



FACULTY OF SOCIAL SCIENCE AND HUMANITIES

DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL STUDIES

Biogeography module

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Course Introduction

This course “Biogeography” deals with the various aspects of biogeography and is carefully prepared to assist students to understand the vast range of

physical and human issues that relate to the study of BIOGRAPHY. The course material incorporates examples, charts and graphs. It is extensively referenced with up-to - date specialist reading material and substantiated with tabular data. It is prepared in such a way that students will be able to understand with tabular data. It is prepared in such away that students will be able to understand the course material by themselves and/or with little help from their tutor.

This material contains seven units. Each unit contains topics and sub topics arranged in a logical order so that students will easily follow the course. Detailed discussions are made on origin, evolution and organizations of living things, the biological entities and the physical of different environments, the interrelationship between living organisms among themselves and the biotic environment as a whole and the transfer of energy and exchanges of chemical resources. The impacts of man on biotic life is also the point of focus. .Different in-text question, self - check exercises and activities are provided in each unit so that students can evaluate themselves in the middle of the course.

Generally, this course material seeks to answer such basic questions as why study biogeography at all; Perhaps the most basic motivation is our simple quest to understand the world in which we live. What allows a species to live where it does, and what prevents it from colonizing other areas ;Why are the animals and plants of large, isolated regions such as Australia and Madagascar so distinctive; How are the organisms adapted to the conditions of the environment in any given area; What environmental or biological factors exist that pre vents the organism from existing in adjacent areas;

Objectives:

After studying this Course, you will be able to:

- Analyze the general principles of the origin, evolution and organizations of living things;
- Discuss the biological entities and the physical aspects of different environments that exist as single working or interacting system,
- Analyze the interrelationships between living organisms among themselves and the impact of man in changing his environment and his role in protection and conservation.
- Discuss the development of the field and the need the application of biogeographically principle,;
- Exchanges how organisms are supported by the transfer of energy and exchanges of chemical resources;

CHAPTER ONE

STUDYING BIOGEOGRAPHY

1. Introduction

This discusses the meaning, scope, sub divisions and the historical development of biogeography. It also gives a detailed expiation on origin, organization and classification of life in different environment.

Objectives:

After reading and studying this Unit, You will be able to:

- Define biogeography;
- Examine the scope of biogeography;
- Identify the subfields of biogeography; and
- Comprehend the historical development of biogeography;

1.1: Background of Biogeography

Dear learner! In this section, you will study about the concept and scope of biogeography. In addition, you will distinguish the different branches and subfields of biogeography.

1.1.1. The Living World

Living things are incredibly diverse. There are probably somewhere between 5 million and 50 million kinds of animals, and microbes living on earth today. Of these, fewer than 2 million have been formally recognized as species and described in the scientific literature. The remainders are represented by specimens in museums waiting to be described or individuals in nature waiting to be discovered. Additional untold millions; probably billions, of species lived at some time in the past but are now extinct; only a small fraction of them have been Preserved as fossils.

Nearly everywhere on earth, from the frozen wastes of Antarctica to the warm, humid rainforests of the tropics, from cold, dark abyssal depths of the near-boiling waters of hot springs- even in rocks several kilometers beneath the earth's surface- at least some kinds of organism can be found. But no single species is able to live in all Places. In fact, most species are restricted to a small geographic area and a narrow range of environmental conditions. The spatial patterns of global biodiversity are a consequence of the ways in which the limited geographic ranges of millions of species overlap and replace each other over the earth's vast surfaces.

1.2. Meaning and Scope of Biogeography

■ What is biogeography?

(You can use the space below to write your response.)



The meaning of Biogeography is different for people with different disciplines. To a biologist, it is traditionally the history and geography of animals (Zoogeography) and plants (phytogeography). Biogeography is the science that

attempts to document and understand spatial patterns of biodiversity. It is the study of distribution of organisms, both past and present, and of related patterns of variation over the earth in the numbers and kinds of living.

Biogeography is the study of the distribution of plants and animals over the surface of the Earth in both a spatial and temporal context. The discipline is important because it study the Earth, its environs and its organisms, to better manage the future to ensure its wellbeing.

Biogeography is the science that attempts to document and understand spatial patterns of biodiversity. It is the study of distributions of organisms, both past and present, and of related patterns of variation over the earth in the numbers and kinds of living things

Biogeography is a broad field. To be a complete biogeography, one must acquire and synthesize a tremendous amount of information. Notice both “spatial” and “temporal” contexts are mentioned, because biogeography is concerned with the analysis and explanation of patterns of distribution, and with the understanding of changes in these distributions that have taken place in the past and which are taking place to day. Here one can easily identify tow scales: spatial and temporal.

;
; What are the goals of biogeography?

(You can use the space below to write your response.)

The goals of Biogeography, as in other related field, are:

- To eventually provide rules and scientific laws, arising from proven theories that can account for such patterns in distributions over space and time. Theses rules provide a general framework of understanding of

our environment that can subsequently be used for prediction about the consequences of human-alteration of the natural world.

- To provide baseline information about our environment, which can be used to provide guidelines for development of policies to better manage our natural Geography?
- Biogeography is usually not an experimental science, but is a comparative observational science. The spatial and temporal scales are for patterns, formulating theories, testing. assumption and predictions with new observations. Often, nature's experiments are used to shed light on biogeography - natural events are monitored over time to look for changes. Biogeography must draw upon principles formulated by other disciplines, such as ecology, climatology, soil science, botany, Physiology, and behavioral sciences and develop new principles by incorporating techniques and principles used in the Environmental Geography.

Biogeography is the science that attempts to document and understand spatial patterns of biodiversity. It is the study of distributions of organisms, both past and present, and of related patterns of variation over the earth in the numbers and kinds of living things. So, it is the subset of geography that deals with living

■
; What are the central questions asked in biogeography?

(You can use the space below to writ your response.)

Central questions commonly asked in biogeography include:

- What taxa are found where?
- How are the organisms adapted to the conditions of the environment in this area?

- What environmental or biological factors exist that prevents the organism from existing in adjacent areas?

What are the principal processes in biogeography?

(You can use the space below to write your response.)

There are three fundamental processes in biogeography: evolution, extinction, and dispersal.

Evolution: any irreversible change in the genetic composition of a population.

Extinction: the process of a species becoming permanently eliminated with no
more living individuals on earth.

The following are persistent themes in biogeography.

- Explaining the differences in numbers as well as types of species among geographic areas.
- Reconstructing the historical development of biotas, including their origin, spread, and diversification
- Classifying geographic regions based on their biota
- Explaining geographic variation in the characteristics of individuals and populations of closely related species, including trends in morphology, behavior, and demography.

1.2.1. Themes of Biogeography

Hierarchy: Provides a scheme for studying living things: Example
Individuals–Populations–Communities – ecosystems.

- **Populations** are large groups of individuals
- **Communities** are assemblages of species of different populations that show a degree of cohesion and interdependence.
- **Ecosystems** are the interactions between the biotic and biotic worlds within and between these communities. These concepts fall within the field known as Ecological Biogeography.

Human impact: The arrival and impact of humans have had a profound impact on the world's Biogeography. The evolution of humans is sometimes considered a catastrophe in the sense that humans manipulate the environment by deflecting energy from other parts of the natural world into the support of one species. Therefore, the impact of humans on ecosystems is a central theme in Biogeography.

Temporal scale: A phenomenon can be studied as it evolves over one day or over several million years. Our expediently of nature represents just one tiny pointing time when compared to the constantly changing mosaic of the landscape as it responds to environmental and climatic change. Biogeography can therefore never be a static.

Spatial scale: a recurring theme in Geography. Different observers conduct their analyses across different spatial and temporal scales. An ecosystem can, in fact be a rotting log or the entire Earth. To help our investigations, Biogeography's use classification schemes, such as the use of biomes, also, known as formations. Biomes include tropical rainforest, savanna grassland, boreal forest, desert, subtropical evergreen forest.

Discipline: When analyzing effects of change over millions of year, such as the impacts of Ice Ages and sea level rise on ecosystems, we use an approach known as Historical Biogeography.

Some of the questions posed by biogeography include the following

1. Why are some group of closely related species confined to the same region, and others found on the opposite sides of the world?

2. How do different kinds of organisms replace each other as we go up a mountain, or move from a rocky shore to a sandy beach nearby?
3. Why is a species or higher taxonomic group (genus, family, order, and so on) confined to its present range?
4. What enables a species to live where it, does, and what prevents it from colonizing other areas?
5. What roles do climate, topography, and interactions with other organisms play in limiting the distribution of a species.
6. Why are the animals and plants of large, such as Australia and Madagascar, so distinctive?
7. Why are there so many more species in the tropics than at temperate or arctic latitudes? How are isolated oceanic islands colonized, and why are there nearly always fewer species on islands than in the same kinds of habitats on continents?
8. How did a species come to be confined to its present range?

The list of possible questions is nearly endless, but in essence we are asking: How are organisms distributed over the surface of the earth and over history of the earth? This is the fundamental question of biogeography. It has always intrigued scientists and who were curious about nature only within the last few decades, however, have scientists begun to call themselves as biogeographers and to focus their research primarily on the distribution of living things.

Activity1

Answer the following question.

1. What is biota?
2. Why we study Biogeography?
3. What enables a species to live where it, does, and what prevents it from colonizing other areas?

1.2.2. Scope of Biogeography

Like geography, there is no clear demarcation of the scope of biogeography. Some limit its content to the study of plant and animal geography with emphasis upon the former; others would broaden its scope to include the study of soils and some aspects of human geography.

In simple and narrower sense, Biogeography is defined as the study of the origin, distribution, adaptation and association of plants and animals. However, the scope of biogeography extends across the fields of plant and animal geography, with many overlaps in genetics, human geography, anthropology, and the social sciences. All of these together form the domain of biogeography.

Biogeography deals with the geography, ecology and history of life-where it lives, how it lives there, and how it came to live there. It has three main branches-analytical biogeography, ecological geography and historical biogeography.

1.3. The Subfields of Biogeography

Biogeography is a recognizable subdivision of geography. The facts of plant and animal distribution and the existence of veritable communities of both plants and animals are themselves facts of geography that help us to differentiate the Earth's surface and are relevant factors in human environment. Evidently in its widest sense, as distinct from physical geography, biogeography must include human geography. In working practice it is taken as concerned simply with plant and animal geography.

In broad terms, biogeography is concerned with the phenomena of the biosphere. More specifically, and traditionally, biogeography has concerned itself with the study of the geographical aspects of plants and animal life,

especially in terms of their distributions, and two branches have long been cerography of animals.

Historical biogeography considers the influence of continental drift, global climatic change, and other large-scale environmental factors on the long-term evolution of life.

Ecological biogeography looks at the relation between life and the environmental complex.

Analytical biogeography examines where organisms live today and they spread. It may be considered as a division of ecological biogeography.

Here we shall talk biogeography to include some study of plant and animal geography, the world of the soil, particular aspects of man. We shall not be concerned so much with man for this is the subject of anthropology and ethnography, but rather with man as animate being who plays an important role in the biosphere through his activities which change, alter, upset and destroy the balance of nature. Man cannot be left out of the biological reckoning, for he is the most significant agent or factor in the situation.

1.3.1. Plant and Animal Geography

Dear learner, let as say a little about plant animal geography, which traditionally has formed the substance of biogeography. The geography of plant life, **Phytogeography**, deals with the distribution of plants, more particularly the vascular plants (i.e plants that have vessels in their bodies, which transmit fluids) and the mutual influence of environment and plants each other. It has long been a subject of intensive study and research-mainly by biologists-and accordingly has developed highly specialized fields of study especially in its historical and ecological aspects.

In addition to this, **Zoogeography**, which corresponds to phytogeography , studies the distribution of animal life and the interaction of environment and animals upon each other, has been less fully studied and developed. This is

not to say there is a lack of work or research upon animal life, on the contrary, there is a very rich literature on Zoogeography. There are great complexities of factors that influence animal life. There are also different reactions of animals with the environment are less direct and obvious than in the case of plants, have made zoogeography a more difficult, if not less easily resolved.

Although the two twin's aspects of plant and animal geography, in practice, form biogeography, it is more concerned with the world of plants than animals. This is partly because animals, like man, are ultimately dependent on plants for their existence; and it is partly because animals, unlike plants, do not exhibit the same close relationship to environmental conditions. Largely for this reason, animal ecology as a branch of zoology has progressed on very different lines from those of plant ecology on which biogeography greatly depends.

A biogeography may specialize and become a:

- Phytogeographer, studying plants;
- Zoogeographer, studying animals;
- Ecological geographer, studying the present distributions of plants and animals in relation to their physical environment; and
- Historical biogeography, attempting to reconstruct the origin, dispersal and extinction of taxa and biotas.

Activity 2

Answer the following questions.

1. Why Analytical biogeography is not concerned so much with man?
2. Why zoogeography is not fully studied subfield of biogeography?

1.3.2. Ecology

One can also approach biogeography from an evolutionary or an ecological perspective

- Ecological biogeography investigates current patterns so distribution through empirical examination.
- Evolutionary biogeography (also known as historical biogeography) addresses the origin, dispersal, and extinction of taxa extending beyond the period of direct empirical evidence.

? What is the principle of uniformitarianism _

(You can use the space below to writ your response).

The principle of uniformitarianism (also known as factualism) maintains that the nature of the biophysical processes now operating at the Earth's surface has remained unchanged through time. Uniformitarianism does recognize that the intensity and pace of these processes fluctuates.

Given its extensive scope of investigation, biogeography draws on diverse disciplines, species have some plasticity in their morphological, physiological and behavioral responses to environmental change. The presence of similar organisms in spatially separate locations may be a consequence of past or present geographical factors.

Anthropogenic impact on the distribution of other species has become increasingly intense use and pervasive. This is due in part to the massive diversion of natural resources to human use and the anthropogenic creation of barriers to dispersal and migration Instances of environmental deterioration have also multiplied.

Activity 3

Answer the following questions.

1. Distinguish between ecological biogeography and Evolutionary biogeography?

2. How can you associate uniformitarianism with biogeography?

1.4. Historical Development of Biogeography

Biogeography has had a long history that is inextricably woven into the development of evolutionary biology and ecology. The problems of distribution and variation on geographic scales were matters of primary interest to evolutionary biologists, including the distinguished “fathers” of the field such as Lamarck, Darwin, and Wallace.

The field of ecology, a relatively young offspring of this lineage, grew out of attempt explain biogeography patterns in terms of the influence of environmental conditions interactions among species. However, the origin of these three fields is ancient, back well before the Darwinian revolution.

The development of biogeography, evolution, and ecology is tied to the exploration. Early European explorers and naturalists did far more than just label catalogue their specimens. They immediately, perhaps irresistibly, took to the comparing biotas across regions and developing explanations for the similarity differences they observed. The comparative method served these early naturalists and by the eighteenth century, the study of biogeography began to crystallize are fundamental patterns of distribution and geographic variation. We here trace development of biogeography from the age of exploration to its current status mature and respected science.

Many, if not all, of the themes central to modern biogeography have their origins pre-Darwinian Period. This is not to say that biogeography has not advert tremendously in the past few decades-only that modern biogeography’s owe debt to those before them who shared the same fascination with, and asked the types of questions about, the geography of nature.

1.4.1. The Age of Exploration

It is hard for us to appreciate that roughly 250 years ago, biologists had described and classified only one percent of all the plant and animal species we know to exist. Biogeography was essentially founded and rapidly accelerated by world exploration and the accompanying discovery of new kinds of organisms.

Biologists and naturalists of the eighteenth century were largely driven by a desire to glorify God. The prevailing belief was that the mysteries of creation would be revealed. These naturalist/explorers developed more complete catalogues of the diversity of life. Until the mid-eighteenth century, the prevailing world view was one of stasis- the earth, its climate and its species were immutable.

However, as the early biogeographers (then called naturalists or simply geologists) returned with their growing wealth of specimens and accounts, two things became clear:

These are:

- I. Biologists needed to develop a standardized and systematic scheme to classify the rapidly growing wealth of specimens; and
- II. It was becoming increasingly obvious that there were too many species to have been accommodated by the biblical Noah's ark.

It was just difficult for these early biologists to explain how animals and plants now isolated and perfectly adapted to dramatically different climates and environments, could have coexisted at the landing site of ark before they spread to populate all regions of the globe.

One of the most ambitious and visionary of these eighteenth - century biologists was Carolus Linnaeus (1707-1778). He developed a scheme to

classify all life- the system of binomial taxonomy that we continue to use today.

Like his contemporaries, he believed that the earth and its species were immutable. He realized that the challenge was not just in explaining the number of species, but in explaining patterns of diversity as well. The rapidly growing list of species included organisms adapted to environments ranging from the moist tropics to deserts, forests and tundra.

? Given that species were immutable, how could they have spread from a single site to become perfectly adapted to such diverse environments?
(You can use the space below to write your response.)

Linnaeus's solution, although perhaps naïve in retrospect, was logically sound. He hypothesized that life had originated or survived the biblical deluge, along the slopes of Mount Ararat, a high mountain near the border of Turkey and Armenia where the ark was said to have landed. At successively higher elevations was a series of environments ranging from deserts to alpine tundra. Linnaeus reasons that each of these elevational zones harbored a different assemblage of species, each immutable but perfectly adapted to that environment. Once the Flood receded, these species migrated down from the mountain and spread to eventually colonize and inhabit their respective environments in different regions of the globe.

Comte de Buffon (1707-1788) was a contemporary of Linnaeus, but his studies of living and fossil mammals led him to a very different view of the origin and spread of life.

Buffon noted two problems with Linnaeus's explanation.

First, he observed that different portions of the globe, even those with the same climatic and environmental conditions were often inhabited by distinct kinds of plants and animals. The tropics, in particular contained a great diversity of unusual organisms.

Second, Buffon reasoned that Linnaeus's view of the spread of life required that species migrate across inhospitable habitats following the Flood. Species adapted to Montana forests, for example, would have had to migrate across deserts before they could colonize deciduous and coniferous forests to the north. If species environmental barriers would have blocked their spread.

Buffon, therefore, hypothesized that life originated not on a mountain in the temperate regions of Eurasia, but on a landmass in the far north, in an earlier period when climatic conditions were more equable. He speculated that this northern landmass was relatively continuous with both the New and Old Worlds; thus when climates cooled, life forms could have migrated south to their current locations. During this migration, the populations of the New and Old Worlds were separated and became increasingly modified, until tropical biotas of the New and Old worlds shared few if any forms. While Buffon's explanation may now seem imaginary, it provided two key elements of what would become central parts of modern biogeography theory the ideas that climates and species are mutable.

Moreover, Buffon's observation that environmentally similar but isolated regions have distinct assemblages of mammals and birds became the first principle of biogeography, known as Buffon's law.

We can explain a lot about the current distribution of species and of similar species by looking at how the land masses were positioned. One possible exception for the occurrence of similar species that occur today in locations far away from each other, such as on separate continents, is that their

ancestors once occurred very near each other when the continents were arranged differently.

From 1750 to the early 1800s, many of Button's colleagues continued to explore the diversity of nature and to write catalogues and general syntheses of their work. One of the most prominent naturalist/collectors of this period was Sir Joseph Banks, who, during a 3-year voyage around the world with Captain James Cook on the Endeavor (1768-1771), collected some 3600 plant specimens, including over 1000 species not known to science (i.e., in addition to the 6000 species described by Linnaeus in his *Species Plantarum*). The efforts of Banks and many other naturalist/explorers resulted in two important developments. First, they affirmed and generalized Button's law. Second, they developed a much more thorough understanding of and appreciation for the complexity of the natural world.

Banks and his colleagues discovered some interesting exceptions to Button's law specifically, cosmopolitan species. Moreover, they noted other biogeography patterns, which in their own right would become major themes as biogeography developed.

In the latter part of the eighteenth century, Johann Reinhold Forster (1729-1798) made many important contributions to phytogeography in particular and to biogeography in general. In his account of his circumnavigation of the globe, he presented one of the first systematic worldviews of biotic regions, each defined by its distinct plant assemblages.

He found that Button's law applied to plants well as to mammals and birds, and to all regions of the world, not just the tropics. Forster also described the relationship between regional floras and environmental conditions and, how animal associations changed with those of plants.

? Where do you find fewer species of plants? Why?

(You can use the space below to write your response.)

Buffon provided some important early insights into what was to become island biogeography and species diversity theory. He noted that insular (island) communities had fewer plant species than those on the mainland, and that the number of species on islands increased with available resources (island area and variety of habitats). Forster also noted the tendency for plant diversity to decrease from the equator to the poles, a pattern that he attributed to latitudinal trends in surface heat on earth.

? Why plant diversity decreases pole wards?

(You can use the space below to write your response.)

In 1792, another German botanist, Karl Willdenow (1765-1812), wrote a major synthesis of plant geography. He not only described the floristic provinces of Europe, but offered a novel explanation for their origin. Rather than one site of creation (or survival during the biblical deluge), Willdenow suggested that there were many sites of origination –mountains that in ancient times were separated by global seas. Each of these mountain refuges was inhabited by a distinct assemblage of locally created plants. As the Flood receded, these plants spread downward to form the floristic regions of the world.

? Who is generally viewed as the father of phytogeography?

(You can use the space below to write your response.)

Ironically, it is not Willdenow, but one of his student, Alexander von Humboldt (1769-1859) who is generally viewed as the father of phytogeography. Humboldt was able to advance the insights of his mentor and add many of his own from his experiences in the New world Tropics. He was a great naturalist, and was keenly aware that fundamental laws of nature could be discovered through the study of distribution.

After studying the works of Latreille on arthropods and Curvier on reptiles, Humboldt further generalized Buttons law to include plants as well as most terrestrial animals. Humboldt noted that the floristic zonation that Forster described along latitudinal gradients could also be observed at a more local scale along lavational gradients. Following conducting many floristic surveys in the Andes, Humboldt concluded that even within regions, plants were distributed in lavational zones, or floristic belts, ranging from equatorial tropical equivalent at low elevations to boreal and arctic equivalents at the summits.

Thus, Forster, Willdow and Humboldt all observed that plant assemblages were strongly associated with local climate. One of Humboldt's friends and colleagues, Swiss botanist Augustin P. de Candolle (1778-1841), added another fundamentally important insight.

Who was the first to write about competition and the struggle for existence?
(You can use the space below to write your response.)

Some of the key elements of ecological biogeography and modern ecology were established by the early 1800s. Moreover, in an essay published in 1820, Candolle appears to be the first to write about competition and the struggle for existence, a theme that would prove central to the development of evolutionary and ecological theory.

Activity 5

Answer the following questions.

1. Who observed that plant assemblages were strongly associated with local climate?

-
-
-
1. What was the theme central to the development of evolutionary and ecological theory?

1.4.2. Biogeography in the Nineteenth Century

By the early 1800s, the first three themes of biogeography were well established. Biogeography's were studying the distinctness of regional biotas, their origin and spread, and the factors responsible for differences in the numbers and kinds of species among local and regional biotas.

? How was it, for example, that isolated regions with nearly identical climates shared so few species?

(You can use the space below to write your response.)

Causal explanations would have to include factors accounting for the differences as well as the similarities among isolated regions. Explanations for Buffon's law would also have to account for the exceptions to it.

During the next century, the legacy of Buffon's work would be evidenced by a long and continuing succession of explanations for his law, which would lead from a view of a static earth populated by immutable, cosmopolitan species to one in which the earth, its climate, and its species were dynamic. This view would prove essential for classifying biogeography regions based on their biota and for reconstructing the origin, spread, and diversification of life. Other biogeography's of the nineteenth century would focus their energies on fundamental patterns of species richness.

? What do we mean by cosmopolitan species?

(You can use the space below to write your response.)

Cosmopolitan species are species that are not localized to a certain area. They are found in many areas of the earth's surface.

For the field to come of age, and to develop more rigorous, testable explanations for its fundamental patterns, it would have to await three important advances of the nineteenth century:

1. A better estimate of the age of the earth
2. A better understanding of the dynamic nature of the continents and oceans (i.e., continental drift and plate tectonics), and
3. A better understanding of the mechanisms involved in the spread and diversification of species—specifically, dispersal, vicariance, extinction and evolution.

To make these advances, biogeography had to draw on new discoveries in geology and paleontology. During the nineteenth century, Adolph Brongniart (1801-1876) and Charles Lyell (1797-1875, regarded as the fathers of paleontology and geology respectively, concluded that the earth's climate was highly changeable. Both men used the fossil record to infer conditions of past climates. They found that many life forms adapted to tropical climates once flourished in the now temperate regions of northern Europe.

Lyell documented that sea levels had changed, and that the earth's surface had been transformed by the lifting up and eroding down of mountains. This, he argued, was the only way to account for the existence of marine fossils on mountain summits. Lyell also provided incontrovertible evidence for the process of extinction. Many fossil forms, once dominant and presumably perfectly adapted to existing climatic conditions, had perished and left no further trace in the fossil record. The causal agent, again, was inferred to be climatic variation and associated changes in sea level.

? Who were the most prominent among the nineteenth-century naturalists?

(You can use space below to write your response.)

Perhaps most prominent among the nineteenth-century naturalists were four British scientists: Charles Darwin, Joseph Dalton Hooker, Philip Lustily Sclater, and Alfred Russel wallace. Although many others produced important works during this period, these four British scientists are responsible for major advances in biogeography and evolutionary biology. They all studied the works of Linnaeus/ Buffon, Forster, Condole, and Lyell. They shared similar experiences as naturalists and explorers, traveling to distant archipelagoes, high mountains, and tropical and temperate regions of the New and old Worlds.

The also shared a common goal: account for the diversity of life, including the origin, spread, and diversifying of biota's. The development of biogeography and evolutionary biology, or that they developed great mutual respect and lasting friendships. They reveal their shared preoccupation with what we now call biodiversity and their conviction that the key to understanding the natural world was to study pattern of distribution. Darwin referred to the study of geographic distribution as "that grand subject, that almost keystone of the laws of creation." The patterns of variability in the Galapagos Archipelago, where different forms of tortoises and finches inhabited different island, suggested to him the idea that geographic isolation facilitates inherited changes within and between populations.

? Where do you locate the Galapagos Archipelago?

(You can use the space below to write your response.)

It is difficult to overemphasize Darwin's contribution to the field of biogeography. He along with Wallace provided the basis for understanding changes in the adaptations and distribution of organisms across time as well as space. He proposed that the diversification and adaptation of biotas from natural selection, while the spread and eventual isolation disjunction of biotas resulted frame long-distance dispersal.

Darwin argued this latter point perhaps more passionately and more convincingly than anyone in the history of biogeography. His arguments were drawn not only from inferences based on the distributions of isolated biotas, but also on ingenious “experiments” on dispersal and colonization. Through these studies Darwin was able to show that seemingly unlikely events, such as dispersal of seeds embedded in mud clinging to the feet of birds, were the most likely means by which land plants had colonized oceanic islands.

Darwin’s arguments on dispersal threatened to over turn the long-held static view of biogeography. In the mid-nineteenth century, this older view was championed by Louis Agassiz (1807-1873) a Swiss-born naturalist. Agassiz argued that not only were species immutable and static, but so were their distributions, with each remaining at or near its site of creation. However, as a result of Darwin’s arguments, which were later bolstered by those of Asa Gray and Alfred Wallace, the static view was abandoned by most biogeography’s of the nineteenth century.

But the battles to be waged by the dispersalist camp had just begun. They were soon challenged by much more formidable adversaries – the “extension’s,” whose ranks were on less prestigious than those of the dispersalists, and included such respected scientists as Charles Lyell, Edward Forbes, and Joseph Hooker.

Both camps agreed that distributions were dynamic in time and space. The extension’s, however, argued that long-distance dispersal across great and persistent barriers was too unlikely to explain distributional dynamics and related phenomena such as cosmopolitan species and disjunct distribution. Rather they proposed that species that species had spread across great but now submerged land bridges and ancient continents.

Despite Darwin's persistent and passionate argument's the extension's camp would remain a viable and influential force throughout the latter decades of the nineteenth century. One of its greatest proponents was Joseph Dalton Hooker. He was a remarkably ambitious plant collector. During his expedition, Hooker studied the floras of many southern landmasses, including Australia, Tasmania, Tierra del fuego, and many archipelagoes in temperate and sub Antarctic waters. Hooker also traveled, to Africa, Syria, India, and North America, where he studied the Horn of the Rocky Mountain region with Asa Gray.

Hooker contended that, for the most part, long - distance was an insufficient explanation for the distributions of species. He argued that the biogeography patterns and peculiarities of the southern floras were not consistent with Darwin's dispersals hypothesis.

? Who was usually considered as the founder of causal historical biogeography?

(You can use the space below to write your response.)

During most of its early, biogeography was dominated by the contributions of botanists, from Linnaeus and Candolle to Forster and Hooker. It is no great mystery why zoogeography lagged behind phytogeography. There are many more animal species than plant species, and most animals are relatively small and difficult to collect and identify.

In addition to Darwin and Hooker, two other British zoologists made major contributions to biogeography: Philip Lutley Sclater and Alfred Russel Wallace. Sclater is an eminent ornithologist, who first described 1067 species, 135 genera, 2 families of birds. Wallace, who is considered the father of zoogeography, developed many of the basic concepts and tenets of the field combining the insights of others with his own experiences as a collector and his theory of evolution through natural selection. Many of the concepts

enunciated by Wallace were actually introduced by earlier scientists, but Wallace rested, documented, and interpreted them in evolutionary context.

Wallace collected innumerable specimens in the East Indies, and made many natural history observations on the biota of that region. He was the first person to analyze faunal regions based on the distributions of multiple of terrestrial animals.

Activity 6

Answer the following questions.

1. What were the three important advances of the nineteenth century?

2. What has replaced earlier catastrophic expiations for the changes in the earth, its landforms, and its inhabitants?

--

1.4.3. Other Contributions in the Nineteenth Century

Other scientists of the 19th Century were also looking for and interpreting important patterns in distributional data. Rather than considering only names and numbers of species, some of these pioneering biogeography's began to analyze geographic variation in the characteristics of individuals and populations. Chief among these early contributors were the generalized morph geographic rules of C.L. Gloger (1833), C. Bergmann (1847) and J.A.Allen (1878). Glover's rule holds that, within a species, individuals from more humid habitats tend to be darker in color than those from drier habitats.

? What do we mean by endothermic and exothermic species?

(You can the space below to write your response.)

Along this same line of reasoning, Allen's rule states that among endothermic species, limbs and other extremities are shorter and more compact in individuals living in colder climates. Birds and mammals of polar Regions tend to be stout with short limbs.

A similar phenomenon was reported by D.S. Jordan in 1891 for exothermic (cold-blooded) tallest fishes inhabiting marine environments. According to Jordan's law of vertebrae, as one moves farther from the equator, the vertebrae of tallest fishes become smaller and more numerous.

In addition to studying geographic variation in the traits of individuals, biogeography's noted that the demographic characteristics of populations also varied across regions. In 1859, Darwin observed that within most genera, species, which range widely over the world, are the most diffused in their own country, and are most numerous in individuals.

In other words, wide-ranging species tend to occur at relatively high densities. This pattern, while not a major emphasis of early biogeography, was rediscovered and documented for a variety of taxa during the twentieth century. The study of how population-level parameters vary along geographic dimensions is now a central focus of an emerging discipline in biogeography termed as macro ecology.

? What is the theory of orthogenesis?

(You can use the space below to write your response.)

Some early evolutionary "rules" were described by paleontologists who searching for patterns in the history of life and trying to interpret the fossil record. The theory of orthogenesis is example. This theory states that the evolution of a group continues in only one direction and that this orientation is an intrinsic property of the organism and is not controlled by natural selection.

A special type of orthogenesis was Cope's rule, which states that the evolution of a group shows a trend toward increased body size. Although there are many exceptions to this rule, it does seem that certain advantages of large size have resulted in repeated increases in size in many animal lineages. Large body size, however, seems to make species susceptible to extinction, so that large forms (such as the dinosaurs and many now extinct groups of giant birds and mammals) die out and is replaced by large representatives of new groups, which in turn evolve to a larger size.

? What are life zones?

(You can use the space below to write your response.)

Early botanists such as Cade and Humboldt were well aware that different types of vegetation occurred at different elevations, but a zoologist, C. Hart Merriam (1894), provided one of the most valuable insights into these broad patterns. Based on his extensive field studies in southwestern North America, Merriam confirmed that latitudinal changes in vegetation type and plant species composition are generally equivalent to the latitudinal vegetation changes found as one moves toward the poles. He called these belts of similar vegetation life zones.

Although Merriam was not successful in generalizing his concept of life zones to animals and to other region of North America, he correctly concluded that latitudinal zonation of vegetation, like latitudinal zonation, is a response of species and communities environmental gradients of temperature and rainfall.

Activity 7

Answer the following questions.

1. What does the Allen's rule postulates?
2. What is difference between Gloger rule and Bergmann's rule?

3. What is the central theme in Jordan's law of vertebrae?

1.4.4. The First Half of the Twentieth Century

From 1900 through the early 1960, several major trends in research had extraordinary effects on biogeography. Paleontology in particular deserves credit for providing new and fascinating descriptions of faunal changes on each continent.

Numerous paleontologists (C. Ameghino, W.D. Matthew, G.G. Simpson, E.H. Colbert, A.S. Romer, E.C. Olson, and B. Kurten), described the origin, dispersal, radiation, and decline of land vertebrates. They showed that new groups increase in number of species, radiate to fill new ecological roles, expand their geographic ranges, and become dominant over and contribute to the extinction of older forms. Thus, our present-day continental faunas have extremely long and complex histories that can be understood only by elucidating the phylogenies of the groups involved that can be understood only by elucidating the phylogenies of the groups involved and the history of their movements between landmasses.

Early in the twentieth century, researchers began to investigate patterns of variation within single species. Following the lead of Bergmann and Allen on chorographic patterns, Joseph Grinnell, Lee R. Dice, and B. Rensch demonstrated close relationship between geographic and ecological properties of the environment and patterns of morphological variation within and among species.

By early 1940s, evolutionary biologists were building on Darwin's syntheses to investigate patterns of geographic variation and to infer the mechanisms responsible for the origin of new species. A long list of scientists contributed to our understanding of the modes of speciation.

? What was the major contribution of Ernst Mayr in the fields of systematic, evolution, and historical biogeography?

(You can use the space below to write your response.)

Ernst Mayr made major contributions in the fields of systematic, evolution and historical biogeography. Out of this work arose one unifying theme, the biological species concept, which states that a species is definable as a group of populations that is reproductively isolated from all other such groups. Moreover, Mayr's studies of patterns in the known as allopatric speciation enabled an important new synthesis in evolutionary biology and biogeography.

By the middle of the twentieth century, many authors had produced new and more general syntheses of biogeography patterns for various taxa. These included studies focusing on: vertebrates by Phillip, marine zoogeography, vascular plants, plants, and island biogeography.

1.4.5. Biogeography since the 1950s

Four major developments have revitalized biogeography in the last 40 Years. These are:

- The acceptance of plate tectonics,
- The development of new phylogenetic methods.
- New ways of conducting research in ecological biogeography, and
- Investigations of the mechanisms that limit distributions.

Up to the 1960s the emphasis in biogeography had been primarily an evolutionary and historical one, emphasizing the phylogenies of groups and their means of dispersing in to and surviving in different regions and habitats. By the late 1950s, G.E. Hutchinson began to focus attention on questions about the processes that determine the diversity of life and the number of species that coexist in local areas or habitats. Ecologists began to emphasize the importance of competition, predation, and mutualism in influencing the distributions of species and their coexistence as ecological communities

Activity 8

Answer the following questions.

1. What deserves credit for providing new and fascinating descriptions of faunal changes on each continent?

2. State the four major developments that have revitalized biogeography in the last four decades?

Check List

Dear learner: Here is a checklist provided for you. Please put a tick (✓) mark in the boxes against the activity which you can perform well. If you find an activity you could not perform, please go back and read the relevant section until you can perform.

I can:

- | | |
|---|--------------------------|
| 1. Define the term biogeography. | ☐ |
| 2. Explain the scope of biogeography. | ☐ |
| 3. State the three fundamental processes in biogeography. | ☐ |
| 4. Identify the persistent themes in biogeography | ☐ |
| 5. Distinguish the subfields of biogeography. | ☐ |
| 6. Define pedology, phytogeography and zoogeography | ☐ |

- 7.. Explain the development of biogeography ☐

8. Define cosmopolitan species ☐

9. Distinguish between Gloger's, Bergmann's and Allen's rule. ☐

10. Explain the principle of uniformitarianism ☐

11. Appreciate the contribution of early European explorers and naturalists. ☐

12. Explain the major advances in the field of biogeography. ☐

13. .Trace the distinguished fathers of biogeography. ☐

14. Describe the fundamental distinction in Gloger's and Allen's rule.

Summary

It must be clear from the foregoing discussion that biogeography is an open and multidisciplinary in nature. The concept is defined in different ways by different authors, although all revolve around the distribution of life as a focal point.

Biogeography is the study of the distribution of plants and animals over the surface of the Earth in both spatial and temporal contexts. It is a synthetic science, bringing in aspects of many other types of science. The discipline is important because administrators, politicians, policy-makers, and consulting firms are looking more and more to scientists who study the Earth, its environs and its organisms, to have better manage the future to ensure its well-being.

The history of biogeography is long, dating old to Linnaeus (1700s, Swedish) and Darwin and Wallace (1800,s, British), when people started exploring the world and noting how species were distributed.

Many great scientists have contributed to the development of biogeography. All of them have shared a common goal-understanding the origin, spread and diversification of biotas. In the mid-1700s Button gave biogeography its first principle, while others tested its generality and broadened the field to explore a diversity of other patterns and their causal forces.

As the field progressed theories of natural selection, continental drift, and immigration/extinction dynamics provided new mechanisms to explain long-standing patterns, while new comparative and experimental methods, phylogenetic, and advances in computer science and statistics provided invaluable tools.

By the 1960s, biogeography had finally come of age as a rigorous and respected science. It has continued to build on those gains and flourish in subsequent decades. Given this long list of biogeography's conceptual achievement a, themselves the seeds of whole disciplines one can easily comprehend how it has become impossible for one person to understand and follow completely all aspects of the field.

Self-check Exercises 1

PART I - MATCHING ITEM

Direction: Match the major soil groups listed under column "B" with the items stated under column "A"

Column "A"	Column "B"
----- 1. Stations	A. father of causal historical biogeography
-----2. Alexander Von Humboldt	B. assemblage of species of different ecosystems
-----3. Joseph Dalton Hooker	C. local habitats

-----4. Vascular Plants
bodies

D. Plants that have vessels in their

-----5. Populations

E. large groups of individuals

F. plant species of humid areas

G. father of phytogeography

H. biotic provinces

PART II MULTIPLE CHOICE ITEM

Direction: Choose the best answer and write the letter of your choice on the space provided against each question.

1. ----- A biogeography may specialize and become a:-
 - a) Phytogeographer, studying plants
 - b) Zoogeographer, studying animals
 - c) Ecological geographer, studying the present distributions of plants and animals in relation to their physical environment
 - d) Historical biogeography, attempting to reconstruct the origin, dispersal and extinction of taxa and biotas
 - e) All can be possible answers
2. ----- Which one of the following statement is correct?
 - a) Man can be left out of the biological reckoning, for he is the most significant agent or factor in the situation.
 - b) Biogeography is the study of distribution of organisms, both past and present, and of related patterns of variation over the earth in the members.
 - c) Biogeography is therefore an experimental science.

d) All of the above

e) None of the above

3 -----The movement of organisms away from their point of origin is said to be:-

a). Evolution b). Dispersal c). Extinction d). Commuting d). Transhumance

4. ----- Which branch of biogeography considers the influence of continental drift, global climatic change, and other large-scale environmental factors on the long - term evolution of life?

a). Historical biogeography b). Ecological biogeography
c). Evolutionary Biogeography d). Analytical biography e). A and C

5. -----Which aspect/s of soil is/are addressed by pedology?

- a) Their physical and chemical properties
- b) The role of organisms in soil production and in relation to soil character,
- c) The description and mapping of soil units,
- d) The origin and formation of soils
- e) All aspects of soil can be studied by the discipline.

6. ----- One of the following personalities is considered as a distinguished father of biogeography.

- a) Lamarck b) Darwin C). Wallace D). A and C
- D. All

7 ----- Which one of the following statement is not correct?

- a). Buffon noted that insular communities had fewer plant species than those on the mainland
- b). Foster noted that the tendency for plant diversity to decrease from the equator to the poles

c). Willdenow is generally viewed as the father of phytogeography

d). Foster and Humboldt observed that plant assemblages were strongly

associated with local climate e). None of the above

8 ----- who was the first to write about competition and the struggle for existence?

- a) Charles Darwin b). Alexander Von Humboldt
c). P. de Candolle d). Sir Joseph Banks
e). Captain James Cook

9----- The fathers of pale botany and geology, were respectively:

- a. Latreille and Curvier b) Comte de Buffon and Linnaeus
b. Adolphe Brongnait and Charles Lyell
c. Joseph Dalton Hooker and philp Lutley Scatler
d. Alfred Russel Wallace and Louis Agassiz

10----- Who was the first person to analyze faunal regions based on the

- distribution of multiple groups of terrestrial animals?
a) Philp Lutley Scatler b) Joseph Dalton Hooker
c) Alfred Russel Wallace d) Sir Joseph Banks
e) Charles Lyell

PART III- TRUE OR FALSE ITEM

Direction: Write a true if the statement is correct and False if it is incorrect.

1. ----- No single species is able to live in all places.

2. ----- Biogeography is the study of the distribution of plants animals over the surface of the Earth in both a spatial and temporal context.
3. ----- The goal of a Biogeography, as for all scientists, is to eventually provide rules and scientific laws, arising from proven theories that can account for such patterns in distributions over space and time.
4. ----- Evolutionary biogeography investigates current patterns of distribution through empirical examination.
5. ----- Evolution, extinction, and dispersal are the three persistent themes in biogeography.
6. ----- The presence of similar organisms in spatially separate locations may be a consequence of past or present geographical factors.
7. ----- Ecological biogeography addresses the origin, dispersal, and extinction of taxa extending beyond the period of direct empirical evidence.
8. ----- Biogeography is an experimental science.
9. ----- Biogeography, defined in its wider sense, is the study of the origin, distribution, adaptation and association of plants and animals.
10. ----- The theory of orthogenesis states that the evolution of a group continues in multidirectional way and is controlled by natural selection.
11. ----- The scope of biogeography is not clearly defined.
12. ----- One possible explanation for the existence of similar species today in locations far away from each other is that their ancestors once occurred very near each other when the continents were arranged differently.

13. ----- The biological species concept states that a species is definable as a group of populations that reproductively isolated from all other such group.
14. ----- Hart Merriam was successful in generalization of his concept of zones to animals and to other regions of North America.

PART IV - FILL IN THE BLANKS ITEM

Direction: Complete each statement below with the appropriate word or phrase.

- A. -----argued that long-term dispersal across great and persistent barriers was
unlikely to explain distributional dynamics
- B. ----- Who contended that, for most part, long distance dispersal was
insufficient explanation for the distribution of species.
- C. ----- Postulates that within a species, individuals from more humid habitats to
be darker color than those from drier parts.
- D. The study of how population-level parameters vary along geographic dimension is now the centurial focus of an emerging discipline in biogeography termed as -----
- E. What are the principal processes in biogeography?

UNIT 2

THE BIOSPHERE: THE WORLD OF LIVING THINGS

INTRODUCTION

★ Dear learner! In this Unit you will learn about the biosphere. There are two sections of this unit. In all those section there are well organized interrelationships. In the first Section, the biosphere and its nature are explained; Section two will treat man and the landscape.

Objectives:

After reading and studying this Unit, you will be able to

- Define biosphere;
- Examine the nature of the biosphere;
- Describe the biosphere cycles; and
- Analyze man and the landscape relationships;

2.1. The Biosphere and its Nature

The geography, when conceding himself with the purely physical aspects of the Earth, frequently refers to the various envelopes or “spheres” the lithosphere, the hydrosphere and the atmosphere which make up terrestrial environment of our planet. To these solid liquid and gaseous inorganic realms the geography who is concerned with the total environment, must add a further realm the sphere of life which is a distinctive component of the environment since it is organic. This further realm is known as the biosphere. It is the realm of living things, of plants and animals, microbes and man,

2.1.1. Definition of the Biosphere

? What is the biosphere?

(You can use the space below to write your response.)

The term “biosphere” has been variously defined. However, the following are commonly used definitions of biosphere

- The totality of living things on the Earth;
- The sphere of living organisms penetrating the lithosphere, hydrosphere and atmosphere.
- The living matter on the surface of the Earth
- The surface zone of the Earth and its adjacent atmosphere in which organic life exists.

These definitions have two points in common: a reference to living thing and the earth’s surface. Hence using these under-planning criteria, we might

devise a satisfactory working delimitations follows; the biosphere is the web of life that lives within and depend u p on the inorganic spheres.

The biosphere organic world is that biologically active part of the earth at the interface between the atmosphere the lithosphere and the hydrosphere. It is relatively shallow zone which extends at its maximum a few hundreds of maters above the land surface and below the oceans, and less than a meter

Despite its limited extent the biosphere is densely populated teeming with myriad forms of life of infinite variety and complexity. They range from plants and animals of microscopic size and simple one-celled structures to those of large size and complex morphology. A comparative estimate might put the total number of known species of plants at about 500,000, of animals at 1 million. The most obvious components of the biosphere the large terrestrial plant and animals represent a very small proportion of the total biotic population. Very high proportions are of microscopic size and live in the soil or in water.

It has, for instance, been estimated that there may be up to 100,000 algae 16 million moulds and other fungi and several million bacteria in 1 gram of rich topsoil and that the average number of micro-organisms living under an area of tropical forest in panama is about 100,000 million.

2.1.2. Components of the Biosphere

The biosphere includes three main components:

- A. **The living matter**, totality of organisms determined quantitatively by the biomass:

B. **Biogenic matter**, i.e. organic minerals and organic product created by living matter. They include coal, bitumen, combustible gases, probably petroleum and in particular, peat sapropel, and soil hums and litter.

C. **Biocosmic matter**, a term used to designate the mineral materials formed by the association of living organisms and dead nature, as for example, the gas composition at lower layers of the atmosphere, sedimentary rocks, clay minerals and water.

Clearly, such a definition is more penetration and purposive, and if one accepts the biogenic chemical functions of living things. This definition provides a basis for considering the biosphere of the Earth as an ancient, extremely complex, multiple, self controlling systems of living matter and dead substance, which accumulates and redistributes immense resource of energy and determines the composition and dynamics of the Earth's crust, atmosphere and hydrosphere. For the purposes of this introductory study, however, we shall think of the biosphere simply as world of living things.

? What are the two features of the biosphere?

(You can use the space below to write your response.)

Two features of the biosphere may be emphasized at the outset. The first is the extraordinary diversity of living organisms. Life forms, beginning perhaps in the oceans some 2, 000 million Years ago and appearing on the land about half a billion years ago, have in the course of their evolution led to the development of some 3 million species of plants, and micro-organisms.

The second biosphere feature is the irregular and systematic pattern of the distribution of life organisms, both quantitatively and in terms at tier variety, differ widely on the Earth's surface (both latitude in order) and tend to form a mosaic pattern each init of which is likely to show markedly differentiating plant and animal forms. This mosaic pattern occurs not only globally, forests here and grasslands there, but each formation itself displays a mosaic pattern

consisting of different associations appellants resulting from local variations in climate, relief, aspect , soils, drainage, etc.

As a concept the biosphere is perhaps, less familiar than the other spheres but it is not less important, Moreover, if we think not only of the presence of living organisms but at the influence they exert biogenically, then the biosphere is of fundamental importance with out it the earth would be a sterile planet and human life and human activities would not exist.

? Why we study the biosphere at all?

(You can use the space below to write your response.)

The biosphere, though only a thin film of life, is of tremendous significance geographically. It is a component of the natural environment equally as important as terrain, water and climate. Although the biosphere is dependent upon land, air and water the terrestrial landscape owes much to the dynamic character of the biosphere. In fact, when we talk about landscape we immediately registers it self. Almost every landscape shows the interaction of soil, vegetation, animal life and man, a dynamic interaction which for good or bad has tremendous consequence.

Activity 9

Answer the following Questions

1. What are the most obvious components of the biosphere?
2. Briefly explain the three main components of the biosphere?

2.1.3. The Limits and Compositions of the Biosphere

? What are the limits and compositions of the biosphere?

(You can use the space below to write your response.)

Having clarified the meaning of the term biosphere and indicated its significance; it will be useful at this point to emphasize true things appertaining to it – its limits and its composition.

The biosphere is a mere $\frac{1}{550}$ th of the thickness of the Earth measured from the tenuous outer edge of the atmosphere to its center. This gives the biosphere a thickness at around 15 miles (24km). Such a figure may be said to represent its maximum thickness. But for all practical purposes it is much more strictly confined, although wild geese Birds normally fly in the air up to heights of a few hundred feet and Fungal spores have been collected at height about 7 miles (11 km). While birds and insects may soar into the air several thousand feet, they must inevitably descend again to the Earth's surface. Some forms of life live mainly in the atmosphere. Such forms are fundamentally land – based. Hence, the biosphere net may be said to extend vertically only as high as the tops at the tallest trees approximately 330 feet (105m).

Life, though capable of penetrating the atmosphere, the hydrosphere and the lithosphere, very quickly comes up against conditions which are beyond its tolerance. Upward lack of oxygen, shortage of moisture, increasing cold and decreasing pressure soon put a limit to life in the air

? What factors limit the presence of life as one goes down ward from the surface of the earth?

(You can use the space below to write your response.)

Downward lack of oxygen and light and probably increasing pressure place a limit on life at shallow depths in the soil and at relatively shallow depths for most forms of marine life.

On land, though man himself mines at depths of several thousand feet, animals do not penetrate very deeply. Burrowing creatures such as earthworms may reach several feet into the soil and so on land the biosphere

proper may be said to extend downwards on as far as the deepest penetrating trees.

Postgate has stated, however, that oil prospectors have obtained microbes from rock cores drilled at depths of 1200 feet (365m). Recently, and unexpectedly, some forms of life have been detected in the deep ocean trenches at around 6 miles (10 kms) below the surface but marine life seldom, it would seem, is present in quantity at depths much greater than 1 mile (1.6 km) and it is most confined to the upper 500 feet (150m) of the sea. Thus, to all intents and purposes, the biosphere is confined within a very narrow zone a mere film - on the surface of the earth.

Although one can distinguish approximately vertical limits, the biosphere possesses no clearly defined boundaries like the hydrosphere, it is interpenetrating. Not merely do plants grow in the soil and use the chemicals therein but they need air and water. Similarly, animals including man require plants for food in addition to air and water. Again while many forms of life are terrestrial, some live in water, e.g. fish, corals, seaweed; some use the air, e.g. birds, insects, microorganisms and some live undergrounds e.g. moles, bacteria.

The biosphere is thus a link between the other spheres of the earth. This link, however, is even closer than one at first suspects, for biological activity plays an important role in affecting the other spheres. For instance, plants and animals contribute to the physical and chemical weathering of rocks; some plants and animals have been responsible for the formation, while vegetation may affect local atmospheric conditions. In these and other ways the biosphere is intimately related to the realms of air, land and water.

? What are principal elements of the biosphere?

(You can use the space below to write your response.)

The biosphere may be said to comprise four principal elements: plants, animals, man and micro-organisms. Man, of course, is merely an animal but he is an intelligent animal with powers of forethought and reason and geographical ubiquity, and so stands apart.

Some include the top soil as part of the biosphere it is very much a living, dynamic zone which owes a great deal to, and it is significantly influenced by, the other biological elements. In fact, between them all there is the closest association and a high degree of interdependence. It is obvious that man sustains himself by using plants and animals as food.

? What type of interaction does exist between these elements?

(You can use the space below to write your response.)

All animals whether directly or indirectly, depend upon plants. Bacteria and microorganisms affect man, animals and plants. Plants often depend upon insects for their fertilization. And all influence soil, which would remain in inert mass of mineral particles were it for the organic matter provided by living organisms. Hence, there is a virtually inextricable relationship and indispensable interaction between the various elements of the biosphere.

2.1.4. Living and Non-living Matter

We have described the biosphere as realm of living things and it will be advantageous and pertinent to indicate the characteristics which define living organisms. It might be thought that such characteristics as mobility, growth, change of form and response to stimuli clearly differentiate animate from inanimate matter, but the distinction between living and dead matter is less clear and less simple than it appears to be.

? What is the distinctive characteristic of living matter?

(You can use the space below to write your response.)

Perhaps the most obvious characteristic of living is capability of movement physical movement or locomotion is a feature of most animals, but, in this sense, plants are immobile. The ability to move in plants is mostly, though not entirely, restricted to growth movements, but these are imperceptible to the eye. The inanimate world however, can show movement, as an absolute and simple criterion movement as a distinguishing feature of animate life must be eliminated. Another clearly recognizable feature of living is physical growth, but if growth merely means increase in material involving increase in size then the ability to grow can not in itself be accepted as a sufficient criterion. This is mainly because mineral crystals, obviously inanimate, grow when placed in supersaturated solution, stalactites and stalagmites grow, and volcanoes may grow, and even the Earth as a whole. Growth however, usually implies increase in complexity as well as mere expansion or increase in size and if judged on this then growth is a distinguishing feature of animate life.

Living organism does also possess a distinctive differentiating feature which is not applicable to inanimate matter, as for instance in the case of crystal growth mentioned, above which proceeds simply by the addition of similar chemical material to the exterior. This is the ability to assimilate chemical substances and, convert them into protoplasm. In other words, a plant or animal builds up its own living material by absorbing and incorporating matter which is quite unlike itself -i.e. living things feed.

Plant, though they have no sense organs as animals have, exhibit a response to stimuli such as light, moisture of warmth, turning slowly towards them, while some are affected by touch. Such response of animate things to stimuli would seem to point to a valid distinction between animate and inanimate matter. The crucial point here is that a non-living thing reacts only through

the agency of external forces, the reaction does not come from within itself as in the case of a living organism.

We seem to be on much safer ground with the reproductive capacity of plants and animals. Organic growth, unlike inorganic growth as in the case of crystals, is not indefinite but rather appears to be directed towards a specific end. When an organism reaches maturity, it reproduces and gives rise to an offspring which though smaller, bears distinct points of resemblance to the parent . Even so, every living organism possesses quite distinctive individual characteristics, which give uniqueness to it. Non-living matter shows no such individual uniqueness.

Again living things possess an organization of complex organs each of which does a specific task contributing to the main function of, and benefiting, the whole organism. Such an organization of functional units is not present in non-living matter, each inorganic particle of matter is capable of existing alone, unsupported by any other particle.

Finally the distinction between living and dead matter is most noticeably evident in the phenomenon of death, which marks a sharp cessation of all the activities we most commonly associate with living things. Inanimate things may disintegrate and break up but they do not die.

It will be evident from what has been said that the distinction between living and non-living matter is not as clear-cut nor as precise as, we have been wont to believe, but the above consideration convince us of the differences between living and non-living things and it can be agreed that plants, animals, micro-organisms and man constitute the animate world.

Activity 10

2.2. The Fundamental Characteristics of Animate Life

Many of the characteristics which distinguish animate from inanimate matter, are shared in common by animals and plants and we might usefully consider, a little more fully, fundamental characteristics. All living things, as we have indicated above, grow and develop or, to express this in a slightly different way increase in size or volume and undergo structural alterations. This they do by taking in substances which chemically are very different from the living substance of which they are constituted and using them for the synthesis of various compounds or breaking them down for the liberation of energy. It is this ability already referred to, to build up its own living substance by taking in something not composed of that substance which basically separates and distinguishes living from non-living matter.

? What is metabolism?

(you can use the space below to write your response.)

The substances which are taken in by plants and animals undergo different changes some parts of them are used, others discarded but in this highly complex process of assimilation and change animate matter procures the materials necessary for building up its own tissues on the one hand derives the energy required for its growth and development on the other. The term metabolism has been given to this complex activities which is characteristic of living only of living organisms.

Metabolism, which embraces all the chemical changes taking place within living organisms, involves two processes-catabolism (destructive activities) and anabolism (synthetic activities)

In catabolic processes an organism breaks down substances or compounds which it can use. In anabolic processes the organism synthesizes substances to build up the material constituting the organism.

Both processes, it will be readily understood, are necessary. Anabolism is so important to build up body substance which is needed in growth in the repair of damaged tissues, in reproduction or in the replenishment of substances lost

in catabolism on other hand is important to provide the energy which is required in the growth, development and movement of the organism.

Respiration is the most important of the katabolic processes. It is an activity common to both plants and animals and is basically the same in both. Respiration involves the taking in of oxygen from the air, the water and the soil which is used in the oxidation of substances to supply. A ready supply of oxygen is necessary for the process of respiration but this is freely abundant at the surface of the Earth. Only at high altitudes and at great depths does the supply begin to run out, but where it deign to run out it has drastic biotical repercussion.

With the exception of some kinds of bacteria, no forms of life are able to live for very long without oxygen and man dies very quickly if deprived of it.

What is nutrition?

You can use the space below to write your response.)

Nutrition, the most important of the anabolic processes, is the process whereby whereby the organism assimilates or absorbs into its system substances which it converts into paganisms ,i.e . its own body substance. Protoplasm. The living substance of all organisms, whether plant or animal, contains, and is built up from, water and such elements as carbon, oxygen, nitrogen, iron, sulfur calcium, phosphorus, etc: these elements are in very unstable combination and constant changes take place in the living substance.

Whereas, the process of respiration is fundamentally similar in both plants and animals, the nutritional process differs completely between plants and animals, this difference, in fact, serves as a basis for separating the two groups.

Green plants synthesize proteins, sugars, cellulose, and carbohydrates of complex chemical composition, from water, carbon dioxide and mineral salts, substances which are freely available in the environment. They synthesize these materials by the process of photosynthesis, the building up of organic compounds in the presence of sunlight which supplies the energy for the necessary chemical reaction; chlorophyll, the green pigment in the leaves of plants, is the active agent in the process.

Animals differ from plants nutritionally in a quite fundamental way: unlike plants they cannot synthesize from such simple materials: they have to use the products of plant anabolism which they digest and distribute and re-synthesize in different parts of their bodies. The following table summarizes the similarities and different parts of their bodies. The following table summarizes the similarities and difference between plants and animals.

2.3. The Biosphere Cycles

All life on the earth is, fundamentally, energized by the sun, but all life needs water, and all life requires oxygen and a variety of other elements. The sun, in the form of the solar rays emits, provides the energy source on which all terrestrial life depends. The energy bequeathed by solar radiation basically motives the biosphere since it makes photosynthesis possible. The photosynthetic process, which is, in turn, engineered by the chlorophyll present in all green plants, results in the reduction of carbon dioxide, present in the atmosphere, to produce organic compounds and molecular oxygen. The simple fact that all plants, animals and human being grow, move and reproduce depends upon this energy.

The solar energy which is absorbed by the earth varies zonally and regionally according to altitude and particular physical conditions; but this energy becomes more evenly distributed over the face of the earth through the circulatory system of the air and the oceans.

Too much ultraviolet radiation is damaging the organic life, but, fortunately; the atmospheric envelope acts as a protective shield against excessive ultraviolet absorption

It will be valued that any changes in the reflective or absorptive capacity of the atmosphere or the earth's surface will result in climatic changes which in turn, would be likely to affect plant and animal life on earth.

While life maintained by the flow and transference of energy living matter needs water for its origin and sustenance. The fact that the plant Mare in all portability supports no life is due as much to its lack of water as to anything else. That life on Earth began in the oceans, as it is generally believed, is readily understandable when it is appreciated that water is once the medium of the life processes and the source of their hydrogen.

Water plays a vital role in all life processes. First, is the medium through which which many nutrients are made available to plants solids and gases have to be dissolved before they can be taken in by plants. Second, not only do most chemical reactions in animate life happen only when substances are in solution but sometimes the water itself enters into the the chemical reactions. Third the hydrogen, which is necessary for the formation of arbitrates, e.g. sugars, starch and cellulose, is derived from water. Thus, in a word, water is physiological prerequisite for protoplasm.

Furthermore water plays a highly significant role, especially as a limiting factor, in the physical environment in which organisms live, for rainfall, humidity, the rate of evaporation and the availability of surface water-supplies determine the rate and extent of growth and chances of survival. Although the amount of water required by organisms varies widely, all need some water and must have a fairly continual supply of it, if water is denied them, organisms become inactive, cease to grow, desiccate or die. The third great cycle relates to the chemical elements. Actually, this involves a whole series of

individual cycles, e.g., the nitrogen cycle, the carbon cycle, the phosphorus cycle, etc. Plants needs of oxygen and carbon dioxide are most easily obtained from the air but most of the other elements required are derived from the soil solution. Plants require nitrogen and, although it is present in the air, it cannot be used directly, certain other forms of life must fix the nitrogen before plants can use also have appreciable supplies of six other elements, viz. nitrogen, phosphorus, potassium, calcium, magnesium and sulfur. All these commonly occur in combination with other elements, forming mineral salts.

Since water is the almost universal solvent, these salts can be supplied to plants in solution. Such dissolved salts which are vital to life are known as biogenic salts. The above nine elements which we have noted are termed the macronutrients by virtue of the fact they or their compounds are needed in relatively large quantities. But other element may often play key roles and of the one hundred or so elements about one-third are known to be of significance; the chief ones are iron, manganese, cobalt, copper, zinc, sodium, boron, molybdenum and chlorine, but others are also sometimes used for special functions: e.g. grasses use silicon for stiffening purposes. These elements, which are required in only very small amounts or traces, are known as micronutrients.

Although we have been discussing plant needs, the same applies to animals. They require nutrient (which they obtain in the form of food) and these perform the same function for animals for plants. However, it should be noted that animals have some needs that are rather different from those of plants: e.g. some creatures need larger amounts of iron in their blood or calcium for their skeletal structures. The processes by which these various materials—water and nutrient salts—circulate within the biosphere are termed the biogeochemical cycles. These cyclical **12** mechanisms are fundamental to the operation of the biosphere.

2.4. Man and the Landscape

Dear learner! In this section, you will study man and landscape relationships. The section also illustrates the impact of man on the landscape.

2.4.1. Man - The Highest Animal

Biologically man is merely an animal, albeit the highest of the animals. Like other animals he has the same physical needs i.e. those of oxygen, water and food and these basic physical requirements bind him firmly to his environment. If he attempts to leave his land base for any length of time he must take some or, all of his basic needs with him.

The numbers and distributions of people on planet earth any given area are strongly influenced by, and sometimes determined by the occurrence of fresh-water supplies, fertile to yield food crops and pastures for the animals he rears.

But man differs from the other animals in possessing a developed brain which makes him an intelligent creature with powers of reason and forethought. By using his intelligence man has been able to adapt himself to habitats of extremely varied climatic, topographic and biogeography conditions. Such adjustments have been possible through his technological development in relation to fire, clothes, implement and food supply. At first sight it would appear that man, because of his geographical ubiquity is the only creator capable of standing aloof from the interaction of living things. Nevertheless, and notwithstanding his remarkable adaptability and accomplishments, he is tied, as are other creatures, to his remarkable adaptability and accomplishments, he is tied, as are other creatures, to his ecological home, for

he needs air, water and food, all of which he must find or take with him if he leaves his home base.

Man was a late arrival in the natural scheme of things. Modern man or Homo sapiens began to emerge about 100,000 year ago, but for much the greater part of this time his numbers were small and he lived largely on the sufferance of nature. Until about 10,000 years ago his impact upon nature was almost nil since then his influence has grown with ever increasing and accelerating effect.

2.4.2. Nature minus Man

Before man appeared on the scene, and indeed for a long time afterwards, any changes that took place on the Earth's surface were the out come of the operation of the blind forces of nature,

In the biotic complex a "natural balance" no doubt emerged, but this was never static because.

- Climatic change occurred from time to time which had repercussions not only up on plants and animals life but also upon the topography and soils of the land surface, and
- Biological evolution produced new species of plant and animal life which often created radical changes in the composition and character of the biotic complex.

It may be stated a general principle that any change affecting any single element in the biotic complex will have repercussions throughout the entire ecological system. The equilibrium, which we are prone to believe, existed in nature before the intervention of man was seldom, if ever, achieved, for long-term changes and short-term -of vicissitudes climate, the ravages of fire and flood, as well as the appearance of aggressive species of plants and animals, continually upset the natural balance. However, it is probably true to say that

such changes as took place were, generally speaking, slow and in the nature of adjustments to gradually changing conditions. The landscape which evolved was essentially a natural landscape, and nature was wild, undisciplined red in tooth and claw.

2.4.3. The Impact of Man

Into this natural landscape, the product of physical and biological conditions and processes, man intruded. At first, and indeed for tens of thousands of years, he made little impression. He was largely child of nature, living off its bounty, and scarcely more significant than any other member of the animal family. Hence his influence upon, and modification, his environment was probably no greater than that exerted by most other species of animal. However, as man increased in numbers developed his intellectual powers and accumulated his technological skill, his ability to modify the environment gradually increased.

The discovery of the art of crop cultivation was one of a number of development, which ushered in the Neolithic Revolution somewhere about seven or eight or eight thousand years ago. This development was fraught with tremendous convince for the first time it brought him an assured supply of food, permitted him to live errantly in one place and allowed large groups of people to live together. Cultivation implied the destruction of the natural vegetation and its replacement by selected species of plants. Tillage of the soil by spade or hoe or plough led to changes in the soil structure and character.

Roughly contemporaneously with man's discovery of cortication was his domestication of certain animals. This development of a pastoral economy led to an interference with the natural pastures, which in turn helped to change the soil of those grassland areas. Furthermore, in addition to the need of land for tillage, settled life brought a demand for timber for constructional purposes. This led to the felling of trees and the beginning of woodland - clearance. As the centuries became history so was the landscape gradually transformed over large areas.

In more recent times, with the agrarian and industrial revolutions and man's techno-scientific expertise, landscape changes have become greater and have become accelerated. Man, flushed with the power at his disposal and greedy for material gain, has wreaked havoc over large areas, destroying the animal life, clearing forest growth, ransacking the soil depleting fisheries, scarring the land with his quarries and spoil heap building his own peculiar stone, brick and concrete jungles. The interference with the natural landscape insidiously goes on: drainage, reclamation and irrigation, the use of fertilizers, insecticides and fungicides, the web of roads, pipelines and cables, the pollution of the air and surface waters are all contributing to the drastic transformation of the landscape and, what is more important, to the danger of a lack of balance in nature.

2.4. 4. Man-made Lakes: An Example of Human Intervention

Not every human intervention in the natural scheme of things is always or necessarily bad: changes are inevitable, for the world is not and cannot remain static. The point is not and cannot remain static. The point is that we now have sufficient knowledge to avoid making tragic mistakes. Before man undertakes any large-scale intervention in his environment there ought to be the most careful of the possible effects which are likely to result from that intervention and, the situation it, detailed investigation and research.

The creation of man-made lakes provides a good example of man's intervention in nature upon a large scale. Such lakes bring obvious benefits to man in addition to creating problems. E.B. Worthington has indicated the effects, which, these lakes have had on man and his environment and the chain-reactions, which occur when man interferes with nature on such a substantial scale. The main influences relate to climate, water supply fisheries forests agriculture transport human health and amenity. Large natural lakes, such as Lake Victoria, create their own local climates with diurnal land sea breezes; in consequence, they influence to some extent rainfall, vegetation and agricultural opportunity.

Man-made lakes of comparable size are likely, similarly, the same sort of effects although these are often rather difficult to forecast and to measure. Any major inundation may have important effects upon the water table in the surrounding area and may even result in the recharging of aquifers, so providing increased water supplies, within the region.

Man-made lakes differ from natural bodies of water in a variety of ways, eg in their properties of sedimentation, in their organic content, in their temperatures, water circulations, especially upon and animal life. For example, the rotting of drowned vegetation may result in the deoxygenating of the water which, in turn, in turn, has ill effects upon aquatic life. In the early years of inundation, the water has an unusually high organic and inorganic content which seems to favor an efflorescence of floating water plants, and such weed infestation is detrimental to fish life, bird life and water storage.

The building of dams may also curtail the movements of migratory fish, while the impounding of water may lead to seasonal flections in the discharge downstream, life in the lower reaches. The change from flowing to static water may,

At least in tropical regions, encourage the breeding of Anopheles mosquitoes and other vectors of disease which can adversely affect man. Thus, it will be clear that no large-scale interference with the natural environment by man can proceed without it having some, and often critical, ecological repercussions.

We have stressed the negative, and not the positive, effects of impoundment simply because the benefits are fairly obvious and receive much publicity whereas the ill effects tend to be ignored. However, whether for good or ill, on a large or smaller scale, any human intervention with the natural order of things will have repercussion; the local climate, the soil water-arability, plant life, animal life along with man, his activities and his welfare, may he affected.

Check list

Dear learner Here is a checklist provided for You. Please put a tick () mark in the boxes against the avidity which you can perform well. If you find an activity you could not perform, please go back and read the relevant section until you can perform.

I Can:

1. Define the concepts biosphere, metabolism and biogenic salts.
2. Explain the fundamental characteristics of animate life. ☐
3. Examine the nature of the biosphere. ☐
4. state the three main components of the biosphere ☐
5. State the two major processes of metabolism. ☐
6. explain the tow features of the biosphere state the limits and compositions of the biosphere ☐
7. Explain the biogeochemical cycles. ☐
8. Distinguish the distinctive characteristics of living matter. ☐
9. describe the biosphere cycles ☐
10. explain the importance of the processes of metabolism ☐
11. State the role of the atmosphere against excessive ultraviolet absorption. ☐
12. Enumerate the two grand-scale cyclical mechanisms of the biosphere. ☐
13. State the fundamental source of energy for all living thing. ☐
14. Compare and contrast plants and animals. ☐

Summary

The geographer, when concurring himself with the purely physical aspects of the Earth frequently refers to the various or “spheres” the lithosphere, the hydrosphere and the atmosphere which make up the terrestrial environment of our planet. To these solid, liquid and gaseous inorganic realms the geographer who is concerned with the total environment, must add a further realm the sphere of life which is a distinctive component of the environment since it is organic. This further realm is known as the biosphere. It is the realm of living things, of plants and animals, microbes and man.

The biosphere or organic world is that biologically active part of the earth at the interface between the atmosphere, the lithosphere and the hydrosphere. It is a relatively shallow zone which extends at its maximum a few hundreds of meters above the land surface and below the oceans, and less than a meter below the earth's substratum.

Despite its limited extent the biosphere is densely populated teeming with myriad forms of life of infinite variety and complexity. They range from plants and animals of microscopic size and complex morphology. Life, though capable of penetrating the atmosphere, the hydrosphere and the lithosphere, very quickly comes up against conditions which are beyond its tolerance. Upwards lack of oxygen, shortage of moisture, increasing cold and decreasing pressure soon put a limit to life in the air. Downwards lack of oxygen and light and probably increasing pressure place a limit to life at shallow depths in the sea and at relatively shallow depths for most forms of marine life.

All animals whether directly or indirectly; depend upon plant. The most obvious characteristics of living things include capability of movement, physical growth reproductive capacity and. Many of these characteristics, which distinguish animate from inanimate matter, are shared in common by animals and plants.

Man was a late arrival in the natural scheme of things. Modern man or Homo sapiens began to emerge about 100,000 Years ago, but for much the greater part of this time his numbers were small and he lived largely on the sufferance of nature. Until about 10,000Year increasing and accelerating effect. Not every human intervention in the natural scheme of things is always or necessarily bad changes are inevitable, for the world is not and cannot remain static.

Self-check exercises 2

Part I: MULTIPLE CHOICE ITEMS

Direction: Choose the best answer and write the letter of your choice on the space provided against each question.

1. One of the following statements is not correct about the biosphere. It is the:-
 - a. Totality of living thing on the earth
 - b. Sphere of living organisms, penetrating the lithosphere, hydrosphere and atmosphere.
 - c. Living matter on the surface of the earth
 - d. Surface zones of the earth and it adjacent atmosphere in which organic life exists
 - e. Non of the above

2. biocosmic matter is the term used to designate:

- a. totality of organisms determined quantitatively by the biomass
- b. organic mineral and organisms and dead nature
- c. chemical functions of living things
- d. non of the above

3. One of the following is not correct?

- a. The biosphere is of fundamental importance; without it the earth would be a sterile planet
- b. The biosphere is a compound of the natural environmental equally as important as terrain, water and climate
- c. Downwards lack of oxygen and shortage of moisture limits the presence of life
- d. The biosphere possesses no clearly defined boundaries like the hydrosphere
- e. None of the above

4. One of the following is nit the principal elements of the biosphere.

- a. plant
- b. animal
- c. man.
- d. micro - organisms
- e. None of the above

5. One of the following differentiates animate from inanimate matter.
 - a. Mobility
 - b. growth
 - c. changes of form
 - d. response to stimulus
 - e. all of the above
6. One of the following marks a sharp cessation of all evidence of life.
 - a. the phenomena of death
 - b. reproductive capacity
 - c. response to stimuli
 - d. physical growth
 - e. capability of movement
7. _____ is the process where by the organism assimilates into its system substance, which it converts into protoplasm.
 - a. Respiration
 - b. metabolism
 - c. catabolism
 - d. anabolism
 - e. nutrition
8. Which one of the following is a common feature both in plants and animals?
 - a. Organisms are made up of cells, with nuclei, chromosome, enzyme, etc.
 - b. Organism need nutrition for their growth, maintenance and health
 - c. Organisms digest food, excrete wastes grow and reproduce
 - d. All of the above
 - e. None of the above
9. Man -made lakes differ from nature bodies of water in their:
 - a. properties of sedimentation
 - b. organic content
 - c) temperature
10. Which one of the following is correct?
 - a. any change affecting any single element in the biotic complex will have repercussion throughout the entire ecological system
 - b. for much of man's history, his numbers were small and his impact upon natural was almost
 - c. Like other animals, man has the same physical needs.

- d. The creation of man made lakes provide a good example of man's intervention in natural upon a large scale E).
None of the above

Part II: matching item

Direction:- Match the major soil groups limited under column "B" with the items stated under column "A"

Column "A"	Column "B"
1. katabolism	A. synthetic activities
2. anabolism	B. man - made lake
3. phosphorous	C. micron ties
4. Manganese	D. destructive activity
5. koka	E. macronutrients
F. natural reservoir	
G. biogenic salt	
H. biogeochemical cycles	

Part III True or False Items

Direction:- Decide whether each of the following sentence are true or false and write True if the statement is correct and false if it is incorrect.

1. The biosphere is the web of life that lives within and depends upon, the inorganic shares.
2. The biosphere is that biologically active part of the earth at the interface between the atmosphere, the lithosphere and the hydrosphere.
3. The most obvious components of the biosphere the large terrestrial plant and animal represent very high proportion of the total biotic population
4. As a concept the biosphere is perhaps, less familiar than other spheres
5. Locomotion is a feature of most plants.
6. Perhaps the most obvious characteristic of living things is capability of movement.
7. Animate things may disintegrate and break up but not die.

8. In anabolic process an organism break up down substances of chemical composition and converts them in to similar chemical compounds which it can use.
9. Anabolism is so importance to build a body substance which is needed in growth in the repair of damaged tissues in reproduction.
10. Without any exception, no forms of life are able to live for long without oxygen.
11. The process of respiration is fundamentally similar in both plants and animals.
12. Man was a late arrival in the natural scheme of things.
13. Every human intervention in the natural schemes of things is always or necessarily bad.
14. Large natural lakes such as Lake Victoria create their own local climates with diurnal land and sea breezes.

Part IV filling the blanks Items

Direction: - complete each statement below with the appropriate word or phrase.

1. _____ embraces all the chemical changes taking place within living organisms.
2. _____ is important to provide the energy which is required in growth, development and movement of organizations,
3. _____ involves the taking of oxygen from the air, water and the soil, which is used in the oxidation substance to supply energy.
4. the process by which various materials - water and nutrient salts - are circulated within the biosphere are termed _____.
5. Modern man or HOMO sapience began to emerge about _____ years ago.

Chapter Three

The Evolution and Distribution of Life

Introduction



Dear learner! In the pervious units you have learnt about the concept of biogeography and biosphere. In this unit you will study about the evolution and distribution of life. The unit focuses mainly on the factors influencing the distribution of life and major geographical realms of the earth. There are two sections in this one is all about the evolution and distribution of life, section two treats the major geographical realms and biomes of the earth's surface.

Objectives:

After reading and studying this unit; you will be able to:

- examine the conditions prior to the emergence of life;
- Analyze the evolution of life;
- Evaluate factors influencing the distribution of life; and
- Examine the major biomes of the planet earth.

3.1. The evolution and distribution of life

3.1.1. Condition prior to the emergence of life



What were the conditions prior to the emergence of life?

(You can use the space below to write your response.)

The earth is approximately 4.6 billion year old. The oldest mineral known as Zircon crystals have been found in western Austria are about 4.3 billion years old. The oldest known rocks have been found in Greenland and are about 3.9 billion years old. They were formed at a time when the earth was fiery with volcanic activity and was pummeled by meteorites. During this time, sometimes referred to as the Hadean Eon, no atmosphere, Ozone layer,

continents, or oceans existed, and life could not be supported under such conditions.

? How is the atmosphere formed?

(You can use the space below to write your response.)

The formation of the atmosphere is believed to have resulted from the release of gases and volcanic eruptions, one example of out gassing. As surface of the earth cooled, water vapour in the newly formed atmosphere condensed to form the water of the oceans.

Until 3.9 billion years, the oceans may have been too hot to supported life by 2.8 billion years ago, the first lightweight silica and aluminum rock, which is typical of the continents, had formed. These rocks expanded rapidly so that by 2.6 billion years ago as much as 60 percent of the continental drift commenced.

3.1.2. The theory of evolution

? Do you have any idea about how life is evolved?

(You can use the space below to write your response.)

The diversity of plant and animal life has been recognized from the very earliest times. Man has long pondered upon the variety and organic life. Traditionally most people, at least in the western world, believed that living organisms could be spontaneously produced from dead or inorganic matter.

Such belief is no longer generally held, and the scientist has been able to show that all living forms have depended from previously living forms.

The fundamental problem of the origin of the initial living matter, from which it is assumed all living forms subsequently were derived, is still with us although the problem of the diversity of organic life has been met with a satisfactory and generally acceptable explanation.

? Who first put forward the theory of evolution?

(You can use the space below to write your response.)

Lamarck (1744 -1829) may be said to be the first to put forward the theory of evolution. Since he was the first to challenge the belief in the fixity of species, he grouped animals on the basis of the presence or absence of certain organs.

However, it was not until the latter half of the nineteenth century that the concept of evolution began to be widely accepted. The theory of evolution was propounded simultaneously by Charles Darwin (1809 - 1882) and Alfred Russell Wallace (1823 -1913).

Darwin's great book on *the origin of species* (1859) dealt with the theme of evolutionary development. Along with Wallace, he put forward the idea that species originate as a result of natural selection or survival of the fittest. Darwin argued that individuals of a species vary and that this variability through small changes was significant. Particular characteristics might make certain individuals more efficient and better able to stand up to conditions in their struggle for life.

Any advantageous characteristics that an organism possessed would give it a better chance of survival and reproduction. Such advantageous characteristics, if transmitted to and through the organism's offspring, would give succeeding generations, superiority in the struggle of existence.

Conversely, any disadvantageous traits would handicap individuals in their life struggle and they would be likely to be eliminated by the competition from the better equipped members of their race. Hence, according to the Darwinian argument, all living things suffer a gradual change or evolutionary development with the passing of time. Furthermore, as a result of this, evolution, the manifold species of plants and animals must have depended from a smaller number of species which, in turn, were derived from a still smaller number.

? What is mutation?

(You can use the space below to write your response.)

According to the Darwinian view, the gradual modification and diversification of organisms arose out of the operation of natural selection and of adaptation to environmental, process that was slow but one, which had been proceeding through prolonged periods of geological time. At this point, we should perhaps not that Darwin made no attempt to explain the mechanism of inheritance and changes. Darwin's suggestion that variations began as slight deviations from the normal which became progressively greater with each succeeding generation was questioned by the Dutch botanist, de Vries, who claimed that it was possible occasionally for an individual to differ so markedly from the mechanism of change. Mutations give rise to inheritable variations which are spread by interbreeding.

With the acceptance of the theory of evolution species no longer came to be looked upon as being fixed and immutable but rather as interbreeding populations which were constantly undergoing changes. If one accepted this interpretation then species of one genus could be said to have emerged through the modification and divergence of a parent stock

Moreover, the parent stock and its close relatives could be traced back to a common ancestor. Thus it became possible to trace a species back -to - its genus, the genus back to its family, and so on. In this way an ancestral hierarchy could be built up. It is in fact, in this way that the biologist builds up his classificatory system. The developments in paleontology have greatly assisted the biologist in tracing the course of evolution, since fossils give the only direct evidence to support it.

3.1.3. The evolution of life

?

Which life form existed fully 1,000 million years before Cambrian?

(You can use the space below to write your response.)

It is generally accepted that life first began in the sea but exactly when is not known. We know little about organisms living in pre - Cambrian time, i.e. earlier than about 6000 million years ago. Traces of life are rare because soft-bodied organisms did not lend themselves to preservation. It has been suggested that some forms of life go back approximately 2,000 million years. For example, in rocks from Ontario, Canada, traces of multicellular algae and possibly a calcareous flagellate have been found and dated as being around 1,900 million years old.

It is therefore possible that certain algae, fungi and unicellular organisms, comparable with simple plant forms, existed fully 1,000 million years before

Cambrian times. Traces of animal life, as distinct from plant life, are uncommon still in still in pre -Cambrian times although there are a few indications that primitive animal forms did exist.

? Which major life forms were evolved in Paleozoic era?

(You can use the space below to write your response.)

With the coming of Cambrian times living forms, both plant and animals, are clearly attested. The early part of the Paleozoic era i.e. the Cambrian Ordovician and Silurian period as are planet life was concerned was essentially the age of algae, while animal life was algae confined - to the invertebrates. However armored jawless fisher becomes abundant towards the end of the Silurian period. The Silurian period and the succeeding Devonian period are designated as the age of fishes by the paleontologist since they are the most numerous animal forms.

? When was vascular plant known to have appeared?

(You can use the space below to write your response.)

However, towards the turn of the Devonian period amphibious from began to develop from air - breathing fishes. In the plant world, the Silurian and Devonian period are important because they see the development of the first true land plants. Vascular plants are known to have appeared and in mid - Devonian times spore - bearing ferns reached tree size in some place. Towards the end of the Devonian period, around 350 million years ago, the first true seed plants appeared.

The succeeding carboniferous period witnessed the development of a rich land flora which included many ferns, giant club - mosses, pteridodperms (seed - bearing fern, like plants) and primitive conifer - type trees. This very rich vegetation, which flourished in the warm, moist swamp, conditions of the time produced the coal measures. Contemporaneously, amphibians developed and spread, reptiles began to make their appearance, and insects evolved rapidly.

In the succeeding Permian period, there was a change in climatic condition: it becomes drier and warmer. This seems greatly to have affected plant life, for many of the old carboniferous genera died out and any new to plant forms came in to being. The former age of spore - bearing fernlike plants gave way to the age of gymnosperms (conifers).

? What were the major evolutionary processes of Mesozoic era (Triassic, Jurassic and cretaceous period)?

(You can use the space below to write your response.)

The Triassic and Jurassic periods, following the Permian, saw the increasing development of cycads and conifers. In the animal kingdom large marine reptiles appeared in the Triassic, while the reptiles spread to the land and the air and became numerous and dominant in the Jurassic. The Jurassic and succeeding cretaceous period are known as the age of reptiles.

The first small primitive mammals appear to have developed around 220 million years ago in Triassic times but their growth was slow and they did not become really important until the tertiary era. The cretaceous period was important from the point of view of developing plant life since it saw the

appearance of the angiosperms or flowering plants. Many present day trees, such as oak, willow, plane, sycamore, walnut and fig developed and spread.

At the commencement of the Tertiary period around 60 million year ago, we find the angiosperms, but trees were dominant over herbaceous plants. By mid - tertiary times, i.e. the Miocene epoch grasses came into their own and wide areas of grassland developed at the expenses of the forests.

?

When were unspecialized apes rampant in Africa?

(You can use the space below to write your response.)

The Tertiary period is known as the age of mammals. Developing gradually but slowly since Triassic time, mammals seem almost suddenly to have become dominant with the extinction of the larger reptiles at the end of the cretaceous period. The Eocene and Paleocene epochs, were characterized by archaic mammalian forms and by the rise of snakes. The succeeding Oligocene saw the emergency of modern mammals which reached their peak development, at least as regards, size, in the Miocene. Unspecialized apes were common in Africa in the Miocene. The Pliocene's epoch which followed the Miocene saw the decline of the large mammals and the rise of the man - asps. The Pleistocene gave rise to modern man.

This briefly traces the development of forms of life from their beginning in pre- Cambrian times up to the present. It is a development from simpler form simpler forms culminating in the evolution of man, the most highly developed organism that nature has ever produced.

One of the interesting things in this course of plant and animals evolution is the some of the early primitive forms have lingered on until the present day. Another interesting thing is that some of this organism is confined to particular habitats. These give rise to question of the great interest, especially

as to how such archaic forms have managed to survive and why they are to be found only in certain areas – and under particular conditions.

□ Activity 15

Answer the following questions.

1. Why the Silurian and Devonian period is were generally regarded as the age of fish by the paleontologist?

2. Why the Silurian and Devonian period is are so important in the plant world?

3. When did vascular plants known to have appeared?

3.2. Geographical Distribution

One of the interesting aspects of biogeography is the study of the distribution of plants and animals. Every family, indeed every species of plants and animals has a geographical range. A map of the world which shows the area occupied by any plant or animals family i.e its geographical distribution is known as distribution map. If we plot the range of a particular family, one of two basic patterns emergence; these patterns show continuous distribution and discontinuous distribution patterns.

The biogeography seek to find explanations for such seemingly odd distribution recent enquire of this nature is this nature is that of p.J.

Darlington who has re - examined to explain one of the unsolved problems of evolutionary biology, namely, how to account for the distribution of related groups of plants and animals found in the southern parts of South America, southern Australia and New Zealand. In attempting to solve these problems Darlington has had to take into consideration numerous factors, such as: biological evolution, modes of dispersal, climatic changes and geological happenings; this factor indicates the intricacy and complexity of factors after involved in trying to satisfactory explanation for particular distributions.

?

What are the major factor influencing the natural distribution of plant animals?

(You can use the space below to write your response.)

Broadly speaking, four main groups of factors may be said to account for the natural distribution of plant and animals. These are-

- A. Evolutionary
- B. Innate;
- C. Environmental
- D. Geology for

There is, however, a fifth factor affecting the distribution of organisms - man. Man may, indeed after has, changed the distributional patterns of plants and animals that resulted from the interplay of the natural patterns of plants that resulted from the interplay on the natural factors.

3.2.1. Evolution Factors

?

How is evolutionary factor affecting the distribution of species?

(You can use the space below to write your response.)

The distribution of a species or group of organisms is influenced by the time and place of its origin. Not all the plants and animals which have evolved during the geological period have survived; many species died out as a result of geological and climatic changes, and competition from other species, etc.

?

Why the families of invertebrates have much greater ranges than those of

Vertebrates?

(You can use the space below to write your response.)

The age of a group, however is of some significance in the extent of its present geological range. It may well be that geological happenings, such as the foundering of certain land areas, destroyed the avenues by which the older forms migrated. If such movements were no longer available for dispersal then younger forms would have their movements more circumscribed. It may be for this reason that the families of invertebrates have much greater ranges than those of vertebrates.

While it appears that greater geological age is a significant factor in the wide distribution of certain genera and families I.C. Willis, who tried to establish an invariable connection between the age of a species and the extent of their range, was forced to the conclusion that any such relationship could be "veiled by the presence of physical and ecological barriers by the action of man and by other factors even among the slow spreading plants."

Evolution helps to explain the virtual restriction of monotremes (egg laying mammals) and marsupials (pouched mammals) to Australia (South America is

only parts of the world outside the Australian area possessing a number of marsupials). The higher placental mammals developed in the other continental mammals to reach Australia were those able to swim or fly or which were accidentally erected there on driftwood. Thus it may be said that evolutionary – factors are responsible in part for present – day distributions.

3.2.2. Innate Factors

The anatomic, physiological and behavioral and specialization of an organism, results in it reacting to the environment in a particular way. Organisms become adapted to specific environmental conditions and so, if they move out of the particular environmental they cannot survive or at least have great difficulties in adjusting themselves to it. In other words, what may be termed innate factors may restrict the distribution of species.

Physical barriers which may present an obstacle to one species may serve as a dispersal route way for another. An obvious case in point is the isthmus of panama, which precludes the movements of tropical marine animals between the Caribbean sea and the pacific but which has allowed tropical land animals freedom of movement between north and south America, Again, while the mountainous cordilleran system has helped to restrain movements between the lowlands on either side of it, its highland character has permitted the spread of the cat family (in the form of puma) from British Columbia to Patagonian.

Creatures vary physiologically. Mammals and birds differ from reptiles and amphibians, for instance, in possessing an internal mechanism which helps them to maintain a constant body temperature; as a result, also and birds are better able to withstand lower temperature and area to be found in latitudes too cold for reptiles and amphibians. Amphibians, like reptiles, take on the temperature of their surroundings, but they are also subject to desiccation

and hence are seldom to be found outside humid environments; only a few highly specialized groups of amphibians occur in dry regions or habitats.

?

Can innate factor influence plants in the same way as they do animals?

(You can use the space below to write your response.)

Innate factor influence plants in much the same way as they do animals. Plants have distinctive life forms which are based on innate characteristics and these life forms exert some effect upon the distribution of plants. It is interesting to note that many conifers possess the ability to grow in habitats which are too rigorous for broad - leaved tree; they will grow in higher latitudes, at higher altitudes, under damper conditions and in poorer soil than the broad - leaved species can tolerate. In other words, they seem to possess innate characteristics which permit them to take over and thrive in conditions which would kill off other trees.

Again, many plants possess special adaptations for dispersal. Dispersal mechanisms are very varied and include winged and plumed seeds that can be

win - b
are rou
water

Activity 16

Give short answers to the following questions.

1. In what aspects do mammals and birds differ from reptiles and amphibians?

2. Where do you find large number of marsupials?

3. What is the fifth factor affecting the distribution of species?

3.2.3. Environmental Factors



Can innate factor influence plants in the same way as they do animals?

(You can use the space below to write your response.)

In addition to the influence of evolutionary development and innate factors, environmental factors also affect distribution. Chief of the physical environmental factors affecting the dispersal and distribution of forms are the configuration of land and sea, including accessibility, area, climate and soil. For the moment we can ignore geographical location and accessibility since these are intimately linked with geographical changes and will be considered later in this section. Let us, therefore devote our immediate attention to the influences of area, climate and soil.

3.2.3.1. Area



What type of relation does exist between geography area and number of specie?

(You can use the space below to write your response.)

It is recognized that there is a relationship between geographical area and number of species. If for example, one compares a large island such as New found land, Ceylon or Tasmania, with a much smaller, through climatically similar, near - by island, it will be found that the larger island possesses many more species of plants and animals than the smaller, even through they may have the same geological history. The larger island is land is likely to have for instance, a varied assortment of mammals, including larger herbivorous and carnivorous type, whereas the near by smaller island is likely to possess few, and small, or be no terrestrial mammals.

At this point it will be convenient note another effect of pace limitation. It would appear that the extent of space a available has a direct effect upon the size of species. There is not space here to elaborate further upon organic forms, but we may, perhaps, make some generalized statements following the finding of Biologist:

1. Species of large animals need a more extended range than smaller related animals
2. Large animals are not normally found on islands of small size.
3. The number of plant species on islands is usually smaller than in adjacent continental land areas
4. The area available exerts a direct effect up on the size of species inhabiting that area.

5. Islands and oases, which are small and circumscribed, possess fewer species than area of the same size which are uncircumscribed and less well defined.
6. The larger area the area, assuming other conditions are equal, the richer, broadly speaking,, is the fauna.

Areas containing widely variable habitats are prone to favor the existence of numerous species and to give rise to the development of sub – species.

While it seems a question that a relationship exists between the size of an area and the number and variety of its fauna, it also appears that there is a relationship between area size and organic dispersal. Evidence of a relation between area and the effectiveness of evolution is found in the observed of plants and animals to disperse from large to small areas more than the reverse.

Studies of exchanges of mammal faunas in more recent geological time indicate that there was great movement of animal forms from Eurasia into North America than the reverse and also, that there was a greater net movement of animals from north to south America than vice versa.

3.2.3.2. Climate



What type of correlation does exist between climate and number of species?

(You can use the space below to write your response.)

There seem to be a correlation between climate and number of species; although attempting to define “favorable climate” is not easy. Areas which are

climatically favorable to life support many species. For different forms of plant and animals life need widely differing conditions. It is much easier to say what unfavorable conditions are; for example, speaking in general terms, low temperatures and scarcity of moisture are the two climatic conditions most inimical to organic life.

In specific cases, other climatic conditions such as too much sunshine, excessive moisture and wind, may have ill effects. Broadly speaking, however, low temperatures and lack of water are the two most significant operative factors, affecting both plant and animal life. A high degree of warmth and moisture seem, generally, to encourage profuse life.

This relationship between climatic conditions and number of species can be illustrated in a broad way. In the first place there is a clearly recognizable decrease in the number of species of both flora and fauna between the tropics and the Polar Regions. One can compare, for instance, the thousands of species of trees found in tropical forests with those found in the northern forest which amount only to a few dozen. Similarly, there is a much more varied fauna in the plant formation type, such as the coniferous forest, one finds a reduction in the number of species of trees as one goes towards the poleward limit of the forest. In like manner there is a general decline in the variety of animal life in the forest.

The South American tropics support thousands of species of plants of diverse groups and many diverse animals, too, including thousands of species of insects of many orders. For example, the Amazonian rain forest probably includes at least 2,500 species of trees, but only 6 species occur on Tierra del Fuego, and one of Antarctica. The latter supports only three species even of smaller flowering plants, and they are confined to the Antarctic Peninsula. The only plants that now tolerate the climate of the main part of the continent are mosses, lichens and algae. Terrestrial vertebrates diminish in numbers southwards in South America and no strictly terrestrial vertebrates now occur

on Antarctica. Of insects (other than ectoparasites of birds and marine mammals), only two species of flies reach Antarctica and they too are confined to the peninsula or islands off the peninsula, although collembolan and free-living mites reach parts of the Antarctic continents proper.



While we may accept that there is a fundamental relationship between favorableness of climate and number of species and agree that the diversity of terrestrial life is greatest in the inter-tropical zone, we must remember that this is acceptable only in general terms, for it is fairly clear that some types of plants and animals prefer and thrive best in warm temperature climates while the richest diversity of plant life may occur in the marginal tropic and sub-tropical lands of South-east Asia.

Although there seems to be a positive relationship between size of area and variety of species and organic dispersal it is much less easy to discern any relationship between climate and dispersal.

Darlington argues that the dominant animals have usually evolved in favorable (general tropical) climates and those dominant groups have then spread into areas of less favorable climates, he says that "selection in competition with other organisms presumably makes generally superior organisms, and should do most effectively in favorable climates where organisms are most numerous. He sustains his argument by going on to that "perhaps the best reason, for accepting this hypothesis of the relation of climate to dispersal is not the direct evidence, which is difficult to interpret, but the fact that area and climate to dispersal is not the direct evidence, which is difficult to interpret, but the fact that area and climate have comparable effects on numbers of species and may therefore reasonably be supposed to affect evolution and dispersal in comparable ways.

We should not, however, that this interpretation is disputed and W.D. Matthew argued that the most successful plants and animal evolved in inhospitable climates.

3.2.3.3. Soil



What is the role of soil in influencing the distribution of species?

(You can use the space below to write your response.)

The influence of soil upon plant distribution is both known and appreciated, but little is known of the effects of soils upon animal life. Apart from such as may have characteristics certain burrowing or soil living creatures, soil conditions usually exert their influences indirectly through plant life.



What property of soil largely affects the distribution of plants?

(You can use the space below to write your response.)

Although the porosity and thickness of soil may influence plant growth, the most important property affecting the distribution of plants is probably the chemical composition of the soil. There are some plants, such as bog and marsh plants which have a predilection of the soil, while forest plants usually prefer a fairly acid soil.



Why certain species in some specific areas is grow poorly, or not at all?

(You can use the space below to write your response.)

We know, too that plants often require specific trace elements for their normal growth and it may well be that certain species grow only poorly, or not at all, in some specific areas because of a specific mineral deficiency.



What is the role of soil- micro - organisms in plant - soil relationship?

(You can use the space below to write your response.)

Soil micro organisms often play a significance role in plant soil relationship. For example, there is an intimate relationship between certain bacteria and leguminous plant; these bacteria living in nodules on the roots of legumes undertake nitrogen fixation and make the nitrogen, needed by the plants, readily available. Such bacterial cannot tolerate a soil which is strongly acid. In contrast, mycorrhizal fungi, which perform a similar sort of function for many other types of plants, require an acid soil.

Animals, like plants, require a variety of chemicals, most of which are obtained indirectly through plants on which they feed. Even where an animal appears to be restricted to a particular kind of soil, it is rather probable that the restriction is a reflection of the nature of the plant cover rather than a specific relationship with the soil, although it is possible to see a clear association between animals and soil in some cases. E.g. snails, which require lime for their shells, are prone to occur in limestone area but are noticeable absent from acidic bog land and marsh were lime is lacking.



Activity 17

1. Which two major climatic conditions are most inimical to organic life?

2. Which plant species tolerate the climate of the main part of the Antarctic continent?

3. Who argued that the most successful plants and animals evolved in inhospitable climates?

3.2.3.4 Geographical Factor



How is the geographical factor influence the distribution of organisms?

(You can use the space below to write your response.)

There are many cases of plant and animal distribution which present problems of explanation. It was, indeed, in an attempt to find a satisfactory answer to problems of plant distribution and major climatic variations in the past that the German scientist Alfred Wagener was led to the idea of continental drifting.

It was, for example, difficult to explain the occurrence of the *Glossopteris* flora, a fern-like plant of Permian times, in South America, Africa, India, Australia and Antarctica but apparently nowhere else in the world without invoking the idea that these particular land areas, now widely separated, must once have been all connected together.

Wagener, suggested that these land areas were originally linked together in a great southern land mass or protocontinent, called by him – “Gondwanaland”, which subsequently split up into pieces which drifted apart.’

Most vertebrates that live today belong to groups that arose after the Jurassic (i.e. the geological period when drift is commonly thought to have taken place), and zoogeographers have therefore concerned themselves but little with problems of continental drift.

But the higher plants on average are much older than the higher animals, and phytogeography have often accepted the drift theory with gratitude. Not only would drift explain some minor puzzles of plant geography (for example, the amphi-Atlantic and some “Tropical” patterns of discontinuous distribution): it would also throw considerable light on two major problems.

- The respective floras of Australia and the Cape kingdom are far more alike than would be exceptive from the great distance that separates the two regions:
- The respective floras of Australia and New Guinea are far more different than would be anticipated from the proximity of the two, even granting the climatic differences.

Both these problems would be solved if Australia today were closer to New Guinea and farther from Africa than it had been in the past. And of course the existence of an Antarctic floral Kingdom, embracing New Zealand, Southern South America, and various scattered islands, is less surprising if its geographic components had once been closer to each other.

?

Can the theory of continental drift clearly explain the presence of common terrestrial organisms in widely separated areas?

(You can use the space below to writ your response.)

To explain the presence of common terrestrial organisms in widely separated areas, continental drift clearly has an appeal: it seems to offer an easy and obvious answer to a problem. But the obvious answer is not always the correct one. The whole question of continental wandering is undergoing reappraisal at the present time in the light of paleomagnetic evidence and new knowledge of submarine rifts, and it may yet be proved that some measure of continental movement has occurred. However, we should note Darlington's continental that in some cases distributions can be accounted for without any involvement of continental drifting.

An alternative method of explaining puzzling distributions, which was invoked by the older authorities, was by migration via land-bridges, e.g. In the form of narrow tracts of land or chains of islands, which, it was supposed, joined continental areas together but which subsequently subsided.

It is known that the shallow Bering Strait was once above water and provided a dry land link between Asia and North America. Similarly South -East Asia and Australia were at one time linked together when the sundra platform and the sahal shelf formed a land-bridge.

Modern research upon the form and structure of the ocean floors renders the concept of former numerous land-bridges quite invalid. Good says the land bridge theory is a weak one and that there is much against it: he briefly summarizes the nature of the evidence for and against the theory. Darlington, in his study of the biogeography at the southern end of the world, concludes that land-bridges are not necessary for the elucidation of the problems in that area.

Whether or not narrow land connections have existed between southern continents in the remote past is relatively unimportant and very difficult to decide. Existing geologic and biogeography evidence apparently does not require connection in the late Paleozoic and Mesozoic and hints that none existed then. The record of mammals forbids southern land connections in the

Tertiary, except possibly for a temporary connection between South America and Antarctica.



Activity 18

Answer the following question.

1. With whom or what do you associate the concepts:

- a) the land bridge theory is a weak one and that there is much weight again it:
- b) Land-bridges are not necessary for the elucidation of the problems in that area.

2. Which theory has an appeal to explain the presence of common terrestrial organisms in widely separated areas?



Self- check exercise 3

Part I : TRUE OR FALSE ITEMS

Direction: decide whether each of the following sentence are true or false
write true if the statement is correct and false if it is incorrect

1. The oldest known rocks have been found in Madagascar and about 4.3 billion years old.
2. Charles drawing is the first person to put forward the theory of evolution.
3. Traces of animate life as distinct from plant life, are uncommon still in pre Cambrian times.
4. Innate factors influence plants in much the same way as they do animals.
5. Evidence of a relation between area and the effectiveness of evolution is found in the observed tendency of plants and animals to disperse from large to small area more than the reverse.
6. There was a great net movement of animals from south to north America than vice versa.

the first small primitive mammals appear to have developed around 200 million years.

PARTII: MULTIPLE CHOICE

DIRECTION: choose the best answer and write the letter of your choice on the space provided against each question.

1. With whom or what do you associate the idea that species originate as a result of natural selection or the survival of the fittest?

- a) Wallace
- b) Darwin
- c) Lamarck
- d) De vries
- e) A and B

2. the first true seed plants appeared around

- a) 1000 million years ago
- b) 350 million years ago
- c) 39 million years ago
- d) 4.3 million years ago
- e) 2.8 million years ago

3. Which of these are evolutionary contemporary?

- a) algae and invertebrates
- b) coal measures and amphibians
- c) confers and marine reptiles
- d) A and B
- e) All of the above

4. One of the following is correct?

- a) low temperature and lack of water are the most significant operative factors affecting both plant and animals life
- b) terrestrial vertebrates diminish in numbers northwards in south America
- c) no strictly terrestrial vertebrate now occur on Antartica
- d) animals, like plants, require a variety of chemical, most which obtained directly through plants on which they feed
- e) all can be possible answers

5. Where do you find frequently high degree of endemism?

- a) temperate
grasslands
- b) tropical savannah
- c) man and his
environment

- d) taiga
- e) Mediterranean
scrublands

Answer key to activities and self – check Exercises

Activity 1

- 1.** The discipline is important because administration, politicians, policy – makers and consulting firms are looking more and more to scientists who study the earth its environment and its organisms, to better manage the future to ensure its well – being.
- 2.** The spatial and temporal scales are often too large for experimentation. Instead and developed by searching for patterns, formulating theories, testing assumption and predictions with new observations.

Activity 2

- 1.** Vascular plants are plants that have vessels in their bodies, which transmit fluids.
- 2.** The fact that the relations of animals with the environment are less direct and obvious than in the case of plants, have made zoogeography a more difficult, if not less interesting, subject of study. Moreover, numbers of zoogeographic problems have been less resolved.

Activity 3

- 1.** soil chemistry, soil physics and soil microbiology
- 2.** Soil science plays a key role in agriculture, helping farmers to select and support the crops on their land and to maintain fertile, healthy ground for planning and construction. Soil engineers carry out detailed analysis of the soil prior to building roads, houses, industrial and retail complexes and other structures.

Activity 4

- 1.** Where ecological biogeography investigates current patterns of patterns of distribution through empirical examination, evolutionary biogeography addresses the origin, dispersal and extinction of taxa extending beyond the period of direct empirical evidence.
- 2.** Anthropogenic impact on the distribution of other species has become increasingly intense and pervasive. This is due in part to the massive diversion of natural resources to human use and the anthropogenic creation of barriers to dispersal and migration. Instances of consequence of past or present geographical factors.

Activity 5

- 1.** Forster, Willdenow, and Humboldt
- 2.** competition and the struggle for existence was the theme central to the development of evolutionary and ecological theory

Activity 6

- 1.** * a better estimate of the age of the earth (many early biogeographers were working with an estimate of only a few thousand years).

*a better understanding of the dynamic nature of the continents and oceans (i.e. continental drift and plate tectonics)

* a better understanding of the mechanisms involved in the spread and diversification of species – specifically, dispersal, vivariance, extinction and evolution

- 2.** the theory of uniformitarianism

Activity 7

- 1.** Allen's rule states that among endothermic species, limbs and other extremities are shorter and more compact in individuals living in colder climates. Birds and mammals of polar regions tend to be stout with short limbs.

- 2.** while Gloger's rule holds that, within a species, individuals from more humid habitats tend to be darker in color than those from drier habitats Bergman's rule postulates that in endothermic (warm - blooded) vertebrates, races from cooler climates tend to have larger body sizes and hence to have smaller surface - to volume ratios, that race of the same species living in warmer climates
- 3.** Jordan law of vertebrae, states that as one moves farther from equator, the vertebrae of teleost fish become smaller and more numerous.

Activity 8

- 1.** Paleontology in particular deserves credit for providing new and fascinating descriptions of faunal changes on each continent.
- 2.** The four major developments that have revitalized biogeography in the last four decades were the following:
 - The acceptance of plate tectonics,
 - The development of new phylogenetic methods,
 - New way of conducting research in ecological biogeography and
 - Investigation of the mechanisms that limit distributions.

Activity 8

- 1.** the most obvious components of the biosphere are large terrestrial plants and animals.
- 2.** the biosphere includes three main components:
 - the living matter, totality of organisms determined quantitatively by the biomass;

- biogenic matter; i.e. organic minerals and organic products created by living matter. They include coal, bitumen, combustible gases, probably petroleum and in particular, peat sapropel, and soil humus and litter.
- Biocosmic matter; a term used to designate the mineral materials formed by the association of living organisms and dead natural, as for example, the gas composition at the lower layers of the atmosphere, sedimentary rocks, clay minerals and water.

Activity 10

- 1.** the major distinctive features, living and non - living matter as the following:
 - capability of movement
 - physical growth
 - the ability to assimilate chemical substances and convert them into protoplasm
 - response to stimuli
 - reproductive capacity
 - organization of functional unit
 - phenomena of death
- 2.** The biosphere may be said to comprise four principle elements plants animals' man microorganisms.
- 3.** Man of course, is merely an animal but is an intelligent animal with power of forethought and reason and geographical ubiquity and so stands apart.

Activity 11

- 1.** a ready supply of oxygen is necessary for the process of respiration but this is freely abundant at the surface of the earth. Only at high altitudes and at great depths does the supply begin to run out but where it does begin to run out it has drastic biological repercussions.
- 2.** animals differ from plants nutritionally in a quite fundamental way unlike plants they cannot synthesize from such simple materials, they have to use the products of plant anabolism which they digest and distribute and re-synthesize in different parts of their bodies.

Activity 12

- 1.** this is due as much to its lack of water as to anything else.
- 2.** whereas the macronutrients are those needed in relatively large quantities the elements, which are required only in very small amount

Activity 13

- 1.** But man differs from the other animals in possessing a developed brain which makes him an intelligent creature with powers of reason and forethought. By using his intelligence man has been able to adapt himself to habitats of extremely varied climatic topographic and biogeographic conditions.
- 2.** Major developments that allowed large groups of people to live together on planet are the following:
 - the discovery of the art crop
 - domestication of certain animals
 - the agrarian and industrial revolutions and man's techno - science expertise

Activity 14

- 1.** man made lakes differ from their counter natural lakes in their
 - properties of sedimentation
 - organic content
 - temperatures
 - water circulation and water - level fluctuations
- 2.** Large natural lakes create their own local climates with diurnal land and sea breezes. In consequences, they influence to some extent rainfall, natural vegetation and agriculture opportunity.

Activity 15

- 1.** because fish were the most numerous of animal forms during that period
- 2.** they saw the development of the first true land plants
- 3.** in mid Devonian period

Activity 16

- 1.** creature vary physiologically mammals and birds differ from reptile and amphibians, for instance, in possessing an internal mechanism which helps them to maintain a constant body temperature; as a result, animals and bird are better able to withstand lower temperatures and are to be found in latitudes too cold for reptiles and amphibians,
- 2.** Australia and south America

Activity 17

1. low temperatures and scarcity of moisture. In specific cases, other climatic conditions such as too much sunshine, excessive moisture and wind may have ill effects.
2. mosses, lichens and algae
3. W.D matthew

Activity 18

- 1.** a) good b) darlington
2. the theory of continental drift

Self-check Exercise 1

Part I

1C 2.H 3.A 4.D 5 E

Part II

1.E	2. B	3.B	4.E	5.E
6.E	7.C	8.C	9.C	10. C

Part III

1. True	4 False	7. False	10.True
2. True	5.False	8.False	11.True
3. True	6. True	9 False	

Part IV

1. Extension's
2. Hooker
3. Glover's rule
4. Macro ecology
5. evolution extinction, and dispersal

Self-check Exercise 2

Part I

- | | | | | |
|-----|-----|-----|-----|------|
| 1.E | 2.C | 3.C | 4.E | 5.E |
| 6.A | 7.E | 8.D | 9.E | 10.E |

Part II

- | | | | | |
|-----|-----|-----|-----|-----|
| 1.D | 2.A | 3.E | 4.C | 5.B |
|-----|-----|-----|-----|-----|

Part III

- | | | | |
|----------|---------|----------|---------|
| 1. True | 2. True | 3.False | 4.True |
| 5.False | | | |
| 6.True | 7.False | 8.False | 9.True |
| 10.False | | | |
| 11.True | 12.True | 13.False | 14.True |

Part I V

1. Metabolism
2. Catabolism
3. Respiration
4. Biogeochemical cycle
5. 100,000

Self-check Exercise 3

Part I

100

1.False 2.False 3.True 4.True 5.True

6. False

Part II

1.E 2.B 3.E 4.A 5.E