

GENERAL BIOLOGY

Course Outline

1. Revision on fundamental of biology

- Scientific approach

2. Cell

- History of cell biology
- Organisation of cell
 - Structure and function of cell
 - Homeostasis
- Cellular metabolism
 - Cellular division & reproduction

3. Genetics, Heredity

- DNA, RNA & proteins
- Central dogma of molecular biology (DNA, RNA, Proteins)
- Theory of Evolution

4. Ecology

- Inter-relationship of living organisms
- Element of ecology
- Man and its environment

5. Classification of living organism (Animal)

- Major invertebrate phylum
- Classification of living organism (plant)

Biology is the scientific study of morphology, physiology and mechanism of life.

COMPONENTS OF BIOLOGY

1. Morphology: The structure of life. It is also called ANATOMY.
2. Physiology: The functional ability of life
3. Mechanism: This is essentially understanding how the body structure function or perform.
 (Fore) Cerebrum: Thinking / Reasoning IQ
 (Mid) Cerebellum: Involuntary action
 (hind) Brain Central control of the body
 Medulla oblongata:

LIFE:

Life ~~is~~ ^{is} anything that can respond to stimulus. Life can be defined as anything living ~~thing~~ ^{having} by the following properties: MR NIGERDA

- M- Movement: Ability to change position
- R- Respiration: Obtaining energy by breaking down glucose...
- N- Nutrition: ~~About~~ Ability to take in food substances.

Monday 24th June, 2024

MR NIGER CAD

- I - Irritability: Ability to respond to stimulus
- G - Growth: Increase in height and size, due to Respiration and Nutrition.
- E - Excretion: Removal of toxic waste products that could be harmful to the body. In human, kidney is responsible. $\rightarrow \text{CO}_2$
- R - Reproduction: A communal responsibility among organisms which is the ability of an organism to perpetuate its existence, i.e. it is ability of an organism to reproduce offsprings.

The rate of natality must be equal / balanced with the rate of mortality, to prevent extinction and or Over population.

Artificial causes of mortality: diseases (epidemic (pandemic), wars, etc.

Sexual: Fusion \rightarrow Asexual: Fission

D - Death: Cease to existence of an organism

A - Adaptation: Ability to change with environmental changes

C - Competition: Strive for scarce means e.g. food, mate

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TOOLS & TECHNIQUES IN BIOLOGY

- MICROSCOPY & MICROSCOPE (Light, Compound, Electron (AEM))
- CHROMATOGRAPHY
- PCR

MONDAY 1ST JULY, 2024

SCIENTIFIC APPROACH TO BIOLOGY TOOLS & TECHNIQUES

MICROSCOPY

MICROSCOPE: A tool used to magnify specimens or samples. It is used in the field of Biological Science.

The fact that life is diverse, ^{makes it to} ~~with~~ ~~make~~ affect sizes, ~~work~~ with different sizes of animals from the ~~largest~~ ^{largest} & gigantic whale to the ~~most~~ ^{smallest} "minutest" or smallest organisms ~~that~~ that we can't see with the naked eye e.g. Amoeba.

Advancement in Biological science would not have occurred if not for the invention of a microscope. Robert Hooke invented a small & simple microscope. Over the years, better and more complex models have been invented. Types include:

1. **Light Microscope:** Uses the power of ^{natural} light & lens to magnify the ^{sample.} ~~specimen~~ ^{to magnify it.}
2. **Electron Microscope:** Electromagnetic waves ~~to~~ to scan over ~~or~~ ^{through} sample.

► **Light Microscope:** Types of light microscope include:

- **Hand lens:** It looks like a magnifying glass; perhaps they're the same.
- **Compound Microscope:** It uses electricity to get light; it could be ocular or binocular. Mostly **binocular**.
- **Dissecting Microscope:** Mostly used in **Entomology**. It is ocular and also called **STEREOMICROSCOPE**. It is used in ^{viewing} ~~studying~~ insects. [A magnified image]
- **Phase-contrast microscope:** It uses ~~view~~ ^{produced} a ~~white~~ ^{black} background and the sample comes out in white. Colours are in contrast with ^{their} original colours.
- **Fluorescent Microscope:** Differential staining of the parts of the organism. Different parts of the organism can be viewed with fluorescent microscope ^{part in different hues} which colours each.

► **Electron Microscope:** It uses electromagnetic waves, and it often has higher magnifying power than light microscopes. Forms of electron microscope include:

- **Transmission Electron Microscope [TEM]:** The **EM wave** moves ~~through~~ ^{of the sample.} through the sample and enlarges it. It transmits through it to produce a magnified image.
- **Scanning Electron Microscope (SEM):** The sample is ~~scanning~~ ^{scanned} and an enlarged image of the sample is produced. ^{with the by electromagnetic waves}

PARTS OF THE MICROSCOPE

NAME: SAMUEL JOHN AYOBAMI

Serial No: 007

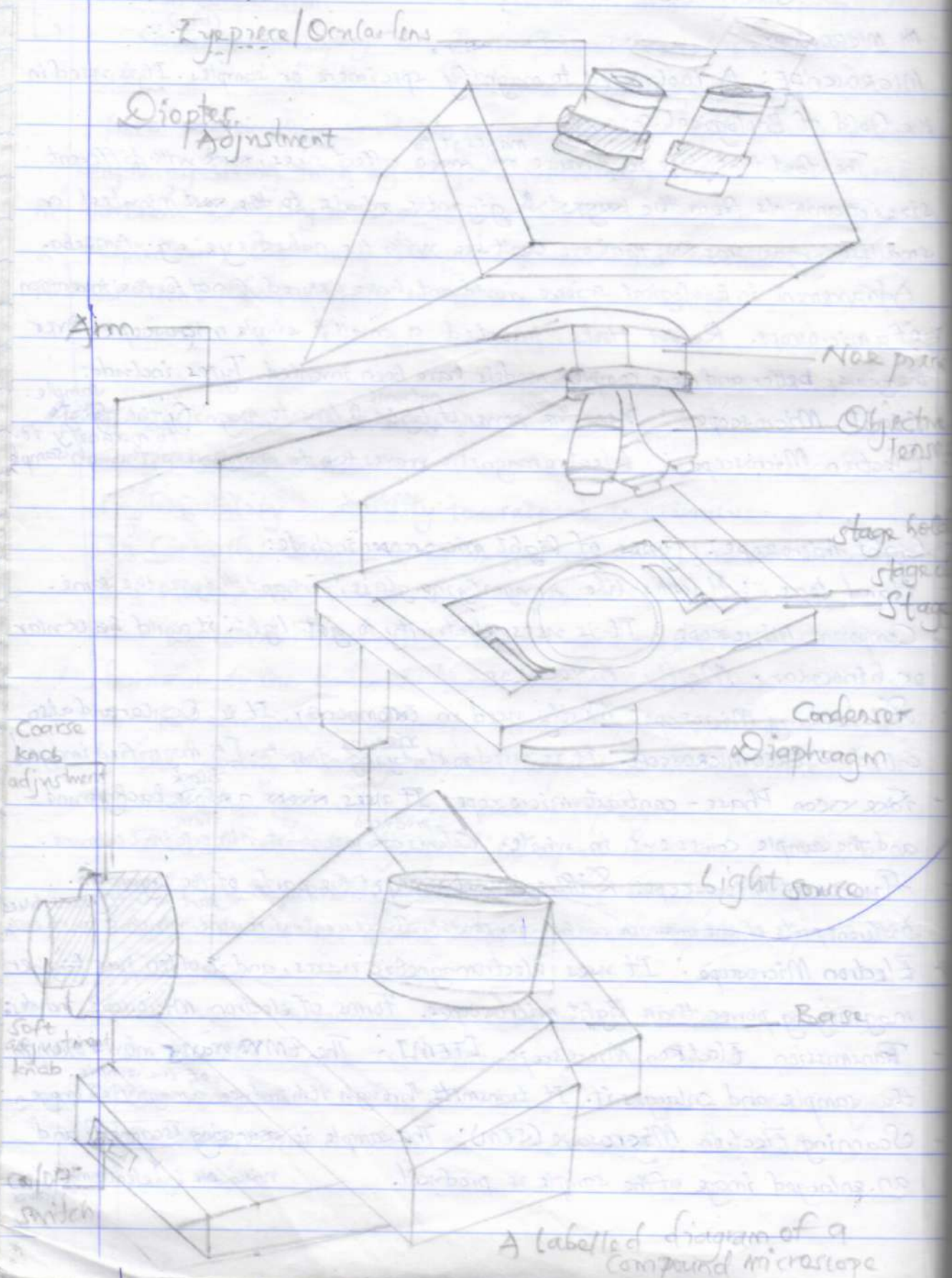
DATE: Monday 1st July, 2024

Assignment:

Draw and label a compound microscope

NAME, DATE, SERIAL NO: 007

NAME:



SCIENTIFIC APPROACH TO BIOLOGY

This refers to how scientist observe and hypothesise to the point of testing or experimenting to either confirm or refute the hypothesis.

STEPS: ~~TO~~ ~~OBSERVE~~ ~~EXPLAIN~~ [OHEICL]

1. OBSERVATION

Scientists have to observe and use insights ^{behaviour} take notice ^{of nature} ~~things~~ observations.

2. EXPLANATION: This is done in the form ^{of} hypothesis to give logical reasons for

HYPOTHESIS: An idea you can test

3. EXPERIMENT: This refers to the simulation in ^{controlled} environment to test out an hypothesis

4. INFERENCE: Results of experiment to either confirm hypothesis or refute it.

5. CONCLUSION: A summary of observation previously inferred after experiment.

6. LAW: A theory of statement that guides and confirms hypotheses after experiments and inference.

CELL (CYTOLOGY)

Why is a cell so important?

A cell is the basic, structural and functional unit of life.

The component of a cell determines the totality of life even to the point of progeny.

HISTORY OF CELL

In the 17th century, with the work of a naturalist, Robert Hooke, an English scientist. In the 1665, he observed the bark of an Oak Tree and noticed that it seemed to have several tiny holes. He used a simple light microscope, which he invented. It used a lens to bend light rays.

He called the holes or rooms cellulae, ~~the~~ and went further to check the stem and roots and found the holes / rooms in them. He named the holes little boxes.

Another scientist invented another microscope which had a magnifying power $\times 10$ ~~than~~ that of Robert Hooke's. He was Anton van Leeuwenhoek, a Dutch trader; he observed cells in spirogyra and described them as ANIMALCULES, now known as Protists. He also observed Vorticella.

Anton van Leeuwenhoek and Robert Hooke were the first scientists to discover cell. After 150 years, more scientists discovered more information about cells using more advanced versions of microscopes.

Mathias Schleiden was a German Botanist, who showed that all

plants are made up of cells after serial experiments in 1838. Then, Theodore Schwann, a German zoologist, in 1839, said that animals are made up of cells. Furthermore,

08/07/24 CHROMOSOMES & GENES

DR. JANYA

CHROMOSOMES

Chromosomes are thread-like structures located in the nuclei of cells. They carry hereditary information in the form of Genes (DNA). Each chromosome is made up of DNA tightly coiled many times around proteins called HISTONES that support its structure.

Each chromosome has a constriction point called the centromere which divide the chromosome into two halves. The short half is called the [P arm] and the long half is called the [Q arm].

The location of the centromere on each chromosome gives the chromosome its characteristic shape and can be used to describe the location of specific genes.

TELOMERES: They are special structures on the chromosome ends which stop the chromosomes from fraying or sticking to each other. They also play an important role in making sure that DNA gets copied properly when cells divide.

Chromosomes are not visible in the nucleus of the cell, even when a cell is not dividing, even under the microscope. However, DNA that makes up chromosomes, becomes more tightly-packed during cell division and then becomes visible under the microscope [electron microscope]. Most of

Most of what researchers know about chromosomes were learned when observing chromosomes under the microscope.

TYPES OF CHROMOSOMES

Autosomes - Sex chromosomes

Autosomes refer to all the other chromosomes within an individual other than the sex chromosomes. They occur in pairs in somatic cells, while in sex cells (gametes), they occur individually or singly.

In humans, a somatic cell normally contains 23 pairs of chromosomes and a total of 46. 22 of these pairs are autosomes and are similar. Autosomes are primarily associated with various metabolic functions of the

cell, except for sex determination

Sex chromosomes: Among the 23 pairs of

Sex chromosomes are largely responsible for sex determination in many species.

Among the 23 pairs of chromosomes in human, only one of them will be a pair of sex chromosomes. In the human female, the sex chromosome is XX. However in the males, the 23 pair are morphologically different and are said to be **HETEROMORPHIC** (X, Y). The hereditary factor in the Y chromosome, determines the tendency to maleness.

Illustration:

XX - Female

↳ Homomorphic (structure)

♀ ♂ → Homogametic (types of gametes prod.)

X Y - Male

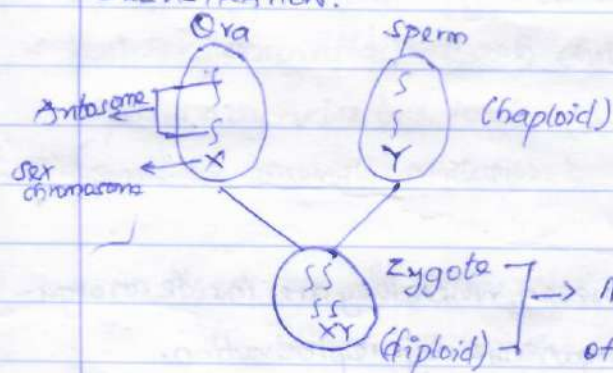
↳ Heteromorphic

♂ ♀ → Heterogametic

GENES

The inheritance of parental characters by offspring is carried out by the genes, which are ultra-microscopic particles occurring in pairs, in linear series in the chromosomes. One pair is usually paternal and the other, maternal.

ILLUSTRATION:



Note Meiosis div converts it
diploid to haploid

A gene or a pair of genes is therefore defined as a factor responsible for the production of a particular character in plants and animals. It can also be defined as an inherited factor that determines the biological characteristics of an organism. [Classical definition].

In the molecular definition, a gene is a sequence of nucleotide parents that determines the sequence of amino acid in a polypeptide chain. The chemical name for genes is Deo-xy Ribonucleic acid (DNA), which is the molecule that carries genetic instructions in all living things. The gene

central information storage system of most animals are plants, including microorganisms, viruses included.

DNA encodes the information the cell needs to make proteins. An entire set of DNA molecule in a nucleus is referred to as GENOME.

Ans: Write on the effect of the genes formation ^{process} of proteins.

GENOME is derived from the structure of the DNA which is a sugar and a phosphate backbone, which has bases sticking out of it. Therefore, the "deoxy-ribo" refers to the sugar and the "nucleic acid" refers to the phosphate and bases together.

DNA: Sugar phosphate & bases are the components of the DNA.

CELL BIOLOGY

ANIMAL

zoans

Proto → before

Unicellularity - Protozoans (Animals)

Multicellularity → Metazoans (Animals)
→ ~~Metaphyte~~ Metaphyte (Plants)

Protonephridia - Platyhelminthes

nephridia - Annelida

Viruses are non-living organisms. However, when they are inside an organism, they behave like ~~as~~ living organisms by reproduction.

CELL STRUCTURE

Multicellularity: Cell Differentiation / Specialisation

- Colonies: An aggregation of ^{genetically identical and} similar structured ~~cells~~ functional cells, with less or no cell differentiation. E.g. Volvox, Spirogyra
- Multicellular: Made up of several cells

ROLES OF CHROMOSOMES & GENES IN HEREDITARY

Chromosomes and Genes play important roles in Evolution and heredity. Chromosomes, which are located in the nucleus of most cells, are bearers of hereditary characters.

Living organisms reproduce by the fusion of the male and female gametes and the zygote so formed, develops into ~~the~~ ^a young of that organism and grows into matured form, so that the parental characters are transmitted to the offspring through the gametes.

The somatic cells (body cells) have $2n$ chromosomes of which n chromosomes are of paternal origin and the other n of maternal origin.

When gametes are produced, $2n$ is reduced to half (n) by MEIOSIS, so that each gamete has n chromosomes. As soon as the gamete fuses to form zygote, $2n$ is regained.

ILLUSTRATION:



The inheritance of parental character by offspring is carried on by genes. Genes are ultramicroscopic particles occurring in pairs (1 paternal and 1 maternal) in linear series in the chromosomes. When a chromosome splits, the genes also split and becomes equally apportioned to 2 chromatids (sister chromatids). Each chromosome, carries several genes in its body. New species may arise due to changes in or loss or degeneration of genes [Evolution] (could be through mutation or crossing-over)

HEREDITY & EVOLUTION

Heredity describes the biological process by which certain characteristics are transmitted from parents to their offspring.

Evolution is the process by which different kinds of living organisms are believed to have changed or developed from earlier forms during the history of the Earth.

Theories of Evolution

1. Darwinism (Natural Selection) → Survival Of the fittest → variation, Heredity, struggle for existence
2. Lamarckism (Acquired characteristics can be transmitted)

MENDELIAN LAWS

Gregor Mendel was an Austrian monk, laid the science of genetics through the discovery of basic principles of heredity. He conducted an experiment

with the garden pea (*Pisum sativum*), for over 7 years (1856-1864) and advocated or advanced two important laws of inheritance.

MENDEL'S FIRST LAW:

Mendel deduced his first law, called "The Law of Segregation," from his study of monohybrid inheritance which states that "members of allelic pair, go into different cells when gametes are formed".

MENDEL'S SECOND LAW:

It is called "Law of Independent Assortment", and it states that members of different allelic pairs assort independent of each other when germ cells / gametes are formed.

GENETIC TERMINOLOGIES

- **Gametogenesis:** The process of producing gametes or spores. This occurs when a haploid cell (n) is formed from a diploid cell ($2n$) through meiosis.
- **Genome:** It refers to the complete set of DNA or genetic materials in an organism. The genome of man is 46, in maize (20), in cow peas (22).
- **Linkage:** It occurs when genes located on the same chromosome cannot act independent of each other. Thus, they cannot obey the Mendelian law of independent assortment. Linkage may be explained as the close location of genes to each other on the chromosomes.
- **Complete dominance:** It occurs between two alleles at the same locus. When one allele is expressed to the exclusion of the other in the F_1 generation.
- **Alleles:** Two individual genes in a particular gene pair.
- **Homozygote:** Individual that has similar alleles in its gene pair. (TT, tt)
- **Heterozygote:** Individual whose alleles of a gene pair are not similar.
- **Recessive gene:** It is a gene whose character is not expressed in heterozygote condition.
- **Dominant gene:** It is a gene whose character is expressed in heterozygote condition.
- **Phenotype:** The expressed character.
- **Genotype:** The genetic make up of an organism, i.e. the producer genetic material that an organism inherits from its parent.
- **Monohybrid:** Individuals that differ in one single pair of gene located in the same locus.
- **Dihybrid:** Individuals that differ in two pairs of genes.
- **Test cross:** Cross that is made to the double recessive trait.

Back cross: The crossing of a hybrid with one of its parents or another individual, genetically similar to the parents in order to achieve offsprings with a genetic identity closer to that of the parents.

22nd July, 2024 (Mon)

DR. SANYA DEVI.

GENETIC CONCEPTS

1. **COMPLETE DOMINANCE:** It occurs between two alleles of the same locus which contains alternative changes when one allele is expressed to the exclusion of the other in the F_1 generation of a cross. In this case, the dominant allele is expressed to the exclusion of the recessive character in a heterozygote condition, this is the case with Mendelian's law of genetics where all the traits observed in his work showed complete dominance of one trait.

F_1 Hybrid

2. **CO-DOMINANCE:** This occurs when both alleles of a pair of gene are fully expressed together in the individual. For instance, if individuals with red flower and white flower are crossed, and the offspring has flowers with red and white patches on them, it is co-dominance. Therefore in codominance, both parental phenotype shows up together on an offspring e.g. A, B, AB and O blood groups.

3. **INCOMPLETE OR PARTIAL DOMINANCE:** This occurs when there is a blending of the two alleles in an individual such that it ~~dissolves~~ ^{results} into a 3rd phenotype that does not look like either of the parent. A classic example is when a white flowered and red flowered individuals are crossed and all their offspring will have solid pink flower, which is a completely new phenotype. In this case, neither of the parental phenotype is observed in the offspring. Another example is in the height of individuals, Offsprings will likely not have the exact height as one or either of their parents but will always have a blend between the two parental phenotypes.

VARIATION

Variation refers to the differences that exist among species which could be phenotypic or behavioural. Genetics or biological variation involves all the variation that occurs as a result of changes in the genes and could be passed on from one generation to another.

MUTATION

Mutation is a sudden heritable change in structure of genetic materials. The modified gene resulting from mutation is a mutant gene.

Mutation usually results in individuals with some characteristics strikingly different from the rest of the population.

⇒ Examples of mutation include: Haemo-
and vestigial resistance of bacteria to penicillin and.
Cystic fibrosis in humans, white eye

ECOLOGICAL CONCEPTS (ECOLOGIST)

The term ecology is derived from two Greek words 'Oikos' which means 'house' and 'logos' which means 'study of' or 'the science of'. Therefore, ecology is defined as the study of organisms in relation to their environment.

ECOSYSTEM

An ecosystem is defined as an ecological unit with its biotic and abiotic components, with noticeable interactions between the groups of components.

An ecosystem is a system that is formed through the interaction between the environment and the organism living in them.

ECOLOGICAL CONCEPT

A concept is a thought or idea about a particular thing. The concept of an ecosystem means viewing organisms as part of a larger system where parts are interacting and interdependent. An ecosystem is a complex network of interaction among organisms and their physical environment. It encompasses all biotic and abiotic concepts in a specific area functioning in a unit. An ecosystem can be as large as a desert or as small as a pond.

STRUCTURE OF THE ECOSYSTEM

Ecosystem structure comprises two main components namely the biotic and the abiotic component which are inter-related in the ecosystem. The structure of an ecosystem is determined by the interaction of these two components within the ecosystem. This includes the distribution of energy in the environment and the climatic conditions prevalent in that environment.

FUNCTIONS OF THE ECOSYSTEM

1. Ecosystem regulates the essential ecological processes & supports life systems.
2. It is responsible for cycling of nutrients between biotic and abiotic components.
3. It maintains a balance among the various trophic levels in the ecosystem.
4. It cycles minerals through the biosphere.
5. The abiotic component helps in the synthesis of the organic component which involves the exchange of energy.

Basic terms:

1. **Environment:** Defined as the surrounding of an organism in a place where it lives. It embraces everything external to the organism that influences the life of the organism in a place where it lives.
2. **Habitat:** A place or locality where organisms live and is also regarded as the physical portion of environment where organisms live.
3. **Ecological factors:** This can also be called "Environmental factors" and are those elements that can cause significant influences on element or their communities resulting in an increase or decrease in the number of organisms which can cause changes in the communities.
These elements or features are used in characterising or differentiating one habitat from another.
4. **Ecological niche:** This is the biological status of organisms in the community. It describes the functional role of the organisms among its species and members of different species with which they exist in the same habitat.

Elytra : ^{hard} Back of a beetle

Thursday 25th July, 2024

5. BIOMES (ECOLOGICAL TERMS)

A biome is a distinct geographical region with its peculiar climate and animal life. It consists of a biological community that has formed in response to its physical environment and regional climate. It also refers to the community of plant and animals that occur naturally in an area, often sharing common characteristics, specific to that area. The major types are:

- Aquatic - Tundra - Grasslands - Deserts - Forests ; Although some other biomes exist as sub-division such as coniferous forest, temperate deciduous forests, rain forests.

6. ADAPTATION

The capacity of organisms living in an environment to utilise the resources available in the environment, undergo development, reproduce at maturity and participate fully in all the ecological essential dynamics that sustain the ecosystem.

7. ECOLOGICAL POPULATION : An assemblage of organisms belonging to

several single species or several closely-related species in an area

8. **ANTHROPOLOGY**: Study of individual plant or animal and their environment. It is also called ~~species~~ "SPECIES ECOLOGY".
9. **COMMUNITY**: A biological community consists of several populations of organisms, living in association with one another in a given natural area.
10. **Natural Disasters**: Also called Natural Destruction, are severe and extra natural events that can have detrimental impact on human lives and properties. Examples include: Earthquake, Tsunami, Volcanic eruption, wild fires, etc.
11. **Ecological Disasters**: Environmental Disasters are catastrophic events in the natural environment that is ~~also~~ caused by human activities. ^{E.g.} Include: Nuclear emissions, Global warming, Soil erosion, Environmental pollution, Deforestation, Climate change, etc.

12. π Types of Habitats

- **Aquatic Habitat** - Terrestrial habitat
 - Fresh water, - marine
 - Estuarine (Brackish water)
 - Desert

AQUATIC

- **FRESH WATER**: It is characterised by low-salt content, making it a suitable environment for various plants and animals. It represents only 3-3.5% of water on earth and is found in ponds, rivers, streams, lakes, etc. Fresh water sources differ from each other in terms of their movements; some fresh water bodies keep moving like rivers & streams, while some are stagnant like ponds & lakes.
- **MARINE HABITAT**: The largest known environment and are characterised by presence of high-salt content. They represent about 97% of water on earth. E.g. Oceans, Salt marshes, Intertidal zones, lagoons, mangroves, Coral reefs, deep sea and sea floors.
- **ESTUARY OR BRACKISH WATER**: Places where fresh water from rivers mixes with salt water from the sea and oceans. Organisms in this include Alligator

TERRESTRIAL HABITATS

1. **Forest**: A complex ecological system in which trees are the dominant life form. It is nature's most efficient ecosystem with a high rate of photosynthesis affecting both plants and animals in a series of complex

organic relationships.

Examples of forests include temperate forest, tropical forests, tiga forest.

2. Arboreal Habitat : Found in trees, Latin word "arbor"

Many different organisms make their home in arboreal forests which are found in almost any forest ecosystem, however, they are more concentrated in the tropical forest. E.g. Amphibians (Tree frogs), Birds (Woodpeckers), Insects (Tree hoppers, Weaver ants) and Mammals (Monkey & squirrel), Reptiles (Chameleon, Bats)

3. Savannah: A vegetation type that grows under hot and seasonally dry climatic conditions which is characterised by scattered trees above a continuous tall grass under-storey. Types: Guinea, Sudan, Sahel. The largest area of savannah are found in Africa, South America, Australia, India, Myanmar & Madagascar

4. Deserts: A barren area of landscape where little precipitation occurs. Consequently, living conditions are hostile for plant and animal life. The lack of vegetation exposes the unprotected ^{surface of the ground} ~~land~~ to ^{one} DENUDATION. It is ^{one} of the earth's major types of ecosystems supporting a community of distinct plant and animals specially adapted to the harsh environments. Examples include Sahara desert, Calahari desert, Libya Libyan desert, etc.

BIOTIC INTERACTIONS

Types:

- Symbiosis - Commensalism - Predation - Parasitism - Competition

BIOTIC INTERACTION (DEFINITION)

Biotic Interactions refer to the various ways that one species of organism, by its ecological status and peculiar mode of life influences another species of organism, that cohabits the same environment.