurs, occupies or happens within a space of time.

6. **Distribution:** The primary aim of the geographer is the search for distribution pattern. The distribution of a phenomena may be random, clustered or uniform (i.e. spatially); it may be discrete, flow or continuous (temporal), or it may be (in terms of density) high, moderate, or low (i.e. Spatio-temporally).

**METHODS/TOOLS OF GEOGRAPHY**

Geographers make use of a variety of techniques and tools for achieving these goals.

(a) **Data Sources**

(i) Field work
(ii) Documented sources like vital statistics, journals; atlas, imageries, photos, maps and charts and other relevant books

(b) **Data gathering tools**

(i) Observation and counting with our eyes
(ii) Conventional land surveying tools like theodolite, measuring tape etc.
(iii) Conventional meteorological tools like rain gauge, thermometer, wind vane, etc.
(iv) Photography i.e. aerial and conventional
(v) Global positioning System (GPS)
(vi) Remote sensing satellite and sensor systems
(vii) Questionnaire and interview schedules, etc.

(c) **Data presentation tools**

(i) Statistical maps and diagrams
(ii) Thematic and topographical maps
(iii) Geographic Information System (GIS), a computer base tool.

**Evaluation**

1. Define local geography
2. Mention FOUR things geographers look out for when studying a place
3. Mention any TWO each of methods/tools employ by geographers (a) data sources (b) data gathering tools (c) data presentation tools

**LESSON 3**

Objectives
At the end students should be able to:
I. Discuss the nature of Geography
II. Highlight the major developments in geography during (a) ancient periods (b) medieval periods (c) modern periods

**NATURE OF GEOGRAPHY**

Geography is a neutral subject in that it cut across all disciplines. It is an interdisciplinary subjects that unites the social and natural sciences in the knowledge of the earth. It applies the unifying vision required by many contemporary environmental and social problems.

At the senior secondary schools and undergraduate levels it gives a general knowledge of how everything in the earth space works especially as an interconnected and interrelated whole. Students in sciences, humanities/art, and business have nothing to lose from either side if they elect geography being that the elements in these respective study areas are adequately blend in geography.

Geography as a subject is currently placed in the Humanities in the just concluded curriculum review by National Education Research and
Development Council (NERDC). In various universities, Geography has find itself in faculties such as Arts, Sciences, Social Sciences, Environmental Sciences, Management Sciences, Engineering and Technology. In public offices, geographers usually occupies planning and administrative departments.

DEVELOPMENT OF GEOGRAPHY

Geography as an enquiry has a very long history. Discussion on the development of geography is often treated in three phases - ancient, medieval, and modern periods. The delimitation of these phases is based on the widespread historical events that took place especially in Western Europe.

The Ancient Period

The development of ancient geography is attributed to Greek philosophers mainly because their ideas were preserved in writing. The contributions of scholars such as Eratosthenes, Strabo, and Ptolemy were highly remarkable amongst makers of ancient geography.

Eratosthenes for example gave the name geography to the subject, Strabo tried to define the subject while the art of transforming the spherical earth into a flat surface (map) was introduce by Ptolemy. Generally, ancient geographers were concern about the nature of the earth and its place in the universe; description of the inhabited world; and Charting, mapping and measurements of the known world (Oikoumene).

The Medieval Period

The medieval period extended from 5th to the 15th centuries A.D. The nomenclature ‘the dark age’ is often used to describe this era because of the assumed dominance of faith in God over scientific thinking. The Bible was seen as the sole source of information and knowledge. The contributions to geography from the medieval Western Europe therefore had scriptural colouration unlike those from the Orient and the Arab world.

The Modern Period

At a time in Europe history people began to question the authorities of the church over their freedom to think independently. This ushered in the renaissance (re-awakening or re-birth of learning). By 14th century A.D extensive voyages of discovery and exploration were on which stimulated geographic knowledge. The era between the industrial revolution and the 19th century witnessed greater advances in geographic methodology and of course the emergence of national geographic schools of thought.

The birth place of the national schools of geography can be traced to Germany with **Alexandra Von Humboldt** and **Carl Ritter** laying the foundation for modern geography. This later on spread to France, Britain and America. Russia too, had a long history of geographical work, including the production of maps and atlases and the writing of regional monographs.

Unlike these western countries, the appearance of geography in the Nigerian school curriculum is a recent development. The foundation of the subject was laid in 1948 when the university college Ibadan was established.

**Figure 1.4** (a) Prof. A. L. Mabogunje, the first Nigerian Geographer and the first African to become president of International Geographical Union (b) Prof. Jerry Gana, a geographer and an all time National Servant of Nigeria

**Figure 1.5** (a) Senator Nenadi Esther Usman; a geographer that championed Education and Empowerment for Women. Former minister of finance (b) Dr. Austin A. Usman, an entrepreneur, a GEOSPATIAL INTELLIGENCE SPECIALIST, C.E.O Remote Sensing and Land Resource Consortium (RESLARC)

**Evaluation**

I. Discuss the nature of Geography
II. Highlight the major developments in geography during (a) ancient periods (b) medieval periods (c) modern periods

**Objective Test**

1. The name geography is derived from two words ‘geo’ and ‘graphus’  
   [a] Latin  
   [b] Greek
2. Three things are fundamental if the definition of geography as a field of study must meet the modern need of society, EXCEPT
   [a] Distribution of things
   [b] interactions that led to such distribution
   [c] The future distribution patterns of such things
   [d] and the access to such future patterns.

3. Geography is ———— oriented
   (a) people
   (b) activities
   (c) settlement
   (d) weather

4. The geographic space would imply
   (a) any part of the universe that has life supporting system
   (b) any part of the sun that has life supporting systems
   (c) any part of the earth that has life supporting systems
   (d) any part of the sky that has life supporting systems.

5. A geographer is at best a planner of
   (a) sustainable development
   (b) unequal development
   (c) equitable development
   (d) uniform development

6. One of these is NOT a core geographic theme
   (a) location
   (b) distance
   (c) direction
   (d) scarcity

7. All of these are elements of the physical environments EXCEPT
   (a) climate
   (b) landforms
   (c) agriculture
   (d) minerals

8. One of these is NOT an example of regional or continental geographic scale study
   (a) your village
   (b) Niger-Delta
   (c) Nigeria
   (d) Africa

9. All of these careers are possible after first degree in geography EXCEPT
   (a) surveyor
   (b) Architect
   (c) Administrator
   (d) Medical doctor

10. One of these is NOT a method of geography
    (a) observing satellites
    (b) data collection
    (c) mapping
    (c) analyzing geo-information

11. In the recent curriculum review geography at the senior secondary school is classified under ————
    (a) sciences
    (b) humanities
    (c) business
    (d) Technology

12. Who was the first Nigerian geographers who became the first African president of International geographical union
    (a) Prof. A.L Mabogunje
    (b) Prof. Jerry Gana
    (c) Senator Nenadi Usman
    (d) Dr. Aminu A. Usman
2. GEOGRAPHY OF THE FCT, ABUJA

**LESSON 1**

**Objectives**
At the end students should be able to:
I. Mention the problems faced by Lagos as the then capital of Nigeria
II. State the THREE terms of reference and recommendations for the New FCT, Abuja
III. State the location, position, size and administrative structure of the FCT, Abuja

**CREATION OF THE FCT**
The Federal Capital Territory, Abuja was created by decree no.6 of 1976 to replace Lagos as the then capital of Nigeria. This was due to the numerous challenges faced by Lagos.

**Terms of Reference**
In respond to the challenges of Lagos, a committee was inaugurated by the then federal government in August 1975 to look into the problems. The seven man committee headed by Justice Akinola Aguda were to follow these three terms of reference:
1. Examine the dual role of Lagos and advice on the desirability or otherwise, of the city retaining the role;
2. If found that Lagos was unsuitable, recommend on which of the two government should move to a new capital;
3. If found that the federal government should be moved out of Lagos, recommend a suitable location with regard to easy accessibility from every part of Nigeria

**Committee’s Recommendation**
In order to make an objective choice of a geographical area that would be most suitable to serve as the new federal capital, the Aguda committee devised a weighting system with the criteria on centrality having the highest.

Reference was made from other countries that relocated their administrative headquarters from the coastal or peripheral location to a more central location. For example Brazil moved their capital from Rio-D’Jenero to Brasilia; Australia moved theirs from Sidney to Canberra; and Cote D’voire had moved theirs from Abidjan to Yamous-soukro.

After thorough investigation the committee came up with the following recommendations:
1. That Lagos was incapable of performing a dual role due to inadequate space for development, commensurate with its status
2. The city of Lagos was identified with predominantly one ethnic group, the Yoruba’s.
3. A new federal capital that should be secure, neutral, accessible, comfortable and healthy was desirable. A new capital was needed as a symbol of Nigeria’s aspiration for unity and greatness.

Amongst the twelve alternatives suggested by the committee, the space between Suleja and Keffi was selected for the federal capital.

**Location, Position, Size and Administration**

**(a) Location:** Absolutely, the FCT is located between Latitude 8°25’ & 9°21’north of equator and Longitude 6°45’ & 7°39’ east of the Greenwich Meridian. It is relatively located north of the Niger-Benue confluence and on the south of the Zuma rock.
(b) **Position:** The FCT was carving out from three mother states which were Niger, Plateau and Kwara states. It shares boundary with Kaduna in the north, Nasarawa in the east, Kogi in the south, and Niger in the west.

(c) **Size:** The land size of FCT is approximately 7,607km²; which is several times larger than the former capital. This Landmass was deliberately carved out in order to meet the future needs of the country particularly in terms of physical development.

(d) **Administrative Structure:** Unlike the states in the federation, the FCT is administered by the federal government through an appointed minister. For administration to get to the grassroots six area councils operates in the FCT (see figure 2.2). One of the vital challenges faced by this ministry is in the area of land administration. However, with the establishment of the Abuja Geographic Information System (AGIS), these problems are gradually been addressed.

**Evaluation**
1. Mention any FOUR challenges faced by Lagos as the then capital of Nigeria.
2. State the THREE terms of reference and THREE recommendations for the New FCT, Abuja.

**Figure 2.2: Map of Federal Capital Territory, Abuja**

**LESSON 2**

**Objectives**
At the end students should be able to:
I. Describe the physical geographic conditions of the FCT.
II. Describe the human geographic conditions of the FCT.

**PHYSICAL SETTINGS OF THE FCT**
What constitute the physical settings of a place are mainly the natural structures of the area. The same may include: the landforms, the drainage system; the vegetation, climate, soil and rock minerals and the general environmental state.

1. **Relief:** Highlands and lowland areas of the FCT share a coverage of 48% and 52% respectively. Notable of these highlands is the Bwari-Aso hills (760m a.s.l.) while that of the lowland is the Gwagwa Plains (1297km² wide).

2. **Drainage:** The FCT is well drained with numerous rivers. The two largest of such rivers are Usuma and Gurara. While R. Usuma drains the...
northern two-third of the FCT, R. Gurara drains the western end towards the south.

3. Climate: The tropical continental airmass driven by the north-east winds brings in the FCT from hamattan as from November. The tropical maritime airmass driven by the south-west winds brings in rain as from April. Settlements like Bwari and Mpape located on highland has lower temperatures while those on valleys are hotter.

4. Vegetation: Both forest and grassland are found in the FCT although located generally on the guinea savannah belt of the country. Note that, much of the natural vegetation in the FCT has been altered by human activities as can be seen today.

5. Soil: Amongst the numerous types of local soils in the FCT are alluvial, found around river basins. Entisols are skeletal soils mainly found around hill slopes, and luvisols which are found on foothills and plains.

6. Rock minerals: There are various types of mineral re-sources in the FCT which are of high quality and have potentials for both the domestic and export markets. These include marble, clay, tin, wolframite, etc.

7. Environmental Problems: Before its creation, there were little or no environmental problems in the FCT. With the influx of people and intensification of human activities, several environmental problems like deforestation, erosion, flooding, solid waste problem, and traffic congestion are now evident.

HUMAN CONDITIONS OF THE FCT

1. People: All the inhabitants of the FCT have a traceable history of migration into the territory. The earliest immigrants were the Koro, Gade, Bassa, and the Gwari.

2. Population: The population of the FCT as at 2006/2007 was 1.4million with a growth rate of 9.3%, the highest in the country. The concentration of people is higher in the north-eastern part and reduces as one moves away especially towards south-west.

3. Settlement: When the FCT was created in 1976 virtually all the settlement were very small. A number of population centers have now emerged as a result of socio-economic and physical developments that have taken place in the last three decades.

Figure 2.3: Map of FCT, showing the major landforms

Figure 2.4: Old-style homes with straw roofs next to new building under construction in Garki Village Abuja

4. Agriculture: Upland and lowlands (fadama) are cultivated in all parts of the FCT for the production of crops. The location of the FCT within the transitional zone between the forests of the southern parts and the savannah of the northern parts of the country, gives it abundant pasture resources for livestock production.

5. Industry: Large number of traditional industries like dyeing, pottery, weaving, spinning and leather work has been on since centuries now. In the bid to encourage rapid industrial development of the FCT, the government has made provision for the development of light, medium and large scale industries at the Idu industrial Park I, II, and III; Gaube and Gwagwalada Parks.

6. Commerce: Both locally produced and import-ed goods are sold in the FCT markets. There are daily markets, weekly, and four-days schedule markets going at different localities.

7. Infrastructure: Infrastructure development lays the foundation of a nation’s economy on which all other economic activities depend. Some
of the infrastructure developed in the FCT are roads, rail, airport, electricity, hospitals, water supply, and schools.

**Evaluation**

1. Describe the physical settings of the FCT accordingly (a) relief (b) drainage (c) climate (d) vegetation (e) soil (f) rock minerals (g) environmental problems
2. Describe the human geographic conditions of the FCT accordingly (a) people (b) population (c) settlement (d) agriculture (e) industry (f) commerce (g) infrastructure

**Objectives Test**

1. The Federal Capital Territory, Abuja was created by decree ----------- to replace Lagos as the then capital of Nigeria
   (a) no.6 of 1976
   (b) no.6 of 1977
   (c) no.6 of 1978
   (d) no.6 of 1979

2. The choice of FCT, Abuja as new capital for Nigeria was based on ----------- more than anything else
   (a) ethnic accord
   (b) multiple role
   (c) peripheral location
   (d) centrality

3. The FCT was carved out from three mother states which were, EXCEPT
   (a) Niger State
   (b) Plateau State
   (c) Kwara state
   (d) Kaduna State

4. There are currently ----------- number of Area Councils in the FCT
   (a) 21
   (b) 9
   (c) 6
   (d) 4

5. The establishment of Abuja Geographic Information System (AGIS) has helped curb the following EXCEPT
   (a) double or multiple land allocation
   (b) Land use mismatch
   (c) 419 and land frauds
   (d) Rural-urban migration

6. The plains which have an aerial extent of 1,297km², and houses the Abuja city is the
   (a) Gwagwa plains
   (b) Iku-Gurara plains
   (c) Bada Plains
   (d) Rubochi Plains

7. The FCT Abuja’s population as at 2006 census is approximately
   (a) 125,000
   (b) 378,671
   (c) 405,201
   (d) 1,405,201

8. The location of the FCT within the transitional zone between the forests of the southern parts and the savannah of the northern parts of the country gives it abundant ----------- for livestock production
   (a) pasture resources
   (b) water resources
   (c) soil resources
   (d) mineral resources

9. One of these is NOT an industrial layout zone for the FCT
   (a) Kuje Park V
   (b) Idu industrial Park I,II, and III
   (c) Gaube Park
   (d) Gwagwalada Parks.

10. ________________ occurs in the FCT when water overflows the land surface
    (a) gully erosion
    (b) flooding
    (c) congestion
    (d) solid wastage
LESSON 1

Objectives
At the end students should be able to:
I. Define and describe the solar system
II. Describe the sun and identify the features of the planets
III. Describe the moons and identify the other orbiting objects

THE SOLAR SYSTEM

The solar system comprises of the sun, planets, moons and other orbiting objects. It describes the functioning of these natural bodies in response to the energy release by the sun.

According to astronomers, there are several solar systems as much as there are stars. For them, each star represents a sun via their solar system. Since our interest in geography is in the zone for which life exist for sure, we will concentration on our solar system which contains the sun and the planets (with our earth inclusive).

1. The Sun

The primary source of energy to the planetary bodies of the solar system is the sun. We all know that without energy no work can be done; the sun is thus the basis for our functioning solar system. All the planets, including the earth, revolve around it. Of all the stars in the universe, our sun is the nearest to the earth and most extensively studied.

2. The Planets

Planets are large natural spherical bodies orbiting round the sun in suspension. Most of the 20th century scientist counted nine planets in our solar system: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune and Pluto. Recent discoveries however shows that Pluto is not qualify to be called a planet.

Table 2: Some features of planets in the solar systems

<table>
<thead>
<tr>
<th>Planet</th>
<th>Distance from the sun in million km</th>
<th>Time of revolution around the sun</th>
<th>Number of moon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury</td>
<td>58</td>
<td>87.97 days</td>
<td>0</td>
</tr>
<tr>
<td>Venus</td>
<td>108</td>
<td>225 days</td>
<td>0</td>
</tr>
<tr>
<td>Earth</td>
<td>150</td>
<td>365¼ days</td>
<td>1</td>
</tr>
<tr>
<td>Mars</td>
<td>228</td>
<td>1.9 years</td>
<td>2</td>
</tr>
<tr>
<td>Jupiter</td>
<td>778</td>
<td>11.9 years</td>
<td>16</td>
</tr>
<tr>
<td>Saturn</td>
<td>1427</td>
<td>29.46 years</td>
<td>20+</td>
</tr>
<tr>
<td>Uranus</td>
<td>2870</td>
<td>84.01 years</td>
<td>15</td>
</tr>
<tr>
<td>Neptune</td>
<td>4486</td>
<td>164.8 years</td>
<td>8</td>
</tr>
</tbody>
</table>

3. The Moons

Figure 3.1: The Planets and the sun in the solar system
Moons are natural satellites that light up the planets at night time. They themselves do not have light on their own, but that received from the sun is reflected to the planet. The moon is however the name given to the one and only earth's natural satellite. The moon moves round the earth from east to west direction once in averagely 27 days.

4. Other Orbiting Objects
I. Pluto is a dwarf planet which lies in part of the kuiper belt, a disk of icy bodies beyond Neptune, once counted as the ninth planet.
II. Asteroids are small rocky or metallic body that orbit the sun. They are generally irregular in shape and often have surface covered with craters.
III. Comets are small icy body in space that shed gas and dust. Some comets can be seen from the earth with unaided eye.
IV. Kuiper Belt Object (KBOs) is a collection of frozen objects made of ice, dust, and rock that orbit the sun in the outer solar system.

Evaluation
1. Define and describe the solar system
2. (a) Describe the sun (b) state one each of distinctive features of each planets in our solar system
3. (a) Describe the moons (b) mention the other orbiting objects

Objectives
At the end students should be able to:
I. Highlight the major debate on the shape of the earth
II. Describe the shape of the earth
III. Mention and explain at least five proves that the earth is spherical
IV. State some of key dimensions of the earth

THE SHAPE OF THE EARTH
Debate of the Shape of the Earth
Issues patterning the shape and size of the earth were a subject of debate in the time past. The Homeric school was of the view that the earth was of a disc shape as against the Aristotelian speculated spherical shape. These views were contrary to the “flat-shape” upheld by the Christian fathers during the medieval period. With the breakthrough in science and technology these disagreement are now resolves.

Description of the Shape of the Earth
The earth is actually an oblate spheroid somewhat like an orange with flatter poles and outward bulges in equatorial regions. To complicate matters further the surface of the earth is far from smooth and regular, as you will appreciate if you have visited any mountainous areas (see figure). At small scales these minor blemishes and imperfection in shape can be ignored. Today, the term “geoids shape” has been widely adopted in describing the spherical but not-perfect-sphere shape of the earth.

Evidence of Earth’s Spherical Shape
It has been proved beyond reasonable doubt that the earth has spherical shape with a lot of surface irregularities. The surface varies in elevation from the highest mountain peak (Mt. Everest, 8848m a.s.l.) down to the deepest ocean trench (Mariana trench, -10,099m deep). Below are eight of such proofs.
example that takes off towards the eastern direction can go round back to that same location from the west. A notable historical expedition carried out by Ferdinand Magellan between years 1519-1522 to discover the Indies from the west eventually led him and his crew into sailing round the world.

2. Observation on approaching ship: A careful observation of an approaching ship at a harbour shows that the ship surfaces gradually from a distance. One eventually sees the ship in entirety at a very close range. Similarly, a ship leaves a harbour, it disappears gradually. If the earth is flat, the ship from a distant view will appear and disappear at once as the case may be.

3. Rising and Setting of the Sun: In the morning we observe the rising sun from the east and the setting sun at the west in the evening. You will notice that the day does brighten up at once during sunrise, and it doesn’t darken at once during sun-set. This can only be expressed on a spherical earth.

4. Eclipse of the Moon: At certain night time the moon exhibit a crescent shape. At that period of the year it is observed that the earth shadow cast is covering the portion of the moon not illuminating light at that time. The shape expressed by that portion is often circular.

5. The Circular Horizon: At any point on the earth surface, the horizon above is circular. Even when you move on the surface or as one climbs higher, the horizon only widens. This is the same everywhere on the globe. This type of feature is seen only on a spherical body. Figure 3.7 shows how the earth would appear if it were flat. The horizon C, B and A are seen from altitude X, X1, and X2.

6. Other Planetary Bodies: From the discussions of the planetary bodies above, one common characteristics discovered among them is that they are spherical. Even the dwarf planets observed from powerful telescope show spherical objects. Since all these planetary bodies are spherical, the earth cannot be an exception.

7. Driving Poles of Equal Length: When three poles of equal length are driven on the earth surface at the same depth; they display varying height, particular that the one at the center project a little higher than those by the side. This gives us a curvature when all are viewed at the same time.
8. **Imageries of the earth**: Since the commencement of manned space-crafts, astronauts have taken immeasurable photographs of the earth from far out in space. All of these imageries show the earth as a sphere.

**Size of the Earth**
The earth is the fifth largest planet in the solar system. The surface area is approximately 443 million km². The earth radius at the equator is estimated to be about 6,400 km with a circumference of about 40,085 km. Its distance from the sun is about 150 million km.

**Evaluation**
1. Highlight the major debate on the shape of the earth
2. Describe the shape of the earth
3. Mention and explain at least FIVE proves that the earth is spherical
4. State some of key dimensions of the earth

**Objective Test**
1. The primary source of energy to the planetary bodies of the solar system is
   (a) the moon
   (b) the stars
   (c) the sun
   (d) the meteorites

2. One of these explains why planet Venus is the hottest planet in the solar system
   (a) it is the nearest planet to the sun
   (b) A thick, cloudy atmosphere traps the sun’s heat
   (c) there is the presence of a protective atmosphere
   (d) changing seasons is a probable reason

3. What planet is 150 million kilometers away from the sun
   (a) Mercury
   (b) Venus
   (c) Earth
   (d) Mars

4. It takes ———— for planet Jupiter to complete its revolution
   (a) 11.9 years
   (b) 29.5 years
   (c) 84.0 years
   (d) 164.8 years

5. All of these are classified as other orbiting objects EXCEPT
   (a) Pluto
   (b) Saturn
   (c) Comet
   (d) Ceres

6. The moon moves round the earth from east to west direction once in averagely
7. One of these school of thought is known with issues patterning the shape of the earth EXCEPT
(a) The Homeric school was of the view that the earth was of a disc shape
(b) The Aristotelian speculated spherical shape.
(c) The Christian fathers during the medieval period were of flat shape
(d) The Magellan view it as an oval shape

8. The earth is actually ___________ somewhat like an orange with flatter poles and outward bulges in equatorial regions
(a) Spherical spheroid
(b) Oblate spheroid
(c) Circular Spheroid
(d) Oval Spheroid

9. In the morning we observe the rising sun from the
(a) North
(b) South
(c) East
(d) West

10. The surface area of the earth is approximately
(a) 443million km$^2$
(b) 6,400km$^2$
(c) 40,085km$^2$
(d) 150million km$^2$
LESSON 1

Objectives
At the end students should be able to:
I. Identify and define the THREE types of movements exhibited by the earth
II. Describe the effects of earth's Rotation
III. Describe the effects of earth's revolution/precession
IV. State at least FIVE differences between earth rotation and revolution/precession

MOVEMENTS OF THE EARTH
The earth exhibit three types of movements. These are rotation, revolution and precession.
1. Rotation of the earth has to do with the movement of the earth within its axis
2. Revolution of the earth is the movement of the earth round the sun along a path known as orbit.
3. Precession is the elliptical movement of the earth leading to changing direction of the axis.

1. Rotation (spinning)
2. Revolution (taking a lap around the sun)
3. Precession (changing direction of the axis)

Effects of Earth’s Rotation
The rotation of the earth causes:

1. Day and night: As the earth rotates, only one part of the earth’s surface facing the sun receives the rays of the sun and experiences daylight (day) while the other part of the earth backing the sun’s rays will experience darkness (night).
2. Apparent sunrise and sunset: During rotation of the earth, part of the Earth that emerges from the darkness into the rays of the sun experiences sunrise while the part that is moving away from the sun’s rays to darkness will experience sunset.
3. Dawn and Twilight: Dawn refers to the brief period between sunrise and full day light while twilight refers to brief period between sunset and complete darkness. Dawn and twilight which are results of rotation are caused because; the earth receives diffused or reflected light from the sun while it is still below the horizon.
4. Time difference from place to place: The earth rotates through 360° in every 24 hours which means that for every one hour, it passes
through $15^\circ$. Since the earth moves from west to east, it means that for every $15^\circ$, the east is always one hour ahead of time while the west is always one hour behind time.

```
If the Earth rotates 15° in 1 hour, it will take 4 minutes to rotate 1°:

60 minutes (1 hr) ÷ 15° = 4 minutes

Therefore...
```

5. **Deflection of winds and ocean currents:** The rotation of the earth causes winds and ocean currents to be deflected to the right of the direction, in which they move in the Northern hemisphere and, to the left of this direction in the southern hemisphere.

6. **Daily rising and falling of tides:** During rotation of the earth, it results in the rising and falling in the level of water in the sea and oceans.

Owing to rotation of the earth, the tide producing forces cause the surface of water to oscillate, resulting in the rising and falling in the level of water in the seas and oceans.

**Effects of Earth’s Revolution/precession**

The revolution of the earth causes:

1. **A year:** The time taken by the earth to move round the sun is fixed at 365¼ days which make up a year. The ¼day or 6hours is added up every four years to make an extra day in a leap year. A leap year has 366 days while a normal year has 365 days.

2. **Earth tilted axis:** The plane having the earth’s orbit is known as the “plane of ecliptic” (i.e. an imaginary surface presumed as passing through the earth and the sun at all portion in the earth’s orbit around the sun), if the earth axis is not perpendicular to the plane. This is why the poles do not receive equal energy from the sun regardless of the time of the year. Instead the earth axis is with respect to the orbital plane by angle that measures $23\frac{1}{2}^\circ$ from the perpendicular or $66\frac{1}{2}^\circ$ with respect to the plane of the orbit.
3. **Perihelion and Aphelion:** Due to the elliptical shape of the earth’s orbit, the earth is closer to the sun at certain times of the year and other times. Thus while the average distance between the earth and the sun is about 150million km, it is about 147million km at the perihelion position on January 3rd and 152million km at the aphelion on July 4th.

![Figure 4.10: Perihelion and aphelion during revolution](image)

4. **Varying length of day and night:** The length of day and night varies depending on the position of the sun. In northern hemisphere, during the winter around December 22nd, as we go northwards, the hours of darkness increases. At the Arctic Circle (66½°N), the sun never rises and there is darkness for the whole day. While in the southern hemisphere, the period of day light increases towards the South Pole in December, 22nd, but the region experiences summer, and vice versa.

![Figure 4.11: winter solstice](image)

5. **Equinox and Solstice:** As a result of earth’s revolution, the altitude of the mid-day sun changes, resulting in Equinoxes and Solstice. Equinox is the time when the mid-day sun is directly overhead occurring especially around March 21st and September 23rd. Solstice on the other hand, is the time when the sun is vertically over-head at the Tropic of Cancer or at the Tropics of Capricorn occurring around December 22nd and June 21st.

6. **Occurrence of seasons:** In tropical areas like West Africa, including Nigeria, there are two seasons- rainy and dry. But in temperate countries, the revolution of the earth causes four seasons- winter, autumn, summer and spring.

7. **Changes in seasonal temperature:** It is observed that summers are usually warm and bright, while winters are cold and dark in the arctic region. This is because during summer, the zenith angle of the sun is higher, and thus the concentration of heat over a small area leads to high temperature.

**Differences Between Rotation and Revolution**

From their definitions and their effects we will notice that the earth movement processes are not the same. However, it is worth noting that one complete revolution of the earth round the sun is made up of several rotations of the earth. Thus rotation and revolution of the earth are not quite independent movements. Specifically, table 3 presents their difference:

**Table 3: Differences of Rotation & Revolution**

<table>
<thead>
<tr>
<th>Rotation of the Earth</th>
<th>Revolution of the Earth</th>
</tr>
</thead>
<tbody>
<tr>
<td>The earth rotates on its axis</td>
<td>It revolves round the sun alone its orbit</td>
</tr>
<tr>
<td>The earth rotates through 360° in 24 hours (one day)</td>
<td>It revolves round the sun in 365½ days (one year)</td>
</tr>
<tr>
<td>The rotating earth is inclined at an angle of 23½° along its axis</td>
<td>The revolving earth is tilted or inclined at an angle of 66 ½° to the plane of ecliptic</td>
</tr>
<tr>
<td>Rotation of the earth cause day and night</td>
<td>Revolution of the earth causes seasons</td>
</tr>
<tr>
<td>Rotation causes the difference of one hour between two meridians - 15° apart</td>
<td>Revolution causes changes in the altitude of the mid-day sun</td>
</tr>
</tbody>
</table>

**Evaluation**

1. Identify and define the THREE types of movements exhibited by the earth
2. Describe the effects of earth’s Rotation
3. Describe the effects of earth’s revolution/precession
4. State at least FIVE differences between earth rotation and revolution/precession

**LESSON 2**

**Objectives**

At the end students should be able to:

I. Define eclipse and mention the types in relation to the earth
II. Describe and identify the types of eclipse of the sun
III. Describe and identify the types eclipse of the sun
IV. Highlight at least FIVE differences between lunar and solar eclipse
ECLIPSE

An eclipse occurs when one thing obstructs a light from passing through, causing a shadow cast on another object. The sun is stationary while the earth and moon are in constant movement. While the moon revolves around the earth once in every approximately 27 days (a month), the earth and the moon travel together, making a complete movement around the sun once in a year. During this movement, there will be a time when these three bodies (sun, earth and moon) will be in a straight or slightly resulting in the formation of eclipse.

TYPES OF ECLIPSE

There are two types of eclipse - that of the sun (also known as the solar eclipse) and the moon (also known as the lunar eclipse).

ECLIPSE OF THE SUN

A solar eclipse occurs when the moon passes between the sun and earth, and the moon fully or partially blocks the sun. This can happen only at new moon, when the sun and the moon are in conjunction as seen from earth in an alignment referred to as syzygy.

Figure 4.12: Solar eclipse

There are four types of solar eclipses. Note that outside these four types, there is a separate category of solar eclipses where the sun is occluded by other orbiting bodies like the case of Saturn in 2006 as observed by Cassini probe.

Figure 4.13: Types of eclipse of the sun

1. Total solar eclipse: A total solar eclipse occurs when the dark silhouette of the moon completely obscures the intensely bright light of the sun, allowing the much fainter solar corona to be visible. During any one eclipse, totality occurs at best only in narrow track on the surface of earth.

2. Annular solar eclipse: An annular solar eclipse occurs when the sun and moon are exactly in line, but the apparent size of the moon is smaller than that of the sun. Hence, the sun appears as a very bright ring surrounding the dark disk of the moon.

3. Hybrid solar eclipse: This is shift between total and annular eclipse. At certain points on the surface of earth it appears as a total eclipse, whereas at other points it appears as annular. Hybrid eclipse comparatively is rare.

4. Partial solar eclipse: A partial solar eclipse occurs when the sun and moon are not exactly in a straight line and the moon only partially obscures the sun. This phenomenon can usually be seen from a large part of earth outside of the track of an annular or total eclipse.

ECLIPSE OF THE MOON

A lunar eclipse occurs when the moon passes directly behind the earth into its shadow. This can occur only when the sun, earth and moon are aligned exactly, or very closely so, with the earth in the middle. The shadow of the earth can be divided into two distinctive parts - the umbra and penumbra.

Figure 4.14: Lunar eclipse

1. Umbra lunar eclipse: Within the umbra, there is no direct solar radiation. When the moon travels completely into the earth’s umbra, one observes a total lunar eclipse (or darkness).

2. Penumbra lunar eclipse: In the penumbra shadow, only a portion of sunlight is blocked. The penumbra causes a subtle darkening of the moon’s surface. This is also known as a partial lunar eclipse.

Comparing Solar and Lunar eclipse

1. Lunar eclipse occurs when the earth comes between the moon and the sun, and the earth’s shadow obscures the moon or a portion of it. A solar eclipse occurs when the moon comes between the sun and the earth, blocking all or a portion of the sun.

2. A lunar eclipse occurs at night and a solar eclipse occurs during the day. There are only certain times when either of them can occur. A lunar
eclipse can only occur when the moon is directly opposite the sun in the sky- a full moon.
3. Even though there is a full moon each month, obviously a lunar eclipse does not occur on a monthly basis because the sun isn’t exactly in line with the earth and the moon. The moon’s orbit is actually tilted 5° more than that of the earth; otherwise, we would see a lunar eclipse each month.
4. We can see lunar eclipses more readily than solar eclipses, and it has to do with proximity. The moon is much closer to the earth (well over 300 times closer than the sun!), so the earth has a much greater chance of blocking sunlight to the moon, compared to the moon blocking the light from the sun.
5. Also, a lunar eclipse can be seen from a greater portion of the earth. Solar eclipses, on the other hand, are rare and when they do happen can only be seen by a very narrow segment of people on earth, for short period of time.
6. It is quite safe to watch a lunar eclipse with the naked eye, while watching a solar eclipse without eyewear protection can seriously damage your eyesight. You can use a telescope, sunglasses or calm water in a basin to get a clearer view of the moon during solar eclipse.
7. A solar eclipse has always had a more profound effect on humans than a lunar eclipse. This probably is because of the importance of the sun to all life form on earth.

**Evaluation**
1. Define eclipse and mention the types in relation to the earth
2. Describe and identify the types of eclipse of the sun
3. Describe and identify the types eclipse of the moon
4. Highlight at least FIVE differences between solar and lunar eclipse

**Objective Test**
1. ____________ is the elliptical movement of the earth leading to changing direction of the axis
   (a) Rotation
   (b) Revolution
   (c) Precession
   (d) Denudation

2. The rotating earth is inclined at an angle of _____ along its axis
   (a) 23½°
   (b) 33½°
   (c) 43½°
   (d) 66½°

3. ____________ refers to the brief period between sunrise and full day light
   (a) Dawn
   (b) Twilight
   (c) Dusk
   (d) Horizon

4. The rotation of the earth causes winds and ocean cur-rents to be deflected to the right of the direction, in which they move in the
   (a) Northern hemisphere
   (b) Southern hemisphere
   (c) Eastern hemisphere
   (d) Western hemisphere

5. All of these are effects of earth precession EXCEPT
   (a) varying length of day and night
   (b) Changes in seasonal temperature
   (c) Occurrence of equinox and solstice
   (d) A year

6. The ¼ day in the 365¼ day a year equals to
   (a) 24 hours
   (b) 12 hours
   (c) 6 hours
   (d) 4 hours

7. ____________ is the time when the mid-day sun is directly overhead occurring especially around March 21st and September 23rd
   (a) Equinox
   (b) Solstice
   (c) Perihelion
   (d) Aphelion

8. ____________ occurs when the dark silhouette of the moon completely obscures the intensely bright light of the sun, allowing the much fainter solar corona to be visible
   (a) A total solar eclipse
   (b) A partial solar eclipse
   (c) An annular solar eclipse
(d) A hybrid solar eclipse

9. This can happen only at new moon, when the sun and the moon are in conjunction as seen from earth in an alignment referred to as
   (a) silhouette
   (b) Syzygy
   (c) Umbra
   (d) pernumbra

10. The knowledge of eclipse is useful for the following reasons EXCEPT
    (a) it save society from wasteful ventures
    (b) save society from superstitious beliefs
    (c) we can now save our eyes from its negative effects
    (d) it has reduced societies dependence on God


LESSON 1

Objectives
At the end students should be able to:
I. Define and identify the important lines of latitude
II. Define and identify the important lines of longitude
III. Highlight at least FIVE importance of latitude and longitude
IV. State at least FIVE differences between latitude and longitude

LATITUDE

Lines of latitude are imaginary lines which run in the east-west direction around the world. They are also called parallels of latitude because they run parallel to each other. Latitude is measured in degrees (°).

Figure 5.1: Some important lines of latitude

The most important line of latitude is the Equator (0°). The North Pole is Ninety Degree North (90°N) and South Pole is Ninety Degree South (90°S). All other lines are given a number between 0° and 90°, either North (N) or South (S) of the Equator. Some other important lines of latitude are the Tropic of Cancer (23½°N), Tropic of Capricorn (23½°S), Arctic Circle (66½°N) and Antarctic Circle (66½°S).

The Equator can also be used as a line to divide the Earth into two equal halves. The Northern half, north of the Equator, is the Northern Hemisphere. The southern half, south of the Equator, is the Southern Hemisphere.

LONGITUDE

Lines of longitude are imaginary lines which run in a north-south direction, from the North Pole to the South Pole. These lines are also called meridians of longitude. They are also measured in degrees (°).

Figure 5.2: Some important lines of Longitude

The most important line of longitude is the prime meridian (0°). This line run through the Greenwich Observatory in London and is therefore known as the Greenwich Meridian. Exactly opposite the Greenwich Meridian on the other side of the world is the 180° line of longitude known as the International Date Line. All the other lines of longitude are given a number between 0° and 180°, either East (E) or West (W) of the Greenwich Meridian.

The Greenwich Meridian (0°) and the International Date Line (180°) can also be used to divide the world into two halves. The half to the west of the Greenwich Meridian is the Western Hemisphere. The half to the east of the Greenwich Meridian is the Eastern Hemisphere.

IMPORTANCE OF LATITUDE & LONGITUDE

i. Latitude and longitude are the most important coordinate systems of which other reference like grid take reference from
ii. Latitude and longitude forms the basis for mapping
iii. They are used to find places in a map
iv. They are used to locate features in a map
v. They are used for navigation e.g. in air flight or sea sailing
vi. They can be used to determined the size of a piece of land
vii. Coordinate systems aid in partitioning the world or it regions into manageable study units
e.g. the tropics.

viii. With latitudes, distance between places can be determined.

ix. With longitudes, we can calculate the local time of a place.

**Figure 5.3: A combination of latitude and longitude to form graticles**

### DIFFERENCE BETWEEN LATITUDE & LONGITUDE

<table>
<thead>
<tr>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>They run from west to east</td>
<td>They run from north to south</td>
</tr>
<tr>
<td>Lines are parallel to each other</td>
<td>Lines are not parallel to each other but converge at the poles</td>
</tr>
<tr>
<td>Lines get shorter towards the poles</td>
<td>Lines are of the same length</td>
</tr>
<tr>
<td>The equator is only a great circle</td>
<td>Has many great circles as any opposite pairs of lines make a great circle</td>
</tr>
<tr>
<td>Lines are called parallels</td>
<td>Lines are called meridians</td>
</tr>
<tr>
<td>Lines are used for measuring distance</td>
<td>Lines are used for calculating local time</td>
</tr>
<tr>
<td>Has equator as its reference point</td>
<td>Has Greenwich Meridian as its reference line</td>
</tr>
<tr>
<td>Latitude measures up to 180° (i.e. 90°N to 90°S)</td>
<td>Longitude measures up to 360° (i.e. 180°W to 180°E)</td>
</tr>
<tr>
<td>Lines decrease in length</td>
<td>All lines are of equal length</td>
</tr>
</tbody>
</table>

### Evaluation

1. Define & identify the important lines of latitude

### LESSON 2

**Objectives**

At the end, students should be able to:

1. Calculate distance between places using the lines of latitude
2. Calculate the local time of a place using lines of longitude

**Calculating Distance**

The lines of latitude can be used to calculate the distance between two places. To calculate the distance between two points on the earth surface, the following procedures should be followed:

**Procedures**

I. Locate the two places involved

II. Find the latitude difference between the two places. The formula used is:

   - North-North = subtraction
   - South-South = subtraction
   - North-South = addition
   - Equator-North or South = addition or subtraction

III. Multiply the latitude difference by 111km. This distance is equivalent to an average of 1° derived from dividing the equatorial circumference (40,085km) by 360°.

**Example 1:** Calculate the approximate distance between Abuja (latitude 8°N) and Lagos (latitude 4°N).

**Solution**

Locate the two places involved

Latitude of Abuja = 8°N

Latitude of Lagos = 4°N

Latitude difference (remember that North-North = subtraction)

8°N - 4°N = 4

Multiply by 111km

4 X 111 = 444km

You may also be required to determine latitude of a point when distance and the latitude of another point is given.

**Example 2:** If the distance between Lagos (latitude 4°N) and Bamako is 1,665km, what latitude is Bamako, assuming that Lagos and Bamako are in the same hemisphere?
Solution
Latitude of Lagos = 4°N
Latitude of Bamako =?
Difference in distance = 1,665km
Difference in degree = 1665/111 = 15°
Therefore latitude in Bamako = (since both towns are in the same hemisphere, add) = 4° + 15° = Latitude 19°N

CALCULATING LOCAL TIME
Lines of longitude can be used to determine or calculate the local time of a place given the local time of another. To calculate local time of one place from another using longitude the following procedures should be followed:

Procedures
I. Locate the two places involved in the question
II. Find the longitude difference. This rules should be applied:
   East – East = subtraction
   West – West = subtraction
   East – West = Addition
   GMT – West or East = Add or Subtract
III. Convert the longitude difference to time. Follow this formula:
   360° = 24hours
   15° = 1hour
   1° = 4minutes
IV. Adjust the time according to direction of movement. Observe this rule:
   Toward East, time is gain = Add
   Toward West, time is loss = Subtract

Example 1: what will be the time in Nigeria (longitude 15°E) when it is 5:00pm in Ethiopia (longitude 45°E)

Solution
Locate the two places involved:
Longitude of Ethiopia = 45°E
Longitude of Nigeria = 15°E
Find the longitude difference:
45°E – 15°E = 30°
Convert longitude difference to time:
Since 15°= 1hour
Therefore 30° ÷ 15° = 2hours
Adjust the time according to the direction:
Ethiopia towards Nigeria
5:00pm (i.e. 17hours) – 2hours =15hours
Therefore time in Nigeria = 15hours = 3:00pm

You may also be required to determine longitude of a place when local time and the longitude of another place is given.

Example 2: What is the longitude of town X whose time is 12:00noon when Greenwich Mean Time (GMT) is 6:00pm?

Solution
Time in town X = 12:00noon
Time in GMT = 6:00pm
Time difference = 6:00pm (i.e. 18hours) – 12:00noon (i.e. 12hours) = 6hours
Longitude difference = 6x15= 90°
Therefore longitude at town x = 0° ± 90° = Longitude 90°W since the time at X is behind GMT.

Evaluation
1 (a) Calculate the approximate distance between South Africa (latitude 30°S) and Spain (latitude 40°N).
(b) Determine the distance between Dares salaam (6°45’00”S) and Harare (7°30’00”S).
(c) what will be the latitude of Egypt when its distance from the equator is 3330km
2. (a) What will be the latitude of Egypt when its distance from the equator is 3330km
(b) A football match between Senegal (longitude 18°W) and Japan (140°E) was played in Senegal on Saturday, the 22nd of September 1995 at 6:00pm. Determine the day and time of the match commentary?
(c) Find the time at Bouake (5°15’00”W) when it is 7:30am in Cayenne (52°30’00”W)

LESSON 3
Objectives
At the end students should be able to:
I. Distinguish between great and small circles
II. Describe the International Date Line (IDL)
III. Distinguish between world time zone and standard time

GREAT AND SMALL CIRCLES
A great circle is any line that divides the earth into two equal halves or hemisphere. The centre of the great circle is also the centre of the earth. The shortest distance between any two points on the earth’s surface lies along the circumference of the great circle which passes these points. Equator (latitude 0°) is the only line of latitude that is a great circle while two opposite lines of longitude make a great circle e.g. Longitude 0° and 180° East or West; Longitude 90°E and 90°W; 30°E and 150°E, etc. The great circle route is often Greenland.

On the other hand, small circles is any line that does not divide the earth into equal halves or hemispheres. The centre of the small circle is not the centre of the earth. All lines of latitude except the equator (0°) are small circles e.g. Tropic of Cancer (23½°N), Tropic of Capricorn (23½°S), Arctic Circle
Great and small circle

(66½°N), etc. Small circles routes are only used by aircrafts on a short journey e.g. the air route between Argentina and South Africa.

INTERNATIONAL DATE LINE (IDL)
International Date Line is where the date changes by exactly one day (24hours) when it is crossed. There is a difference of one whole day (24hours) on both sides of longitude 180° meridian represents theoretically, a date l. Any traveller going east gains one full day on crossing the longitude 180°. The International Date Line is not straight for it avoids cutting across island to prevent confusion in days and dates in the tiny Islands.

WORLD TIME ZONES
World Time Zones is the division of the world into twenty four (24) time zones each of which differs from the next zone by 15° in longitude or 1 hour in time. The local time of the central meridian for each zone is applied to that zone which is called, a time zone.
All places located on the same time zone have the same time. For every 15° movement across the longitude west of the Greenwich Mean Time (GMT), an hour is always lost while to the east, an hour is gained. For example, if the GMT in London

Figure 5.4: Great and small circle

Figure 5.5: The International Date Line (IDL)

Figure 5.6: World time zones.
or Accra (longitude 0°) is 4:00pm, Nigeria (longitude 15°E) local time will be 5:00pm.
Some countries adhere to these divisions but others cannot, due to their irregular size and location e.g. North America is so large, that it, has five standard time zones. While former U.S.S.R has eleven standard time zones.

STANDARD TIME
Standard time is the time generally adopted by a country. It is usually taken from the central meridian of that country. The need for standard time is to eliminate differences in local time between one town and others within the same country.

Evaluation
1. Distinguish between great and small circles
2. Describe the International Date Line (IDL)
3. Distinguish between world time zone and standard time

Objective Test
1. The earth surface is arbitrary divided into system of reference
   (a) longitude
   (b) latitude
   (c) equator
   (d) coordinates

2. For increased accuracy in locating a point on the earth surface, degrees (°) may be subdivided into
   (a) 60 subdivisions known as degrees
   (b) 60 subdivisions known as minutes
   (c) 60 subdivisions known as seconds
   (d) 60 subdivisions known as microseconds

3. The lines of latitude can be used to calculate the
   (a) location of two places
   (b) distance between two places
   (c) direction of two places
   (d) time of two places

4. Calculate the approximate distance between Abuja (latitude 7°N) and Lagos (latitude 4°N)
   (a) 1221km
   (b) 777km
   (c) 444km
   (d) 333km

5. Longitude is measured in degrees west or east of the
   (a) Equator
   (b) Prime Meridian
   (c) Cancer
   (d) Capricorn

6. What will be the time in Nigeria (longitude 15°E)

7. When it is 5:00pm in Ethiopia (longitude 45°E)
   (a) 7:00am
   (b) 3:00am
   (c) 7:00pm
   (d) 3:00pm

8. Any traveller going eastward gains one full day on crossing the
   (a) Greenwich Meridian
   (b) Graticles
   (c) Equator
   (d) International Date Line

9. World Time Zones is the division of the world into twenty four (24) time zones each of which differs from the next zone by
   (a) 1°
   (b) 15°
   (c) 90°
   (d) 180°

10. The implication of not having a standard time is that it will result in ———— from one place to another
    (a) changing time
    (b) retaining time
    (c) maintaining same time
    (d) sustaining same time

7. ------------------ is any line that divides the earth into two equal halves or hemisphere
   (a) GMT
   (b) IDL
   (c) Great Circle
   (d) Spherical coordinates
LESSON 1

Objectives
At the end students should be able to:
I. Identify both the internal and outer layer structures of the earth, mention their sub layers and main content
II. State the characteristics and importance/relationship of the lithosphere as an internal layer

LAYERED STRUCTURES OF THE EARTH
From our position, we may want to see the earth as having an internal and outer structure. See figure 6.1 for the different component layers and their main content.

Table 6: Layers of the earth and their content

<table>
<thead>
<tr>
<th>Major Structure</th>
<th>Sub-layers</th>
<th>Main Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal layers</td>
<td>Crust</td>
<td>Hard Rocks</td>
</tr>
<tr>
<td></td>
<td>Mantle</td>
<td>Ultra Basaltic</td>
</tr>
<tr>
<td></td>
<td>Core</td>
<td>Molten Rocks</td>
</tr>
<tr>
<td>Outer Layers</td>
<td>Lithosphere</td>
<td>Rocks</td>
</tr>
<tr>
<td></td>
<td>Hydrosphere</td>
<td>Water</td>
</tr>
<tr>
<td></td>
<td>Atmosphere</td>
<td>Air</td>
</tr>
<tr>
<td></td>
<td>Biosphere</td>
<td>Living things</td>
</tr>
</tbody>
</table>

THE CRUST
The surface on which we habit directly to a given depth below is the lithosphere (earth’s crust). It thickness is approximately 85km and terminates at the Mohorovicic. In comparison to the crust, the mantle is much thicker. The crust is very thin in relation to the rest of Earth. The crust is solid and relatively thin, and it lies below both landmasses and oceans. The crust is divided into Upper (SIAL) lower (SIMA) layers

1. Characteristics of Sial
. The Sial is the dry land of Earth’s surface also called the continental crust
. The name SIAL derived from the main mineral composition- silica and aluminum
. It is about 15 to 75 km thick
. Continental crust consists of lighter coloured, less dense rocks, such as granite and diorite
. Continental crust also includes metamorphic rocks and sedimentary rocks, which the oceanic crust lacks
. The rocks that make up continental crust possess an average density of 2.7 times the density of water.

2. Characteristics of Sima
. The Sima also called the oceanic crust is thinner than the continental crust
. The name SIMA is derived from the minerals silica and magnesium
. Its average thickness is 5 to 10 km
. Oceanic crust consists of dark, dense rocks, such as basalt and gabbro
. The rocks that make up oceanic crust are denser, with a density of 3.0 times the density of water.

Importance/Relationship
. The crust contains much of the minerals use in development
. It is the layers on which internal forces from the core and the mantle expresses themselves
. The lower crust provides basins and reservoirs for holding some elements of the hydrosphere like streams, rivers, lakes, seas and ocean
. The crust provides foundation for various human construction like buildings and other engineering structures
. Through the rock parent materials soils are formed from the crust
. The crust provides habitation for living things both plants and animals

Evaluation
1 Mention both the internal and outer layers structure of the earth,
2 (a) State THREE characteristics each of sial and sima
(b) State THREE importance/relationship of the lithosphere as an internal layer

LESSON 2

Objectives
At the end students should be able to:
I. State the characteristics and importance/relationship of the mantle as an internal layer
II. State the characteristics and importance/relationship of the core as an internal layer

THE MANTLE
Lying below the earth’s crust is the mantle also known as the mesosphere, 2897km thick. The mantle is separated from the crust by a sharp boundary known as the Mohorovicic discontinuity, or Moho. It is separated from the core by another sharp boundary known as the Gutenberg discontinuity. The mantle is chemically distinct from both the crust and the core and three layers can be identified— upper, transition and lower.

1. Upper Mantle
   - The upper mantle extends from the Moho to a depth of about 400 km
   - The upper mantle is composed of iron and magnesium silicates, such as the minerals olivine, pyroxene, and amphibole
   - Within the upper mantle is a zone called the asthenosphere
   - The asthenosphere is a zone of weakness
   - It is thought that the asthenosphere contains a small amount of melt, or liquid fused rock, which acts as a lubricant, for continental drifting

2. Transition Zone
   - This is the zone from about 400 km to about 670 km
   - Here, the minerals that make up the upper mantle undergo a process of phase transition
   - The pressures at these depths compress the minerals into more compact forms
   - For example, olivine is compressed into the mineral spinel
   - With each phase transition, the rock becomes denser with an average of 3.3
   - This transition at 670 km corresponds to the lowest depths at which earthquakes have been recorded.

3. Lower Mantle
   - The lower mantle may consist of magnesi-um, silicon, and iron
   - Unlike the upper mantle, this region does not change much in composition or phase as it gets deeper
   - It is denser than the upper mantle due to the increase in pressure.

Importance/Relationship
   - The mantle is the layer on which the crust is directly seated on
   - Some useful minerals can be derived from the mantle
   - The mantle at the asthenosphere encourages plate tectonic and continental drifting (i.e. repositioning of the continents)
   - In the mantle especially around rocks starts transforming in magma
   - The mantle supplies the core rocks that are transformed to magma
   - The focus (point of origin) of earthquakes beginning, is located the mantle of the earth
   - When earthquakes occurs the lithosphere, hydrosphere, atmosphere and biosphere are influenced

THE CORE
The earth’s core or barysphere is said to be the innermost part of earth with the outer and inner core differing in rock state.
landforms
. Iron and nickel are pretty rock minerals use for different purposes by man
. During volcanism gases and geysers (hot water) are release into the atmosphere/ hydrosphere
. cooling/solidification of magma alters the bio-

**Evaluation**

1 (a) State TWO characteristics each of upper, transition and lower mantle
(b) State THREE importance/relationship of the mantle as an internal layer
2 (a) State TWO characteristics each of the core
(b) State THREE importance/relationship of the core as an internal layer

**Objective Test**

1. This is NOT among the internal layered structure of the earth
(a) the core
(b) The mantle
(c) the crust
(d) the atmosphere

2. The solid portion of the earth is known as ------- ------
(a) atmosphere
(b) hydrosphere
(c) lithosphere
(d) barysphere

3. The mesosphere is made up of
(a) ultra basaltic rocks
(b) molten rocks
(c) granitic rocks
(d) living things

4. The thickness of the earth crust is approximately ------- and terminates at the Mohorovicic.
(a) 95km
(b) 85km
(c) 75km
(d) 65km

5. The lower part of crust is called
(a) Sial
(b) Sima
(c) Nife
(d) Oluine

6. Which pair of minerals is found at the upper part of the earth crust?
(a) copper and aluminum
(b) iron and magnesium
(c) magnesium and silica
(d) silica and aluminum

6. This NOT true about the SIAL
(a) The Sial is the dry land of Earth’s surface
(b) It is about 15 to 75 km thick
(c) it consists of lighter coloured, less dense rocks,
(d) The name SIAL is derived from the minerals silica and magnesium

7. The rocks that make up oceanic crust are denser, with a density of ------ times the density of water.
(a) 1.0
(b) 2.7
(c) 3.0
(d) 4.0

8. The mantle is separated from the crust by a sharp boundary known as the
(a) Asthenosphere discontinuity
(b) Mohorovicic discontinuity
(c) Gutenberg discontinuity
(d) Inter tropical discontinuity

9. The two minerals collectively referred to as NIFE are __________________
(a) iron and gold
(b) iron and nickel
(c) iron and silver
(d) iron and bronze

10. The temperature of the core is as high as
(a) 6000°C
(b) 4000°C
(c) 2000°C
(d) 1000°C
LESSON 1

Objectives
At the end students should be able to:
I. State the characteristics and importance/relationship of the lithosphere as an external layer of the earth
II. State the characteristics and importance/relationship of the hydrosphere as an internal layer of the earth

THE LITHOSPHERE
The lithosphere is the solid portion of the outer earth. It represents 30% of the earth surface and forms the landmass which is about 10-20km thick. The lithosphere on the surface may be covered by soil or ice or maybe an entirely bare rock. We can therefore see lithosphere on the surface as divided into pedosphere, cryosphere, and the bare rocks.

1. Pedosphere
Characteristics
. This is the zone of the lithosphere that contains soil
. Usually portions of the lithosphere that contains soil has evidence of plant growth
. The soils are products from rock weathering
. It is often referred to as the skin of the earth
. The tropics has deeper soil profile when compared with the Desert, Temperate and the Tundra

Importance/Relationship
. The lithosphere provides soil on which plants grows
. Human activities like farming takes place on the pedosphere of the lithosphere
. The pedosphere provides habitat for soil living organisms
. The pedosphere helps in purifying the other outer layers like the atmosphere, hydrosphere and biosphere

2. Cryosphere
Characteristics
. The cryosphere are those portion of the lithosphere where water is in solid form
. Frozen water is found on the earth’s surface primarily as snow cover, frozen ground (permafrost)
. Most of the world’s ice volume is in Antarctica
. In terms of areal extent, Northern Hemisphere winter snow and ice extent comprise the largest area.
. The size of the cryosphere is influence by season

Importance/Relationship
. The cryosphere provides igloo for the Eskimos
. The cryosphere presents a wonderful scenery for tourism and filming
. The cryosphere helps in controlling the sea level
. The cryosphere supports few special kinds of plants and animals especially those that produces wool and fur
. The cryosphere naturally exemplifies how matter changes from one state to another

3. Bare Rock
Characteristics
. Bare rocks are features of areas devoid of vegetation and icecap
. They texture maybe sand, gravels, and stones or rock outcrop
. They maybe of igneous, sedimentary, metamorphic or basement complex types
. They maybe hard or soft but not in molten form
. They may display eroded, dissected or hilly surfaces
. They maybe crystalline or dull in appearance with varying colours
. Mineral resources are held in bare rocks

THE HYDROSPHERE
The hydrosphere is the liquid portion of the earth (streams, rivers, lakes, oceans, and ground water). Sometimes the ice cap (cryosphere) and water vapour may be included too. It covers about 70% of the earth with ocean alone accounting for about 97%. These elements of hydrology are connected to form the water cycle. (see figure 5.9). Table 12 identify three major groupings of the hydrosphere – atmospheric water, surface water and ground water.

1. Atmospheric Water
Characteristics
. Water in the atmosphere exist at vapour (humidity) and cloud
. They are generated from the surface water during evaporation
. They falls to the surface after condensation and saturation has taken place (precipitation)

2. Surface Water
Characteristics
Figure 7.1: The Hydrological cycle

This includes bodies of water ranging from streams, rivers, lakes, seas and oceans. The flowing streams and rivers (runoff) empties their water into lakes and seas as the case maybe. Sometimes surface water infiltrates or seeps into the ground and recharges the underground water. Water on surface evaporates as they get heated up into the atmosphere.

3. Groundwater Characteristics
- Groundwater may naturally express itself on the surface through springs.
- Through water capillarity, plants tap water from the ground giving rise to evapotranspiration.
- Groundwater may directly evaporate through the soil.
- The groundwater reservoir is known as an aquifer.

Importance/Relationship
- The hydrosphere supports human activities in the form of water supply, agriculture, transportation, generation of electricity, etc.
- The survival of plants and animals cannot be without water.
- The water cycle connects the hydrosphere with the atmosphere, lithosphere, and the biosphere.
- The hydrological cycle acts as a natural purifying agent as it makes our environment clean and healthy.

Evaluation
1. (a) State TWO characteristics each of the THREE sub-layers of the lithosphere.
(b) State TWO importance/relationship each of the THREE sub-layers of the lithosphere.

2. (a) State TWO characteristics each of the THREE sub-layers of the hydrosphere.
(b) State THREE importance/relationship of the hydrosphere.

LESSON 2

Objectives
At the end students should be able to:
I. State the characteristics and importance/relationship of the atmosphere as an external layer of the earth.
II. State the characteristics and importance/relationship of the biosphere as an internal layer of the earth.

THE ATMOSPHERE
It is the gaseous portion of the earth containing nitrogen (78%), oxygen (21%), carbon dioxide (0.03%), amongst others (figure 7.2). It also contains water vapour in the form of humidity and cloud, and particulates materials such as aerosols like smoke, dusts; and evaporates like salt as well as other sol-id pollutants. Weather phenomena such as cloud, rain, temperatures, humidity are largely confined in the atmosphere.

The atmosphere can be structured into a number of layers using temperature variation. From the ground level we the troposphere, followed by the stratosphere, mesosphere, and thermosphere. There are also ionosphere, exosphere and magne-
1. Troposphere
This is the lowest layer of the atmosphere extending from the earth’s surface to a height of about 13km.
In this layer, temperature decreases with increasing height at an average rate of 6.5°C for every 1000m ascent.
The behaviour of the air in the troposphere gives rise to our weather.

2. Stratosphere
It is the second layer of the atmosphere extending from the tropopause to a height of about 50km above the ground.
In the stratosphere, temperature increases with height because it contains much of the total atmospheric ozone.

3. Mesosphere
The mesosphere begins from the stratopause to a height of about 80km above the ground.
In this layer pressure is very high and temperature is on a decrease.

4. Thermosphere
The thermosphere extends to a height of about 100km above the ground.
Here, temperature increases with height due to the absorption of x-rays by atomic oxygen.

Importance/Relationship
- The atmosphere supports man and other living things in the area of respiration.
- The atmosphere is vital when it comes to burning (combustion).
- The atmosphere provides a natural medium through which telecommunication signals are transmitted.
- The atmosphere serves as a means of transportation.
- The atmosphere is the zone where rain water is formed which serves different domestic and industrial uses.
- Atmospheric substances like ozone layer protects living things from the harmful effects of ultraviolet rays.

Air is present in the soil, water and living organisms thereby serving as a connector.

THE BIOSPHERE
The biosphere is the zone of the earth occupied by living organisms. It is said to have arisen from the complex interaction between the lithosphere, the hydrosphere and the atmosphere. Different organisms have adapted to these different outer spheres of the earth. Birds for examples fly in the sky, but beyond the earth atmosphere they cannot survive; fishes lives in waters, but with given depth from the surface hydrosphere; and other animals including human being inhabit the land, to a given extent below and above.

Biodiversity is the sum total of living things on earth. Estimate of 1.5 and 30 million species of plant and animals exist on earth.

1. Plants
Characteristics
- Plants are multicellular eukaryotes—that is, their cells contain membrane-bound structures called organelles.
- The most important characteristic of plants is their ability to photosynthesize.
- A few plants however have lost their chlorophyll and have become saprophytes or parasites—that is, they absorb their food from dead organic matter or living organic matter.
- They are called autotrophs because they can make their own food.
- Plants range in size and complexity from small,
nonvascular mosses, which depend on direct contact with surface water, to giant sequoia trees, which can draw water and minerals through their vascular systems to elevations of more than 100 m. Plants are stationary and are better geographic features than animals

**Importance/Relationship**

- Only a tiny percentage of plant species are directly used by humans for food, shelter, fibre, and drugs.
- Plants have laid down the fossil fuels that provide power for industrial society e.g. petroleum and coal.
- Plants have supplied sufficient oxygen to the atmosphere to have supported higher animals.
- Plants modify climates and their presence purifies the atmosphere, hydrosphere and lithosphere.
- The organic content of soil is a product of decomposition of plants.
- Plants provide habitats to most animals.

### 2. Animals

**Characteristics**

- These are organisms that obtain energy by eating food.
- Animals are the most diverse forms of life on earth.
- They live in a vast range of habitats, from deserts and Arctic tundra to the deep-sea floor.
- Animals are the only living things that have evolved nervous systems and sense organs that monitor their surroundings.
- They are also the only forms of life that show flexible patterns of behaviour that can be shaped by past experience.
- Not a very good locational feature since they can change their location.
- Compared to plants, animals make up only a small part of the total mass of living matter on earth.

**Importance/Relationship**

- Most trees rely on animals to distribute their pollen and to disperse their seeds.
- Soil is partly the result of animal activity, because earthworms and other invertebrates help to break down dead remains and recycle the nutrients that they contain.
- Without its animal life, the soil would soon become compacted and infertile.
- By preying on each other, animals also help to keep their own numbers in check which prevents abrupt population peaks and crashes and helps to give living systems a built-in stability.

> On a global scale, animals also influence some of the nutrient cycles on which almost all life depends.
> They distribute essential mineral elements in their waste, and they help to replenish the atmosphere’s carbon dioxide when they breathe.
> This carbon dioxide is then used by plants as they grow.
> Humans use animals primarily as a source of food and also for raw materials that could be used for making tools and clothes.
> While are kept for food or for clothing, others for muscle power, and some simply for companionship.

**Evaluation**

1. (a) Mention the key gaseous constituent of the atmosphere
   (b) State TWO characteristics each of the FOUR sub-layers of the lower atmosphere
   (c) State THREE importance/relationship of the atmosphere

2. (a) State THREE characteristics each of plants and animals as components of the biosphere
   (b) State THREE each of the importance/relationship of plants and animals as components of the biosphere

**Objective Test**

1. The zone of the earth covered with soil is better called
    (a) lithosphere
    (b) pedosphere
    (c) cryosphere
    (d) biosphere

2. What covers about 70% of the earth crust is the
    (a) atmosphere
    (b) lithosphere
    (c) biosphere
    (d) hydrosphere

3. ____________ constitutes the highest proportion of gases in the atmosphere
    (a) oxygen
    (b) carbon dioxide
    (c) nitrogen
    (d) inert gases

4. The geographic lapse rate operates in what zone of the atmosphere
    (a) troposphere
    (b) stratosphere
    (c) mesosphere
    (d) thermosphere

5. Most animals depends on what for food.
(a) Photosynthesis
(b) oxygen
(c) plant
(d) carbondioxide

6. Which of these is not an importance of lithosphere to man?
(a) all farming activities are carried out on lithosphere
(b) all mineral resources are derived from lithosphere
(c) It aids transportation through construction of roads, rail-ways and airports
(d) it does not permits the penetration of ultra-violet radiation

7. Water in rivers, lakes and seas are translated to atmospheric water through the process of the ______
(a) evaporation
(b) precipitation
(c) runoff
(d) condensation

8. In the stratosphere, temperature increases with height because it contains much of the total atmospheric
(a) atomic oxygen
(b) X-rays
(c) ozone
(d) Chlorofluorocarbons

9. ___________ is the sum total of living things on earth.
(a) Biosphere
(b) Biogeography
(c) Biodiversity
(d) Biogeochemical

10. ONE of these does not describe animals in the biosphere
(a) These are organism that obtain energy by eating food
(b) Animals are the most diverse forms of life on earth
(c) They live in a vast range of habitats, from deserts and Arctic tundra to the deep-sea floor
(d) Animals have supplied sufficient oxygen to the atmosphere to have supported higher plants
8.
ROCKS OF THE EARTH

LESSON 1

Objectives
At the end students should be able to:
I. Define rocks and identify rock types
II. Define the rock types, mention their subtypes and state their characteristics

ROCKS AND ROCK TYPES
Rocks are aggregate of minerals. This may take the form of sand, mud and stone. Generally, rocks are classified into three types based on their origin, mode of formation and physical appearance. These are igneous, sedimentary and metamorphic rocks. And a fourth undifferentiated type called Basement Complex.

Table 8: Rock types and their characteristics

<table>
<thead>
<tr>
<th>Classes</th>
<th>Types/examples</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Igneous rocks:</strong></td>
<td>Plutonic (intrusive) e.g. granite, gabbro</td>
<td>. they are glassy, crystalline and do not contain fossils</td>
</tr>
<tr>
<td></td>
<td>Volcanic (extrusive) e.g. Basalt</td>
<td>. they do not occur in layers i.e. they are not stratified</td>
</tr>
<tr>
<td></td>
<td></td>
<td>. they are usually very hard and impervious</td>
</tr>
<tr>
<td></td>
<td></td>
<td>. they are resistant to erosion, light and dark in colour</td>
</tr>
<tr>
<td><strong>Sedimentary rocks:</strong></td>
<td>Mechanically formed e.g. sandstone</td>
<td>. they occur in layer, strata and sheets</td>
</tr>
<tr>
<td></td>
<td>Chemically formed e.g. gypsum, potash, sodium chloride,</td>
<td>. the rocks are coarse in texture</td>
</tr>
<tr>
<td></td>
<td>Organically formed e.g. by plants (carbonaceous: coal, petroleum); animals (calcareous: limestone, chalk</td>
<td>. they contain fossils of plant and animals</td>
</tr>
<tr>
<td></td>
<td></td>
<td>. they are soft and as such not resistant to erosion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>. they react with weak acid e.g. dilute HCL</td>
</tr>
<tr>
<td><strong>Metamorphic rocks:</strong></td>
<td>Igneous rocks e.g. gneiss from granite</td>
<td>. some may occur in layers or strata</td>
</tr>
<tr>
<td></td>
<td>Sedimentary rocks e.g. Slate is formed from clay</td>
<td>. the rocks may be hard or soft</td>
</tr>
<tr>
<td></td>
<td></td>
<td>. they are non-crystalline in structure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>. they exist in different colours and texture</td>
</tr>
<tr>
<td></td>
<td></td>
<td>. they may contain fossils</td>
</tr>
<tr>
<td><strong>Basement Complex rocks:</strong></td>
<td>BCR of Oceanic Crust</td>
<td>. thick foundation of ancient rocks</td>
</tr>
<tr>
<td>(BCR):</td>
<td></td>
<td>. forms the crust of continents</td>
</tr>
<tr>
<td></td>
<td>BCR of Continental Crust</td>
<td>. combination of the oldest metamorphic and igneous rocks</td>
</tr>
<tr>
<td></td>
<td></td>
<td>. often in the form of granite</td>
</tr>
<tr>
<td></td>
<td></td>
<td>. sedimentary maybe deposited on top</td>
</tr>
<tr>
<td></td>
<td></td>
<td>. it is found everywhere</td>
</tr>
</tbody>
</table>

Figure 8.1: Formation of igneous rocks from cooling and solidification of magma
Figure 8.2: **Granite** is an example of crystalline igneous rock composed primarily of quartz and feldspar.

Figure 8.3: **Basalt** is the most common type of igneous volcanic rock.

Figure 8.4: **Sedimentary rocks layers**

Figure 8.6: **Limestone** is a sedimentary rock composed of the mineral calcite.

Figure 8.7: The metamorphic rocks shown here are mica-schist, quartzite and marble.

Figure 8.9: **Gneiss** is a metamorphic rock in which quartz and feldspar alternate with bands of dark minerals, such as dark mica.

Figure 8.10: The **marble** is used by artists and craftspeople as well as in industry.
Evaluation
1. (a) Define rocks
   (b) Mention FOUR rock classes
2. (a) Define each of the FOUR classes rocks
   (b) State TWO characteristics each of the FOUR classes of rocks

LESSON 2
Objectives
At the end students should be able to:
I. Describe the rock cycle
II. State the at least SIX general importance of rocks

THE ROCK CYCLE
It has been theorised that rocks are related to each other and change from one form to the other. The main idea is that rocks are continually changing from one type to another and back again, as forces inside the earth bring them closer to the surface (where they are weathered, eroded, and compacted) and forces on the earth sink them back down (where they are heated, pressed, and melted). So the elements that make up rocks are never created or destroyed instead, they are constantly being recycled.

GENERAL IMPORTANCE (USES) OF ROCKS
1. Rocks are sources of valuable minerals such as gold, diamond, limestone, petroleum etc. which can be exported to provide foreign exchange.
2. Sedimentary rocks like petroleum and coal are sources of fuel for domestic and industrial uses.
3. Some rocks like granite and sandstone are quarried and used for road, bridge and building construction.
4. Huge rock masses or mountains serve as tourist centres e.g. Olumo rocks, Zuma rocks, Shere hills etc.
5. Some beautiful rocks such as marble can be polished as ornaments for decorating floors, walls of buildings, tombstones, etc.
6. Rock salts such as sodium chloride (table salt) and potash from sedimentary rocks provide minerals used in seasoning and cooking.
7. Soils are formed from the disintegration and decomposition of rocks. Over 45% of soil is occupied by rock minerals, and this forms the foundation of plant growth.
8. Rocks are sources of metals which are derived from mines e.g. silver, iron, aluminum, copper, etc.
9. Rock pebbles from granites are used for domes-
tic and cookery purposes e.g. grinding stones.
10. Some sedimentary rocks are used as raw materials in industries e.g. limestone is used for making cement, dolomite and marble for glass and house paint.

**Evaluation**
At the end students should be able to:
I. Describe the rock cycle
II. State SIX general importance (uses) of rocks

**Objective Test**

1. Rocks are __________
   (a) harden part of the earth
   (b) stony areas of the earth
   (c) aggregate of minerals
   (d) mountains and hills for tourism

2. Rocks formed by the cooling and solidification of magma is said to be
   (a) igneous
   (b) sedimentary
   (c) metamorphic
   (d) basement complex

3. Sedimentary rocks are stratified and the plane between two strata is called __________
   (a) deposition
   (b) stratification
   (c) strata
   (d) bedding plane

4. Limestone and chalk are example of organically formed sedimentary rocks within a group called
   (a) calcareous
   (b) carbonaceous
   (c) mechanical
   (d) solution

5. An example of sedimentary rock that is a source of fuel for domestic and industrial use is __________
   (a) limestone
   (b) petroleum
   (c) lead
   (d) zinc

6. The following are examples of metamorphic rocks except
   (a) slate
   (b) marble
   (c) quartzite
   (d) gabbro

7. One of these is not a characteristics of basement complex rocks
   (a) thick foundation of ancient rocks
   (b) forms the crust of continents
   (c) combination of the oldest metamorphic and igneous rocks
   (d) sedimentary maybe deposit-ed underneath

8. The elements that make up rocks can __________
   (a) never be created or destroyed
   (b) be created and can be destroyed
   (c) be constantly static all the time
   (d) cannot be recycled

9. __________ is the process by which rocks on the earth surface are weathered, eroded, transported and deposited in another location
   (a) erosion
   (b) melting
   (c) weathering
   (d) Denudation

10. Igneous rocks are form through the process of
    (a) crystallization
    (b) volcanism
    (c) Lithification
    (d) metamorphism
LESSON 1

Objectives
At the end students should be able to:
I. Define relief
II. Identify the major continental landforms
III. Identify and explain the forces that produce the landforms

RELIEF
The relief of a place constitute the landforms elevation and topography. While the elevation of a landform is its height above sea level; the topography is its configuration on the surface.

Figure 9.1 is a schematic graph and map showing both the elevation and configuration of Nigerian relief system.

CONTINENTAL LANDFORMS
The are three major continental landforms. These are mountains, plateau and plains. (see figure 9.2).

FORCES THAT PRODUCE LANDFORMS
Forces producing landforms are both internal and external. Internal forces also known as tectonic forces are those operating in the inside of the earth. Examples of internal forces are earth movements, volcanic eruptions, and earthquakes. The external forces are those operating on the surface altering or modifying it e.g. denudation, deposition, mass wasting, and activities of man.

1. Earth movements: Earth movements maybe vertical or lateral. Vertical earth movements are ups and downs movements which cause the crustal rocks to fault. Features produced include plateaus, Block Mountains, basins, some types of escarpment. Lateral are sideways movements which cause crustal rocks to fold. Features produced include Fold Mountains, sometimes rift valleys, block mountains. They are also known as compression and tensional forces.

Figure 9.3: compressional force

Figure 9.2: Major Continental Landforms
2. **Volcanic eruptions**: Volcanic eruptions take place when molten rocks (magma) moves from the core of the earth towards or on the surface. As the magma comes towards or on the surface it cools and solidifies, producing different landforms. If on the surface, features such as lava plains and plateaus, volcanic cones, and geysers are produced. Features such as dykes, sills, batholiths, laccoliths, etc. occur when solidification takes place inside.

3. **Earthquakes**: Landforms can be altered from earthquakes which arise from shock waves emitted from the interior part of the earth. This may take the form of landslide, subsidence or a total collapse of a given land surface. When earthquakes hits the bottom of the sea it may give rise to tsunami (which are gigantic tidal waves) which often sweeps into the continents altering landforms, and has led to loss of lives and properties.

4. **Denudation**: Denudation is lowering and building of the earth surface by agencies such as running water, wind, glaciers, and waves. Denudation begins with weathering which is the breaking or decomposition of rocks insitu. Features produced include scree, earth pillars, exfoliation domes, soils, etc. Erosion which is another stage of denudation involving the wearing away gives rise to valleys, cliffs, peneplain, rivers and coastal terraces, escarpment, rock basins, etc.

5. **Deposition**: This is often seen as the last stage of denudation after transportation. If deposition is by water features produce will include flood plains, levees, alluvial fans, deltas, beaches, lake plains, marine alluvial plains. If it by ice we will have boulder clay, outwash plains, moraines, drumlins, eskers, etc. By wind will include loess plains, sand dunes, etc. By living organisms features produced include coral reefs, and of organic matter, we will have coal, petroleum, etc. finally, by evaporation and precipitation we have salt deposit.

6. **Mass wasting**: This involves the movement of rock materials down slope due to the influence of gravity. It may take the form of soil creep, mudflow, rock fall or avalanche. Movement of rock down slope can be facilitated by presence of lubricating moisture and these can give rise to the development of pediments at the foot of slopes. Pedi plains are extensive features of mass wasting.

7. **Activities of Man**: Man and his activities are increasing becoming agents of landform development. Anthropogenic activities of landforms are broadly excavation and constructional. Excavation ranges from mining of minerals, soil scooping to quarrying of rocks. Degraded landscapes and relics are often left behind. Sometimes these excavated earth materials might be use for constructional purposes such as roads, housing, etc. Man has also interfered on drainage system by construction of dams and irrigation facilities thereby altering the original landscapes.

**Evaluation**

1 Define relief
2. Mention the THREE major continental landforms
3. Identify and explain TWO each of internal and external forces that produce the landforms

**Objectives**

At the end students should be able to:

I. Define mountain
II. Identify and describe the FOUR types
III. Highlight at least SIX importance of mountains

**MOUNTAINS**

Mountains are distinct great elevation resulting from structural imbalances and alteration from internal and external forces. They have steep slopes and show distinct peaks.

**TYPES OF MOUNTAIN**

According to their mode of formation and appearance, there are four types- fold, block, volcanic and residual mountains.

1. **Fold Mountains**: Fold Mountains are formed as a result of stress and compression forces which cause expansion and contraction of the crust. They have wrinkling or folding appearance and show distinct peaks of great heights. Folding shortens the earth crust and is associated with regions of active volcanoes. Examples of Fold Mountains include Himalayas in Eurasia, Rockies in USA, Andes, Alps and Atlas in Algeria etc.

2. **Volcanic Mountains**: Volcanic Mountains are formed from ejected magma which cools and solidify to build a large mould. They have irregular sides with conical shape. Materials that make up volcanic mountains include ash, volcanic bombs, cinders etc. Examples include Mt. Fuji in Japan,

Figure 9.5: Volcanic Mountain

3. **Block Mountains:** Block Mountains are formed when the earth cracks due to faulting arising from tensional and compression forces. They are made up of old hard rock's with flat or slightly sloping surfaces associated with rift valleys. Examples of Block Mountains include Hunsruck Mt., Vosges Mt, and the Black forest Mt of Rhineland.

Figure 9.6: Block Mountain

4. **Residual Mountains:** Residual Mountains are formed from already existing mountains which are reduced by agents of denudation such as running water, ice and wind. They have irregular surfaces, varying heights and sizes (see figure 9.7). Examples include Mt Monadnock in USA, highland of Scandinavia and Deccan plateau.

**Figure 9.8: Residual Mountain**

the forests of the mountains. Tea and coffee plantations and some fruits orchards have been developed on mountain and hill slopes.

II. **Generation of Hydro-electricity:** Hydro-electricity is generated from the waters of perennial rivers in the mountain regions. The mountainous countries like Japan, Italy and Switzerland, which suffer from the shortage of coal have developed hydro-electricity.

III. **Abundant Sources of Water:** Perennial Rivers rising in the snow fed or heavily rain fed mountains are the important source of water. They help in promoting the irrigation and provide water for many other uses.

IV. **Formation of Fertile Plains:** The rivers that originate in the high mountain region bring silt along with water to the lower valleys. This helps in the formation of fertile plains. The great alluvial plain of northern India has been formed by the rivers Ganga, Sutlej and the Brahmaputra.

V. **Natural Political Frontiers:** The mountain ranges do act as natural political frontiers between countries and protect them from invasions to some extent. The Mandara and Atlantika Mountains a political frontier between Nigeria and Cameroun.

VI. **Defence and Security:** Both in the olden days and now mountainous areas forms defence sites. People head themselves to escape attacks and to launch an offensive or defensive attack.

VII. **Effect on Climate:** Mountainous areas have lower temperatures. They serve as climatic divide between two adjoining regions. The Himalaya for example forms a barrier to the movement of cold winds from Central Asia towards the Indian sub-continent. They also force the South West Monsoons to ascend and cause rainfall on their southern slopes.

VIII. **Tourist Centres:** The pleasant climate and the beautiful scenery of the mountains have led to their development as centres of tourist attraction. The tourist and hospitality industries get an additional encouragement in such regions. Shimla,
Nainital, Mussorie and Srinagar are some of the important hill stations of India which attract tourists all over the world.

**Evaluation**

I. Define mountain
II. Identify and describe the FOUR types of mountains
III. Highlight at least SIX importance of mountains

**Objective Test**

1. The configuration of relief system is better called
   (a) elevation
   (b) Altitude
   (c) topography
   (d) landforms

2. Examples of internal forces of landforms development are as follows EXCEPT
   (a) volcanism
   (b) earthquakes
   (c) earth movement
   (d) denudation

3. Features such as the following are produces when occur when solidification takes place inside EXCEPT
   (a) dykes
   (b) Sills
   (c) Batholiths
   (d) Geysers

4. If deposition is by water features produce will include EXCEPT
   (a) flood plains
   (b) Levees
   (c) alluvial fans
   (d) Moraines

5. ___________ are distinct great elevation resulting from structural imbalances and alteration from internal and external forces
   (a) Swells
   (b) Mountains
   (c) Plateau
   (d) Plains

6. ___________ are formed as a result of stress and compression forces which cause expansion and contraction of the crust
   (a) Fold mountains
   (b) Block mountains
   (c) Volcanic mountains
   (d) Residual mountains

7. ___________ is an example of volcanic mountain
   (a) Mt Cameroun
   (b) Hunsruck Mt.

8. Which of these land form is produced by faulting?
   (a) plain
   (b) syncline
   (c) Horst
   (d) anticline

9. Residual Mountains are formed from already existing mountains which are reduced by agents of denudation such as the following except
   (a) running water
   (b) ice
   (c) wind
   (d) rift

10. This is NOT an economic importance of mountains
    (a) store house minerals
    (b) Source of fresh water
    (c) Defense and security
    (d) Construction site
Objectives
At the end students should be able to:
I. Define plateau
II. Identify and describe the FIVE types of plateau
III. Highlight at least SIX importance of plateau

PLATEAU
Plateau also known as high plain or tableland, usually consisting of relatively flat terrain. They can be formed by a number of processes, including upwelling of volcanic magma, extrusion of lava, and erosion by water and glaciers.

TYPES OF PLATEAU
Plateaus are classified according to their surrounding environment. Five types can be recognized
1. Tectonic Plateau
   These plateau are formed as a result of earth movement which causes the uplift of some areas and the depression of others. Uplifted areas of land or undulating land form tectonic plateau and the depressed area form basins.
   Tectonic plateau are of two types - table-land and intermont. Table lands are the uplifted areas of the level land slope down to surrounding lower land. Whereas intermont plateau are uplifted areas of the level land slope up or are enclosed by Fold Mountains

Figure 10.1: Intermont plateau a product of tectonic activities
Examples of tectonic plateaux are the Deccan Plateau in India. Some maybe tilted e.g. Mesetal plateau in central Iberia, or faulted e.g. Hartz of Germany. Examples of Intermont plateaux are the Tibetan plateau between the Himalayas and Kunlun mountains and Bolivian plateau between two ridges of the Andes.

2. Volcanic or Lava Plateaux
   They are produced by volcanic activity. These plateau is formed when molten rocks comes out of the crust through a vent and spreads out of the earth crust through a vent and spreads out in successive layers. The lava cools and solidifies to form volcanic or lava plateau. Examples include Antrim plateau of Northern Ireland and Columbia Snake Plateau in North West USA.

Figure 10.2: Formation of Lava Plateau

3. Dissected Plateau
   These are highly eroded plateaus cut by rivers and broken by deep narrow valleys. They are formed due to weathering and agents of denudation such as running water, wind, ice, etc. which wear down a large and extensive plateau into remnant structures of irregular surfaces. They may also be formed as a result of uplift. Examples of intermont plateau are Jos plateau (Nigeria), edges of Fouta Djallon plateau (Guinea) and Kumasi plateau in Ghana.

Figure 10.3: A small Scale Dissected Plateau

4. Piedmont Plateau
   Piedmont plateau are bordered on one side by mountains and on the other by a plain or sea.
What form the piedmont plateau are the eroded and de-posited materials. The plateau of Malwa in India, those of Patagonia facing the Atlantic ocean and the Appalachian situated between the Appalachian Mountain and the Atlantic Coastal Plain in U.S.A are their examples.

Figure 10.4: A Piedmont Plateau

5. Continental Plateau

Continental plateau are bordered on all sides by the plains or seas, forming away from mountains. These are formed either by an extensive continental uplift or by the spread of horizontal basic lava sheets completely covering the original topography to a great depth. The volcanic lava covered plateau of Maharashtra in India, Snake River Plateau in North West USA are the examples of this type. They are also, called the plateau of accumulation.

Figure 10.5: Continental Plateau

All continental plateaus show an abrupt elevation in contrast to the nearby lowland or the sea (fig.10.5). As compared to other, these plateaus, cover a vast area like the Great Indian Plateau and those of Arabia, Spain, Greenland, Africa and Australia. They may be tilted on one side without any disturbance in the horizontal nature of underlying rock strata as in the case of Great Indian plateau.

IMPORTANCE OF PLATEAU

Plateaus are extremely useful to mankind in the following ways:

I. Storehouse of Minerals: Most of the minerals in the world are found in the plateaus. Besides, the extraction of minerals is relatively easier on plateaus. These minerals are indispensable raw material for our industries. We get gold from the Plateau of Western Australia; copper, diamonds and gold from the plateaus of Africa e.g. tin in Jos plateau and coal in Udi-Nsukka plateau.

II. Generation of Hydro-Power: Rivers falling down the edges of plateaus form water-falls. These water-falls provide ideal sites for generating hydro-power.

III. Cool Climate: The higher parts of the plateaus even in tropical and sub-tropical regions have cool climate. Hence they have attracted Europeans to settle there and develop their economy e.g. South and East Africa and the Jos, Obudu and Mambilla plateau in Nigeria.

IV. Useful for Animal-rearing and Agriculture: Plateaus have large grassland areas suitable for animal-rearing specially sheep, goat and cattle. They provide a variety of products such as wool, milk, meat and hides and skin. The lava plateaus as compared to all other plateau are richer in agriculture since their soil is very fertile.

Evaluation
1. Define plateau
2. Identify and describe the FIVE types of plateau
3. Highlight at least SIX importance of plateau

LESSON 2

Objectives
At the end students should be able to:
I. Define plains
II. Identify and describe the THREE types of plains
III. Highlight at least SIX importance of plains

PLAINS

A plain is a flat or undulating region occurring as lowlands and at the bottoms of valleys but also on plateaus or uplands at high elevations. In a valley, a plain is enclosed on two sides but in other cases a plain may be delineated by a complete or partial ring of hills, by mountains or cliffs. Where geological region contains more than one plain, they may be connected by a pass or gap.

TYPES OF PLAINS

Plains may have been formed from flowing lava, deposited by water, ice cold wind, or formed by erosion by these agents from hills and mountains. Based on the mode of formation, there are three major types of plains. These are Structural, Erosion-al and Depositional plain.
1. **Structural plains**: These are relatively undisturbed horizontal surface of the earth, formed by bedded sedimentary rocks. Examples include the Russian platform and the Great Plains in USA.

![Figure 10.6: Example of a structural plain](image)

2. **Erosional plains**: These plains are formed by agents of denudation such as rivers, wind, rain, glacier and ocean waves which wear out irregular rock surfaces and smoothen them into plains. There are three forms of erosion plain.
   - A **peneplain** is erosion plain considered to have formed by the lowering of an entire region to a base level or almost.
   - A **pediplain** is assumed to have formed by the lateral cutting back of a cliff or scarp so that a steep slope becomes progressively gentler.
   - An **etchplain** is by deep weathering followed by a gradual flushing away of the weathered material.

![Figure 10.7 Example of an Erosional plains](image)

3. **Depositional plains**: These are plains formed by the deposition of materials or sediments transported there by various agents of transportation such as rivers, winds, waves and glaciers. Depositional plains are grouped into the following:
   - **Alluvial plains** formed from deposition of sediments eroded from the upper course of a river to the lower course of that river.
   - **Flood plains** are plains arising from deposit of sediments when rivers or sea overflows from flood.
   - **Scroll plain** is a plain through which a river meanders with a very low gradient.
   - **Deltaic plains** are formed from the deposition of sediments brought down by a river on to the mouth of that river.
   - **Lava plain** formed by sheets of flowing magma (lava).
   - **Outwash plains or sandur** are formed from the deposition of materials brought down by glaciers.
   - **Till plain** is a plain of glacial till that forms when a sheet of ice becomes detached from the main body of a glacier and melts in place depositing the sediments it carries. Till plains are composed of unsorted material (till) of all sizes.
   - **Aeolian plains** are formed in desert regions where wind-blown sand is deposited to form an extensive plain.
   - **Lacustrine plain** are formed from deposition of sediments which cover the beds of lakes that have become dry.
   - **Coastal plains** are formed from the deposition of sediments brought by ocean waves on the continental shelf. They can also be formed by the uplift of part of the sea-floor bordering a continent.

![Figure 7.14: A deposition and accumulation of debris before a pediplain](image)

**IMPORTANCE OF PLAINS**

Plains are important in several ways:

**I. Fertile Soil**: The plains generally have deep and fertile soil. Since the plains have a flat surface, the means of irrigation are easily developed. Both these factors have made the plains agriculturally so important that they are often called ‘food baskets of the world’.

**II. Growth of Industries**: The rich agricultural resources especially of alluvial plains have helped in the growth of agro based industries. This has
given employment to millions of people and has registered a marked increase in the national production and per capita income. Since the plains are thickly populated, plenty of labour is available for the intensive cultivation and for supplying work force for industries.

**III. Expansion of Means of Transport:** Since the plains have an even surface it favours the building of roads, airports and laying down of railway lines. Even pipeline are easier to lay on lowlands that on highlands.

**IV. Centres of civilization:** The plains have been the centres of many modern and ancient civilizations. The major river valley civilizations of the world have flourished in the plains only. Hence, they are aptly referred to as the cradles of civilization. For example, there are the civilization of the Indus and the Nile Valley.

**V. Setting-up of Cities and Towns:** Easy means of transport on land, the growth of agriculture and industries in plains have resulted in the setting-up and expansion of cities and towns. The most developed trade-centers and ports of the world are found in the plains only. Rome, Tokyo, Calcutta, Yangon (Rangoon), Varanasi, Paris and other famous cities are situated in the plains. As much as 80% of the world’s population lives in the plains.

**VI. Mineral Deposit:** Most mineral resources especially those of sedimentary types are deposited in plains. Crude petroleum are found in the deltaic plains of most part of the world e.g. the Niger Delta in Nigeria.

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**Evaluation**

1. Define plains
2. Identify and describe the THREE broad types of plains
3. Highlight at least SIX importance of plains

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**Objective Test**

1. ___________ also known as high plain or tableland, usually consisting of relatively flat terrain
   (a) Mountains
   (b) Plateau
   (c) Plains
   (d) Valleys

2. These plateau are formed as a result of earth movement which causes the uplift of some areas and the depression of others
   (a) tectonic plateau
   (b) Lava plateau
   (c) Dissected plateau
   (d) Piedmont plateau

3. _______ is not an examples of tectonic plateau
   (a) Deccan Plateau in India
   (b) Mesetal plateau in central Iberia
   (c) Tibetan plateau
   (d) Columbia Snake Plateau in North West USA

4. The type of plateau bordered on one side by mountains and on the other by a plain or sea is called
   (a) Continental plateau
   (b) Piedmont plateau
   (c) Dissected Plateau
   (d) Lava Plateau

5. The __________ as compared to all other plateau are richer in agriculture since their soil is very fertile.
   (a) lava plateaus
   (b) Continental plateau
   (c) Dissected plateau
   (d) Piedmont plateau

6. A relatively undisturbed horizontal surface of the earth, formed by bedded sedimentary rocks is
   (a) Depositional Plains
   (b) an etchplain
   (c) Erosional plains
   (d) Structural plains

7. An examples of structural plains is
   (a) Great Plains in USA
   (b) Niger Deelta Nigeria
   (c) Lake Chad Basin
   (d) Sokoto-Rima plains

8. __________ are formed from the deposition of sediments brought down by a river on to the mouth of that river
   (a) Alluvial plains
   (b) Deltaic plains
   (c) Aeolian plains
   (d) Lacustrine plain

9. _______________ are formed in desert regions where wind-blown sand is deposited to form an extensive plain.
   (a) Scroll plain
   (b) Till plain
   (c) Aeolian plains
   (d) Scroll plain

10. One of these plains is NOT situated in plains
    (a) Rome
    (b) Tokyo
    (c) Calcutta
    (d) Abuja
LESSON 1

Objectives
At the end students should be able to:
I. Define ocean basin and Mention the world oceans and their sizes
II. Describe the ocean relief system
III. Highlight at least SIX importance of the ocean

OCEAN BASIN
The ocean is the largest body of water that does not have a definite direction of flow. About 97% of earth’s water is contained in oceans. The world’s oceans and seas vary greatly in their average depth, area, and volume. Currently, the Pacific Ocean is the deepest ocean, it covers the most area, and thus it has the greatest volume. The so-called world ocean refers to all of the earth’s major bodies of water combined.

The five oceans of the world and their relative sizes are presented below:

Table 9: World oceans are their relative sizes

<table>
<thead>
<tr>
<th>Oceans</th>
<th>Size in km²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pacific ocean</td>
<td>165million km²</td>
</tr>
<tr>
<td>Atlantic Ocean</td>
<td>82million km²</td>
</tr>
<tr>
<td>Indian Ocean</td>
<td>74million km²</td>
</tr>
<tr>
<td>Southern ocean and Arctic Ocean</td>
<td>14million km²</td>
</tr>
<tr>
<td>Seas and other salty water bodies</td>
<td>25million km²</td>
</tr>
</tbody>
</table>

TOPOGRAPHY OF THE OCEAN
The ocean basins are not featureless earth surface. Much of our knowledge about the topographic features that exist here is derived from remote sensing technology.

1. Continental Shelf: This feature is structurally part of the continental landmasses despite the fact that it is under water. It forms a gentle sloping platform extending from the sea-level to an average depth of about 200m. It is a good fishing ground and a site for natural harbour development.

2. Continental Slope: This region is narrow, steep and drops in depth to about 400m. The base of this steeply sloping (from 1° to 25°, average about 4°) topographic features occurs at depth of approximately 2000m, marking the edge of the continents. The width of the slope varies from 20 to 100km.

3. Ocean Floor: Also known as Abyssal Plains, the ocean floor is found at the base of the continental rise in water 4000 to 6000m deep. This region accounts for nearly 30% of the earth surface. The composition of the ocean floor consists of relatively thin layer (on average 5km thick) of basaltic rock. Numerous volcanoes as well as oozes, clay and mud populate the floor of the ocean basins.

4. Mid-Oceanic Ridge: Mid-oceanic ridge is normally found rising above the ocean basins. Some volcanic islands are part of the mid-oceanic ridge system (e.g. Iceland). When the sea levels falls
these ocean ridges appears as islands.

5. Ocean trenches: Ocean trenches are long, narrow, steep-sided depressions found on the ocean floor that contains the greatest depths in the ocean (11,000m – western pacific). There are 26 oceanic trenches in the world: 3 in the Atlantic Ocean, 1 in the Indian Ocean, and 22 in the Pacific Ocean with Mariana trench the deepest (-10,099m).

IMPORTANCE OF THE OCEAN

1. Oceans are used worldwide as a major means of transportation and communication between countries.
2. International trade is made possible through ocean and many other economic activities such as ship building, transport, etc.
3. Oceans also provide employment to many people e.g. fishermen, sailors and ship builders.
4. Oceans provide food for man especially proteins in form of fish, prawns, crabs, crayfish, etc.
5. Ocean especially around the beaches and coasts are centres of tourist attraction e.g. Bar beach in Lagos.
6. The ocean water provides raw materials from which domestic and industrial salts are extracted.
7. Ocean waters influences the weather and climate through ocean currents.
8. Some minerals like petroleum and natural gas are associated with the ocean especially in the continental self.
9. Seaports which are terminal points for ships are located on the coast e.g. Apapa port in Lagos.
10. Some seaweed is known by certain industries for the production of cosmetics.
11. The ocean also provides a means for research in aquatic plants and animals that are useful to man e.g. Nigerian Institute of Oceanographers and Marine Research in Lagos.

Evaluation
I. Define ocean basin and Mention the world oceans and their sizes
II. Describe the ocean relief system
III. Highlight at least SIX importance of the ocean

LESSON 2

Objectives
At the end students should be able to:
I. Define ocean salinity and the mention its sources
II. Identify and explain the factors affecting the distribution of ocean salinity
III. Highlight at least THREE importance and THREE problems of ocean salinity

SALINITY OF THE OCEAN

Salinity is defined as the degree of saltiness or concentration of salt solution in ocean. Most of the salt comes from rock minerals and soil that have been washed from the land and carried into the oceans by rivers. Salinity is express in part per thousand and the average salinity of the ocean is 35part per thousand.

EFFECTS OF OCEAN SALINITY

The difference between 34ppt and 36ppt salinity doesn’t sound very much, but it is enough to cause a difference in density. Even slightly denser seawater sinks below less dense water. However, the effect is greater if the salty water gets cold, as temperature has a greater effect on density than salinity does. A combination of high salinity and low temperature makes seawater so dense that it sinks to the bottom of the ocean and flows across ocean basins as deep, slow currents.

SOURCES OF SALINITY

The sources of salt in ocean water include the following:
1. when volcanoes erupt, rock materials and gases, such as chlorine spew forth
2. As rivers, streams and glaciers moreover rock and soil, they dissolve salts, such as magnesium, sodium and potassium, in them
3. As waves pound the shoreline, they dissolve salts from the rocks
4. Human activities both domestic and industrial discharge chemicals that are saline directly or indirectly into the ocean

DISTRIBUTION OF OCEAN SALINITY

The salinity of the ocean varies from place to place, especially at the surface. Much of the ocean has salinity between 34ppt and 36ppt, but there are places that tend to be higher or lower. The distribution of ocean salinity is dependent upon the following factors:

1. Location of the ocean water: oceans in warm, dry areas are more salty than the oceans in cold climates, such as near the North and South Poles. That’s because ocean water in warmer areas evaporates quicker, leaving more salt behind. The saltiest water in the world is the Red Sea, which is almost entirely surrounded by deserts.
2. The rate of evaporation: high evaporation increases salinity while low evaporation reduces salinity. Evaporation is higher in the tropics but lower in the Arctic.
3. Amount of fresh water added: when fresh water from precipitation and streams adds to the sea it dilutes and thus lower the level of salinity. Amount of fresh water added is higher in the equator because of high rainfall and high humidity. The Baltic Sea, almost enclosed by northern Europe and Scandinavia, has a very low salinity of
about 10ppt. This is mainly due to the huge amount of freshwater added from hundreds of rivers.

4. Thawing of Iceberg: The ocean around Antarctica has a low salinity of just below 34ppt, and around the Arctic it is down to 30ppt in places. Thawing icebergs add freshwater – icebergs that have broken off ice sheets formed over land do not contain salt, and the freezing of seawater into ice floes removes more salt.

5. Degree of water mixing with ocean currents: salinity is higher in enclosed water such as in Caspian and Red sea because of absence of ocean current but lower in seas that are not enclosed because of their mixing with ocean currents. The Mediterranean Sea between Europe and Africa has very high salinity – 38ppt or more. It is almost closed from the main ocean, and there is more evaporation than there is rain or extra fresh-water added from rivers.

6. Presence of rock salt: If an area bordering the sea or lake is characterized by rock salt the sea will be salty. As rain falls, rock salt dissolves and are washed into the sea there by increasing the salinity level.

7. Frequency of volcanic activity: When volcanoes erupts, rock materials and gases, such as chlorine pew forth. Frequency of such as activity in or around ocean waters adds to the salinity level.

8. Domestic and industrial activities: The dumping industrial effluent, slugged, and human waste that has salt contain into the sea will increased salinity. Some toxic salt dumped into the sea by industrialized nations of the world could be the reason for the increasing salinity of the ocean.

**IMPORTANCE OF OCEAN SALINITY**
I. Table salt may be extracted from ocean salinity
II. It is ideal for salt tolerant sea lives
III. It’s variation makes it a driver of ocean circulation
IV. Its regulates the world thermohaline conditions i.e. weather.
V. High salinity of the ocean can force missing items in the sea to float on the surface water

**PROBLEMS OF OCEAN SALINITY**
I. Salinity level of the ocean makes it unfit for drinking
II. Too much salts hinders some living organisms or detrimental to continual habitation
III. Saline water cannot serve irrigation and other industrial purposes
IV. High salinity of the ocean does not encourages sea diving or other recreational purposes

**Evaluation**
At the end students should be able to:
1. (a) Define ocean salinity
2. (b) State any TWO effects of ocean salinity
3. (a) Mention the FOUR sources of ocean salinity
4. (b) Identify and explain any FIVE factors affecting the distribution of ocean salinity
5. (a) Highlight at least THREE importance of ocean salinity
6. (b) Highlight any THREE problems of ocean salinity

**Objectives**
At the end students should be able to:
I. Define ocean currents
II. Identify the types of ocean currents
III. Mention and explain any FOUR causes of ocean currents
IV. Highlight at least SIX effects of ocean currents

**THE OCEAN CURRENTS**
Ocean currents refer to the regular movement of water from one part of the ocean to another. Ocean currents can flow for great distances, and together they create the great flow of the global conveyor belt which plays a dominant part in determining the climate of many of the earth’s regions.

**TYPES OF OCEAN CURRENTS**
There two groups of ocean currents. These are vertical and horizontal ocean currents (see figure 11.2).

**Table 10: Classes of ocean currents**

<table>
<thead>
<tr>
<th>Types</th>
<th>Sub-types</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical ocean currents</td>
<td>Upwelling ocean currents</td>
<td>upward vertical current that brings deep water to the surface.</td>
</tr>
<tr>
<td></td>
<td>down welling ocean currents</td>
<td>downward vertical current that pushes surface water to the bottom</td>
</tr>
<tr>
<td>Horizontal ocean currents</td>
<td>Cold ocean current</td>
<td>those that flow from the equatorial regions towards the poles</td>
</tr>
<tr>
<td></td>
<td>Warm ocean currents</td>
<td>those that flow from the poles towards equatorial regions</td>
</tr>
</tbody>
</table>

**CAUSES OF OCEAN CURRENTS**
1. **Planetary wind:** wind is one of the most important factors responsible for the movement of surface water in the oceans. Wind is air in motion, and as such, the pressure exerted on surface water will force the ocean water to move.
2. **Movement of the Earth:** In the course of the
elliptical movement of the earth (revolution) surface water are shaken giving rise to tides which produces currents. Moreover, as the earth rotates, ocean waters are deflected to the right in northern hemisphere and to the left in the southern hemisphere as a response to Coriolis force.

3. Crustal Disturbance: Volcanism and earthquakes for example causes shaken that may directly or indirectly affect the ocean waters. Tsunamis which are effects of earthquake that takes places in ocean basins may lead to swash and backwash that may last for so many days on coastal areas far away from their point of origin.

4. Temperature Differences: ocean waters at the equator are more heated and therefore warmer and lighter than those at the poles. Thus, those at the equator flow on the ocean surface towards the poles. While those at the poles are cold and heavy, thus creeping below the bottom of the ocean towards the equator.

5. The shape of the landmasses: warm and cold currents flow in obedience to the topography and configuration of the landmasses. The landmass may divert the currents from the direction initially taken by the current to totally different directions.

6. Levels of Salinity: where the salinity of an ocean is high, the ocean water is dense or heavy, and creeps (or moves) at the bottom of the ocean to low salinity areas. Where the salinity is low, the ocean water is light and flow at the ocean surface toward a high salinity area.

EFFECTS OF OCEAN CURRENTS

I. Upwelling tends to bring deep water nutrients up into shallow water. It also relate to significant weather patterns.

II. Down welling are important in carrying and cycling nutrients to deep ocean ecosystems and sediments.

III. It modifies the climate of an area by either, lowering the temperature if the current is cold or by raising it if it warm.

IV. Cold currents contribute to aridity (deserts) on the landmass they affect e.g. the cold Benguela currents of west coast of South Africa causes Namib and Kalahari deserts. Also, the cold Canary current of North-West Africa causes Sahara desert.

V. Cold currents also cause coastal fogs instead of actual rain which is a sort of danger as it reduces visibility for aero planes and sailors.

VI. Warm currents bring regular and heavy rainfall to their coastland e.g. Mozambique current of South East Africa and Guinea current of West Africa brings rain to their coastlands.

VII. Coastal fogs caused by cold current reduce the temperature of the areas where they occur.

VIII. It modifies the climate of an area by either, lowering the temperature if the current is cold or by raising it if it warm.

IX. Cold currents contribute to aridity (deserts) on the landmass they affect e.g. the cold Benguela currents of west coast of South Africa causes Namib and Kalahari deserts. Also, the cold Canary current of North-West Africa causes Sahara desert.
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XII. Coastal fogs caused by cold current reduce the temperature of the areas where they occur.

**Evaluation**

1. Define ocean currents
2. Identify the types of ocean currents
3. Mention and explain any FOUR causes of ocean currents

IV. Highlight at least SIX effects of ocean currents

**Objectives Test**

1. Pacific ocean is the largest with a surface area of _______________
   (a) 165million km²
   (b) 82mil-lion km²
   (c) 74million km²
   (d) 14million km²

2. Which of these seas is not enclosed sea?
   (a) Caspian Sea
   (b) Black Sea
   (c) Mediterranean Sea
   (d) Red Sea

3. This feature is structurally part of the continental landmasses despite the fact that it is under water
   (a) continental shelf
   (b) continental slope
   (c) ocean floor
   (d) mid-oceanic ridge

4. There are ______________ oceanic trenches in the world
   (a) 20
   (b) 22
   (c) 24
   (d) 26

5. Most of the salt in the oceans comes from
   (a) rain
   (b) currents
   (c) rocks
   (d) ice

6. The degree of salinity varies from ocean to ocean and it is measured in ______________ per thou-
   sand
   (a) metre
   (b) percentage
   (c) part
   (d) calorie

7. Which of these has the highest salinity level
   (a) Baltic Sea
   (b) Red Sea
   (c) Dead Sea
   (d) Mediterranean sea

8. ______________ refer to the regular movement of water from one part of the ocean to another
   (a) ocean salinity
   (b) ocean currents
   (c) ocean relief
   (d) ocean island

9. The predominant circulation patterns in the