BIOLOGY

FOR

Senior Secondary School

2

AKADALEARN

FIRST TERM NOTES ON BIOLOGY

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Biology, SS 2 First Term,

Week: 1

Topic: What is a Cell?

The cell was discovered by Robert Hooke in 1665, who named the biological unit for its resemblance to cells inhabited by Christian monks in a monastery. Cell theory, first developed in 1839 by Matthias Jakob Schleiden and Theodor Schwann, states that all organisms are composed of one or more cells, that cells are the fundamental unit of structure and function in all living organisms, that all cells come from preexisting cells, and that all cells contain the hereditary information necessary for regulating cell functions and for transmitting information to the next generation of cells.

Cell can be defined as the structural and functional unit of life. It could also be describe as the simplest and basic unit of life in which are living organism are made of cells. The **cell** (from Latin cella, meaning "small room") is the basic structural, functional, and **biological** unit of all known living organisms. A **cell** is the smallest unit of life that can replicate independently, and **cells** are often called the "building blocks of life". The study of **cells** is called **cell biology**. A cell is the smallest unit of life that can replicate independently, and cells are often called the "building blocks of life". The study of cells is called cell biology.

Cells consist of cytoplasm enclosed within a membrane, which contains many biomolecules such as proteins and nucleic acids. Organisms can be classified as unicellular (consisting of a single cell; including bacteria) or multicellular (including plants and animals). While the number of cells in plants and animals varies from species to species, humans contain more than 10 trillion (10^{12}) cells. Most plant and animal cells are visible only under a microscope, with dimensions between 1 and 100 micrometres.

Classification of Living Organism Based on the Number of Cells

This Includes

1. **Unicellular Organism:** These are organisms which consist of only one cell e.g. Amoeba, Paramecium.
2. **Multi-cellular Organism:** These are organisms which consist of two or many cells e.g. flowering plant, Bird, Hydra.

History of Cell

Many scientist have contributed to the distribution of history of cell which are listed below;

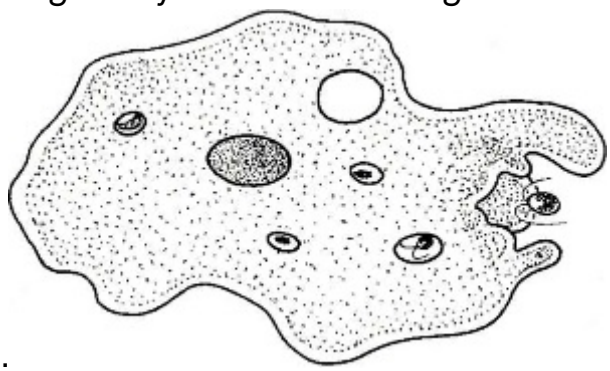
1. **Robert Hooke:** He is regarded as the father of cell. He was the first human being to discover the honey comb structure of the cell in 1665. In his book, Micrographic, he described his observation of a slice of a cork of an oak tree. He established that the cork is made up of thin components or rooms which he later named the components of cells. 
2. **Felix Dujardin:** He was a French biologist in 1835, which he discovered that the cell was made up of living substance. He however named the living substance protoplasm.
3. **Matthias Schledien:** He is also a German botanist in 1838 revealed that the bodies of plants are made of cells which were described as units of life.

4. **Theodore Schwann:** He was also a German zoologist in 1839; He discovered that the bodies of all animals are composed of cells.
5. **Rudolf Von Virchow:** He was also a German biologist in 1855, concluded in his research that all cells come from previously existing cells.

Forms In Which Living Cells Exist

These include;

1. As Independent or Single and Free Living Organism: This means that organism that possesses only one cell and is capable of living freely on their own. e.g. Amoeba,



Paramecium.

2. As a Colony: This means that some organism are made of many similar cells which are joined or massed together but they cannot be differentiated from each other .e .g Volvox, Pandorina, etc.
3. As a Filament: This simply that certain cells are organised into filaments. Each cells functions as an independent living cell. E.g. Spirogyra, Zygnema.
4. Cells as Part of a Living Organism: This means that in a multi-cellular organism, a group of numerous, similar cells are arranged together to perform specific functions and this is called a tissue. A group of similar tissue forming a layer in an organism which performs a specific function is called an

organ. A group of organs which work together to perform specific functions is called a system.

Colonial Organism	Filamentous Organism
1. There is absence of intercellular wall.	There is presence intercellular wall.
2. The identical cells forms a mass.	The identical cells form end to end arrangement in linear form.

ASSESSMENT

1. Death or mental retardation takes place if accumulation happens in
   (a) somatic cells
   (b) brain cells
   (c) meristemetic cells
   (d) sensory cells
2. In a normal human being number of chromosomes is
   (a) 23
   (b) 46
   (c) 53
   (d) 26
3. Pigments containing bodies which are bounded by membrane are called
   (a) plastids
   (b) chlorophyll
   (c) chloroplast
   (d) hemoglobin
4. In word Lysosoma, ‘lyso’ means splitting and ‘soma’ means
   (a) cell
   (b) body
   (c) tissue
   (d) organic

5. hagocytosed food is digested with help of enzymes which are present in
   (a) ribosome
   (b) lysosomes
   (c) mitochondria
   (d) Golgi complex

ANSWERS

1. b
2. b
3. a
4. b
5. b

Biology SS 2 First Term

Week 7

Topic: Cell Reactions to Its Environment (Irritability)

Irritability or sensitivity is the ability of a cell to respond to stimuli. All living things respond to stimuli. A stimulus is a change in the cell's environment that can make it change its activity. The cell's change in activity is known as its response to the stimulus.

The cell responds both externally and internally to changes. The external stimuli are due to non-living or abiotic factors of the environment such as change in light intensity, temperature, humidity etc. while an internal stimulus is a change within the cell itself.

Types of Response

- **Phototropism**: This is the response of plants to light. The shoots are positively phototropic while the roots are negatively phototropic.
- **Hydrotropism**: This is the response of plants to water. The roots are positively hydrotropic while the shoots are negatively hydrotropic.
- **Geotropism**: This is the response of plants to gravity. The roots are positively geotropic while the shoots are negatively geotropic.

How Environmental Factors Evoke Response

A plant that is starved of adequate light responds towards any source of light available. The shoot will respond positively to the source of light while the root will respond negatively.

Placing a plant in a horizontal position causes an unequal diffusion of hormones. This will make the shoot negatively geotropic by growing upwards.

In a shaded area, smaller plants in an attempt to get light from top grow taller. This is called aetiolation.

Movement

Movements that are due to external stimuli may be nastic, tactic or tropic movement.

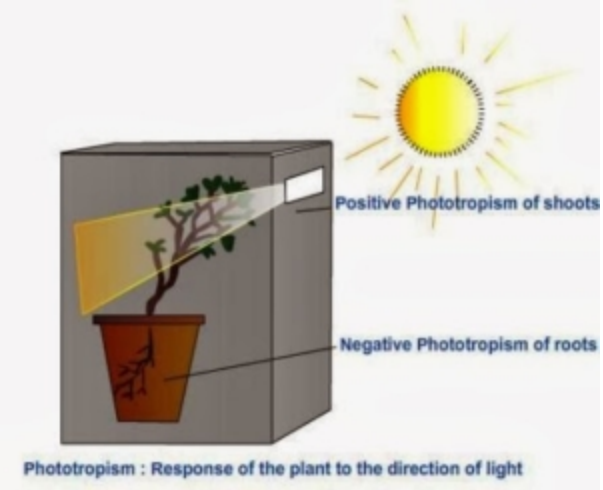
- **Nastic movements**: These are responses shown by a part of a plant to non-directional stimuli such as changes in light intensity, temperature or humidity. Examples are closing of the morning glory flower when the light intensity is low.
- **Tactic movements**: This is when a whole organism moves directly towards or away from a stimulus. The stimulus comes from a particular direction. This type of response is said to be directional, and is positive if the organism moves towards the stimulus and negative if it moves away from it. Tactic movement are named according to the type of external stimuli:

1. **Phototaxis**—if the stimulus is light.
2. **Chemotaxis**—if the stimulus is chemical
3. **Thermotaxis**—if the stimulus is temperature

Tactic movements occur in motile organisms such as Amoeba, Chlamydomonas, Euglena and Earthworm.

Tropic movements: when a part of a plant moves in response to a directional stimulus. The direction of the response is related to that of the stimulus, and is positive if the plant parts grow towards the stimulus and negative if the part grows away from it. Tropisms are very slow growth movements. They are named according to the

stimuli, e.g. phototropism is a response to light, while hydrotropism is a response to water.



Cyclosis

This is the streaming rotary motion of protoplasm within certain cells and one-celled organisms, i.e. circulation of cytoplasm or cell organelles, such as food vacuoles in some protozoan.

Movement in plants is not as conspicuous as found in animals. Their movement is by continuous and uniform flow of cytoplasm. In animals, cyclosis occurs in protozoa like amoeba (amoeboid movement).

Organs for Movement

1. **Flagella**: They are long and are used in moving in liquid medium by flashing against water current. Euglena and Chlamydomonas have flagella.
2. **Cilia**: They are usually numerous and short. It aids movement in water just like flagella. Paramecium has cilia.

Practice Questions

1. _____ is the ability of a cell to respond to stimuli
   a) Adaptability

b) Irritability
c) Sensation
d) Stimuli

2. _____ is the response of plants to light
3. _____ is the streaming rotary motion of protoplasm within certain cells and one-celled organisms, i.e. circulation of cytoplasm or cell organelles
   a) Cyclosis
   b) Sporosis
   c) Neurosis
   d) Stimuli
4. Euglena and Chlamydomonas move by their _____.
5. A response to a cemical stimulus is called _____
6. ____ is the response of plants to gravity
   a) Gravitropism
   b) Neotropism
   c) Geotropism
   d) Phototropism
7. _____ is the response of plants to water
   a) Gravitropism
   b) Hydrotropism
   c) Geotropism
   d) Phototropism

Answers

1. B
2. Phototropism
3. A
4. Flagella
5. Chemotaxis

6. C
7. B

Biology, SS 2 First Term

Week: 2

Topic: Structure of Plant and Animal Cell

The cell is composed of protoplasm which can be divided into two main parts namely;

1. The cytoplasm
2. The nucleus

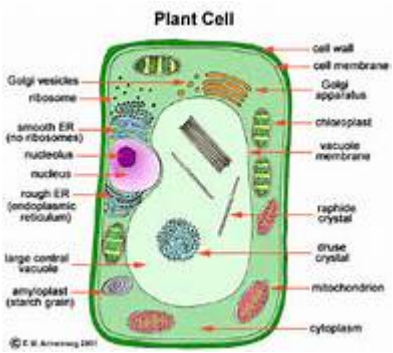
Each cell is bounded by a thin membrane. The cytoplasms are fluid materials that consist of cytoplasmic organelles such as Lysosome, golgi bodies, endoplasmic reticulum, and mitochondria, etc.

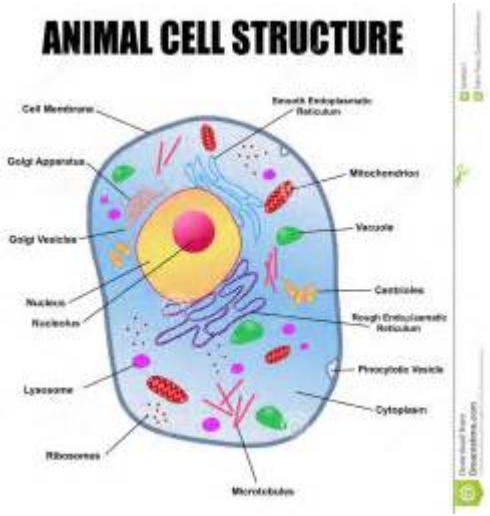
The nucleus is bounded by a nuclear membrane and it consists of chromosomes and nucleolus.

The animal cell in addition has centrosome. It also has starch granules, cellulose cell wall and some plastid e.g. chloroplast. The table below shows some cell organelles and functions.

Cell Organelles	Functions
Nucleus	It controls all life activities of the cell.
Chromosome	It controls the DNA which stores genetic traits.
Mitochondria	It is described as the power house of the cell.
Vacuole	It contains cells sap which act as an osmoregulation by helping to remove excess water in cells.
Nucleolus	It produces the ribosome for protein synthesis.

Endoplasmic reticulum	It aids the transport of materials within the cytoplasm.
Golgi bodies	It functions in synthesis, packaging and distribution of materials.
Chloroplasts	They contain chloroplast which aids photosynthesis in green plants.
Lysosomes	They are sites for respiratory enzymes.
Ribosomes	They are responsible for protein synthesis.
Cell wall	It provides protection, shape and mechanical support for the cell.
Centrioles	They are important in cell division. They may also serve as basal body from which flagella or cilia arise.
Starch granules	They store starch for cell.





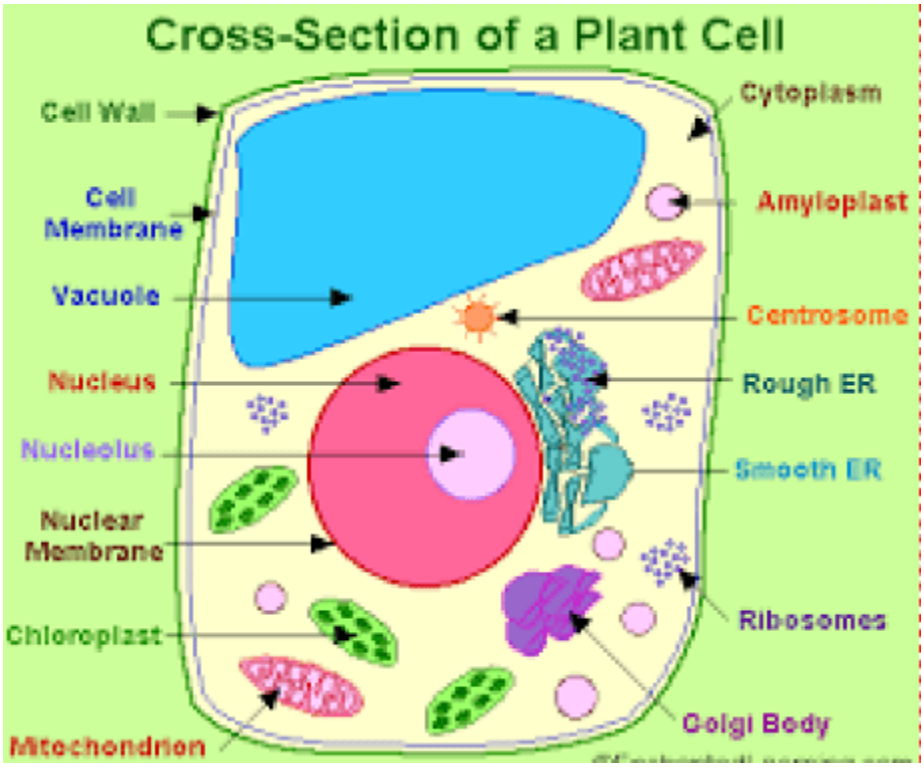
- **Cell nucleus**: A cell's information center, the cell nucleus is the most conspicuous organelle found in a eukaryotic cell. It houses the cell's chromosomes, and is the place where almost all DNA replication and RNA synthesis (transcription) occur. The nucleus is spherical and separated from the cytoplasm by a double membrane called the nuclear

envelope. The nuclear envelope isolates and protects a cell's DNA from various molecules that could accidentally damage its structure or interfere with its processing. The nucleolus is a specialized region within the nucleus where ribosome subunits are assembled. In prokaryotes, DNA processing takes place in the cytoplasm.

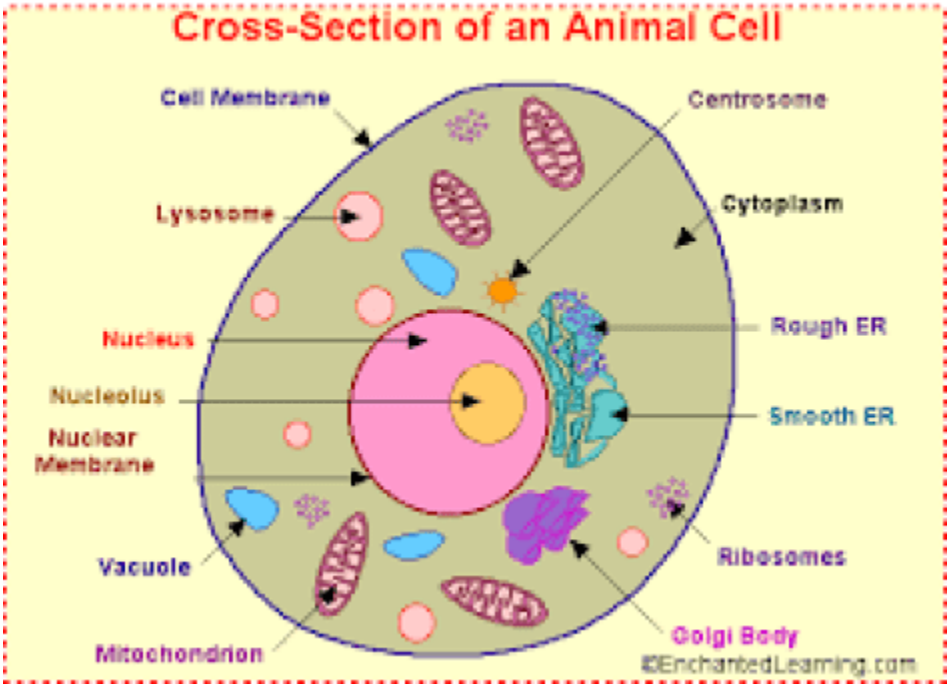
- **Mitochondria and Chloroplasts**: They generate energy for the cell. Mitochondria are self-replicating organelles that occur in various numbers, shapes, and sizes in the cytoplasm of all eukaryotic cells. Respiration occurs in the cell mitochondria, which generate the cell's energy by oxidative phosphorylation, using oxygen to release energy stored in cellular nutrients (typically pertaining to glucose) to generate ATP. Mitochondria multiply by binary fission, like prokaryotes. Chloroplasts can only be found in plants and algae, and they capture the sun's energy to make carbohydrates through photosynthesis.
- **Chloroplast***:* They are the site of photosynthesis, which are present in chlorophyll bacteria, blue-green algae.
- **Endoplasmic reticulum**: The endoplasmic reticulum (ER) is a transport network for molecules targeted for certain modifications and specific destinations, as compared to molecules that float freely in the cytoplasm. The ER has two forms: the rough ER, which has ribosomes on its surface that secrete proteins into the ER, and the smooth ER, which lacks ribosomes. The smooth ER plays a role in calcium sequestration and release.
- **Golgi apparatus**: The primary function of the Golgi apparatus is to process and package the macromolecules such as proteins and lipids that are synthesized by the cell.
- **Lysosomes and Peroxisomes**: Lysosomes contain digestive enzymes (acid hydrolases). They digest excess or worn-out organelles, food particles, and engulfed viruses or bacteria. Peroxisomes have enzymes that rid the cell of toxic

peroxides. The cell could not house these destructive enzymes if they were not contained in a membrane-bound system.

- **Centrosome**: The cytoskeleton organiser: The centrosome produces the microtubules of a cell – a key component of the cytoskeleton. It directs the transport through the ER and the Golgi apparatus. Centrosomes are composed of two centrioles, which separate during cell division and help in the formation of the mitotic spindle. A single centrosome is present in the animal cells. They are also found in some fungi and algae cells.
- **Vacuoles**: Vacuoles sequester waste products and in plant cells store water. They are often described as liquid filled space and are surrounded by a membrane. Some cells, most notably *Amoeba*, have contractile vacuoles, which can pump water out of the cell if there is too much water. The vacuoles of plant cells and fungal cells are usually larger than those of animal cells.
- **Ribosomes**: The ribosome is a large complex of RNA and protein molecules. They each consist of two subunits, and act as an assembly line where RNA from the nucleus is used to synthesise proteins from amino acids. Ribosomes can be found either floating freely or bound to a membrane (the rough endoplasmatic reticulum in eukaryotes, or the cell membrane in prokaryotes)


Cross-Section of a Plant Cell
Cell Wall
Cell Membrane
Vacuole
Nucleus
Nucleolus
Nuclear Membrane
Chloroplast
Mtochondrion
Cytoplasm
Amyloplast
Centrosome
Rough ER
Smooth ER
Ribosomes
Golgi Body

Plant Cell



Animal Cell

Similarities between Plant and Animal Cell

Both plant and animal cells have in common the following organelles;

- Nucleus
- Mitochondria
- Cytoplasm
- Ribosome
- Cell membrane
- Lysosome
- Chromosome
- Endoplasmic reticulum
- Golgi bodies
- Nucleolus

The Difference between Plant Cell and Animal Cell

Plant Cell	Animal Cell
Plant cell has chloroplast	Animal cell has no chloroplast
It is usually rectangular and definite in shape	Animal cell is usually spherical
It has rigid cell wall	It has no cell wall
It has no flexible cell membrane	It has flexible cell membrane
It has a large vacuole	It has a small vacuole

The Cell Theory

The cell theory is stated below;

1. The cell is the structural and functional unit of life.
2. All living organisms are made of cells
3. All cells come from previously existing cells.
4. There is no life apart from the life of cells.
5. All living things are either single cells or multicellular cell.

Practice Questions

1. The nucleus is bounded by a _____ and it consists of chromosomes and nucleolus.
2. The site of photosynthesis in the body is the _____
   a) Chlorophyll
   b) Chloroplast
   c) lysosome
   d) Ribosome
3. RNA means _____

4. Lysosomes contain digestive enzymes called _____
   a) acid hydrolases
   b) hydrolases
   c) acid hyalases
   d) lipase
5. Centrosomes are composed of _____ which separate during cell division and help in the formation of the mitotic spindle
   a) one centriole
   b) two centrioles
   c) three centrioles
   d) centrioles
6. _____ is the power house of the cell that generates energy
7. _____ controls the DNA which stores genetic traits.
8. One of the following can be found in the plant cell but not in the animal cell
   a) Cell membrane
   b) Cytoplasm
   c) Chloroplast
   d) Nucleus
9. Another name for centrosome is _____
10. Centrosome is commonly found in _____ cell

Answers

1. Nuclear membrane
2. B
3. Ribonucleic Acid
4. A
5. B
6. Mitochondria

7. Chromosome
8. C
9. The Cytoskeleton Organiser
10. Animal

Biology SS 2 First Term

Week: 8

Topic: What is Reproduction?

Reproduction means the act of bringing to life young ones that are of the same species. In other word, reproduction is the creation of a new individual or individuals from previously existing individuals.

Types of Reproduction

There are two types of reproduction. These are:

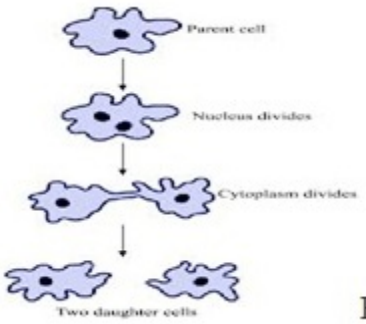
Asexual Reproduction: Only one organism divides to form new ones.

Sexual Reproduction: Two gametes (male and female) fuse together to form a zygote which later develops to a young one.

ASEXUAL REPRODUCTION

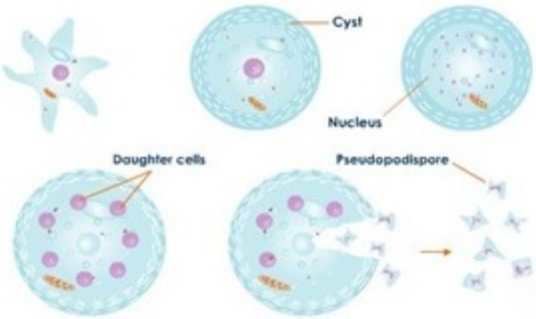
In asexual reproduction, one individual produces offspring that are genetically identical to itself. These offspring are produced by mitosis. There are many invertebrates, including sea stars and sea anemones for example, that produce by asexual reproduction. Common forms of asexual reproduction include:

Binary Fission: This is the division of cell into two. Examples are found in protozoa and bacteria.



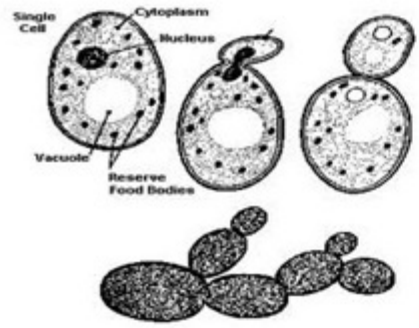
Binary Fission in Amoeba

Cyst Formation (Multiple Fission): This is the division of cell into many daughter cells especially during adverse weather condition – dry season. Example is seen in plasmodium.



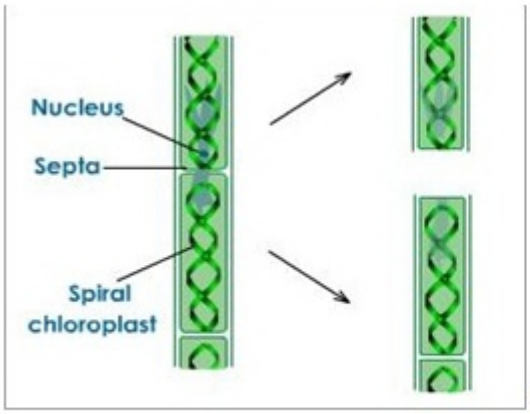
Multiple fission in Plasmodium sp

Budding: In this form of asexual reproduction, an offspring grows out of the body of the parent. Hydras and yeast cells exhibit this type of reproduction.



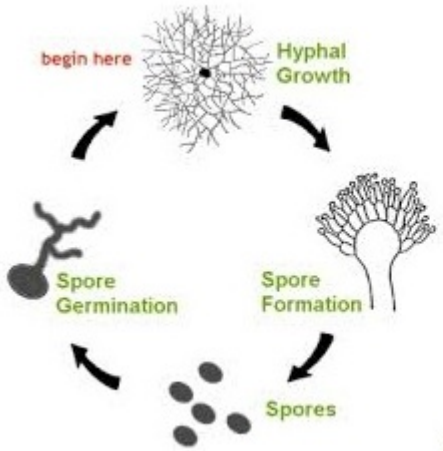
Budding in yeast cell.

Fragmentation: In this type of reproduction, the body of the parent breaks into distinct pieces, each of which can produce an offspring. Planarians and spirogyra exhibit this type of reproduction.



Spirogyra fragmentation

Spore Formation: Commonest among fungi. Also are the bacteria, mosses and ferns.



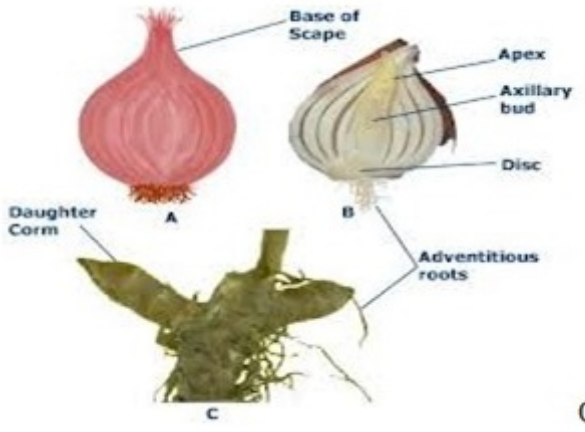
Spore Formation in Fungi

Vegetative Propagation: There are two types – Natural and Artificial Vegetative propagation.

Natural Vegetative Propagation: This is the use of natural parts of plants to reproduce and get new individuals. Such part includes stems, leaves and roots. Forms of natural vegetative reproduction are:

- Planting of creeping stems e.g. elephant grass.
- Planting of underground stems and shoots such as rhizomes e.g. spear grass, ginger and canalily.
- Corms e.g. gladiolus, crocus corm and cocoyam.
- stem tubers e.g. irish potato, tiger nuts
- Suckers e.g. banana, plantain and pineapple.

- Bulbs e.g. onion is one of many forms of natural vegetative reproduction.



Onion bulbs

Artificial Vegetative Propagation: This involves the use of intelligence by man to grow new plants from cut portion of the vegetative body of an older parent plant. It can be carried out by:

1. Cutting e.g. cassava, cane sugar and most garden shrubs.
2. Layering e.g. bougainvillea, cocoa and cola
3. Grafting e.g. Orange, grapefruit
4. Marcotting e.g. mango

Diagram of artificial vegetative propagation

Advantages and Disadvantages of Asexual Reproduction

Asexual reproduction can be very advantageous to certain animals. Animals that remain in one particular place and are unable to look for mates would need to reproduce asexually. Another advantage of asexual reproduction is that numerous offspring can be produced without “costing” the parent a great amount of energy or time. Environments that are stable and experience very little change are the best places for organisms that reproduce asexually. A disadvantage of this type of reproduction is the lack of genetic variation. All of the organisms are genetically identical and therefore share the same weaknesses. If the stable environment changes, the consequences could be deadly to all of the individuals.

EXERCISES

Lets see how much you’ve learnt, attach the following answers to the comment below

1. One of the following is not an example of asexual reproduction (a) stem cutting (b) grafting (c) conjugation (d) layering
2. Hydra reproduces asexually by (a) budding (b) binary fission (c) Multiple fission (d) Vegetative propagation
3. Multiple fission occurs in this organism (a) Paramecium (b) Plasmodium (c) Amoeba (d) All the above
4. Sugarcane is normally grown by _____. (a) grafting (b) cutting (c) budding (d) marcotting
5. Vegetative propagation in *Bryophyllum* is by _____. (a) leaf (b) stem (c) root (d) all of the above

6. _____ the act of bringing to life young ones that are of the same species. (a) fission (b) vegetative propagation (c) reproduction (d) budding
7. One of this is not an example of natural vegetation. (a) Bulbs (b) Suckers (c) Corns (d) Corms
8. _____ involves the use of intelligence by man to grow new plants from cut portion of the vegetative body of an older parent plant. (a) Vegetative propagation (b) Artificial Vegetative Propagation (c) Natural Vegetative Propagation (d) Binary Fission

Answers

1. C
2. A
3. B
4. B
5. D
6. D
7. C
8. B

Week: 3

Topic: The Cell and Its Environment

Diffusion is defined as the process by which molecules or ions of a substance (i.e. liquid and gases) move from a region of high concentration to a region of low concentration until they are evenly distributed.

Factors Affecting or Controlling Diffusion

The speed of diffusion is controlled by a number of factors which includes;

1. State of matter
2. Molecular size
3. Differences in concentration
4. Temperature

Diffusion in Nature or Non Living Condition

Diffusion is also very important in nature or non living condition through the following processes;

1. The speed of the smell or odour of perfume from a person or a corner of a room.
2. Diffusion of molecules (gases and liquid) in iodine, potassium permanganate.

Osmosis

It is defined as the flow of water or solvent molecules from a region of dilute or a weaker solution to a region of concentrated or stronger solution through a selectively differential permeable membrane.

Condition Necessary for Osmosis to Take Place

1. Presence of a stronger solution e.g. Sugar.
2. Presence of a weaker solution e.g. Distilled water.

Living Cell as Osmometer

1. Hypotonic: When the cell of a living plant or animal is surrounded by pure water whose solute concentration is lower, waste passes into the cell by osmosis. The solution is therefore is said to be hypotonic.
2. Isotonic solution: When the solute concentration of the cell and its surrounding medium are the same, the solution is said to be isotonic.
3. Hypertonic solution: When the cell is surrounded by a stronger solution; water will be lost by the cell. The shrinking of the cell is as a result of the surrounding solution being hypertonic

The Differences between Diffusion and Osmosis

DIFFUSION	OSMOSIS
It occurs in gases and liquid.	It occurs in liquid medium only.
It occurs in living and non in living things.	It occurs naturally in living organism.

Plasmolysis

This is defined as the outward movement or flow of water from living cells when they are placed in a hypertonic solution. It is often regarded as the opposite of osmosis.

Haemolysis

This is defined as the process by which red blood cells or corpuscles split or burst as a result of too much water passing into it. This situation will occur when a red blood cell is placed in a weaker or hypotonic solution where the red blood cell takes in water and becomes swollen and may even burst.

Similarities between Plasmolysis and Haemolysis

1. They both occur in living cells.
2. Both processes can lead to the death of the cells concerned.

Differences between Plasmolysis and Haemolysis

PLASMOLYSIS	HAEMOLYSIS
It occurs in plant cells.	It occurs in red blood cells.
Plant cells shrink.	Red blood cells burst.

Turgidity

It is defined as the condition in which cells absorb plenty of water up to a point where the cell is fully stretched. At this point, the cell is said to be turgid.

Importance of Turgidity

1. It is useful to the plant because it makes them stand erect.
2. It gives support to the stem, flower, leaves and guard cells.

Flaccidity

This is defined as the condition in which plants lose water to their surrounding faster than they can absorb. When a plant looses more, it is said to be flaccid.

Practice Questions

1. _____ is defined as the condition in which plants lose water to their surrounding faster than they can absorb.
   a) Plasmolysis
   b) Haemolysis
   c) Flaccidity
   d) Turgidity
2. _____ is defined as the flow of water or solvent molecules from a region of dilute or a weaker solution to a region of concentrated or stronger solution through a selectively differential permeable membrane.
   a) Osmosis
   b) Diffusion
   c) Flaccidity
   d) Turgidity
3. _____ is defined as the outward movement or flow of water from living cells when they are placed in a hypertonic solution.
   a) Plasmolysis
   b) Haemolysis
   c) Flaccidity
   d) Turgidity
4. _____ is defined as the process by which red blood cells or corpuscles split or burst as a result of too much water passing into it.

a) Diffusion
b) Haemolysis
c) Flaccidity
d) Osmosis

5. _____ is defined as the process by which molecules or ions of a substance (i.e. liquid and gases) move from a region of high concentration to a region of low concentration until they are evenly distributed.
   a) Diffusion
   b) Haemolysis
   c) Flaccidity
   d) Osmosis
6. The speed of the smell or odour of perfume from a person or a corner of a room
   The process above is an example of _____
   a) Plasmolysis
   b) Haemolysis
   c) Osmosis
   d) Diffusion
7. Hypotonic solution is a solution of ____ concentration
8. _____ is defined as the condition in which cells absorb plenty of water up to a point where the cell is fully stretched.
   a) Plasmolysis
   b) Haemolysis
   c) Flaccidity
   d) Turgidity
9. A solution in which the concentrtion of the cell and the environment are the same is called _____
10. When a cell is placed in sugar solution, and contents move from the environment into the cell, the cell is said to have been placed in a _____ solution

Answers

1. C
2. A
3. A
4. B
5. A
6. D
7. lower
8. D
9. Isotonic Solution
10. Hypertonic

Week 10

Topic: Reproductive Health

Introduction

Health is a state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity, reproductive health addresses the reproductive processes, functions and system at all stages of life. Reproductive health, therefore, implies that people are able to have a responsible, satisfying and safe sex life and that they have the capability to reproduce and the freedom to decide if, when and how often to do so.

Reproductive Health Care

A comprehensive reproductive health programme might include the following elements as part of primary health care:

- Family planning information and services, including counseling and follow-up, aimed at all couples and individuals;
- Prenatal, delivery (including assisted delivery) and post-natal care;
- Prevention of abortion, management of the consequences of abortion and post-abortion counseling and family planning;
- Prevention of reproductive tract infections including sexually transmitted diseases, and treatment of systemic infections;
- Prevention of HIV/AIDS;
- Prevention of infertility and sub-fecundity;
- Routine screening for urinary tract infections, cervical infections, cervical and breast cancer and other women's reproductive health conditions;

- Active discouragement of harmful practices such as female genital mutilation.

Harmful Traditional Incision (Female Genital Mutilation)

The traditional practice of female genital mutilation, sometimes referred to as female circumcision, has attracted increasing international attention in the past 20 years. Both traditional and modern genital surgery is performed in different societies for a variety of medical, cosmetic, psychological or social reasons. Female genital mutilation are limited to cutting rituals performed exclusively for cultural and traditional reasons on girls or young women, often without their approval or full understanding of the consequences of the procedures.

Female genital mutilation is mostly performed as a rite of passage from childhood to adulthood and is undertaken in most communities between the ages of four and 14 years. However, the age varies from area to area. For example, in southern Nigeria female genital mutilation is performed on babies in the first few months of life

Types of Harmful Traditional Incision (Female Genital Mutilation)

There are 4 main types, these are:

Circumcision proper (Type 1): This is the circumferential excision of the clitoral prepuce and is clearly analogous to male circumcision. In Muslim countries it is known as Sunna circumcision.

Excision (Type 2): Besides the prepuce, this involves the removal of the glans clitoridis or even the clitoris itself and may include part, or the whole, of the labia minora.

Infibulation (Type 3): This is also called Pharaonic circumcision. It involves partial closure of the vaginal orifice after excision of a varying amount of vulval tissue. In its drastic form, all or part of the labia majora and minora, and the clitoris are removed and the raw areas left to heal across the lower end of the vagina. After the

operation, the thighs are strapped together and kept so for 40 days.

Introcision (Type 4): This is the cutting into the vagina or splitting of the perineum at an early age, either digitally or by means of a sharp instrument, and is the severest form of circumcision.

Importance of Pre-natal Care

Prenatal care refers to the regular medical and nursing care recommended for women during pregnancy. With regular prenatal care women can:

- Reduce the risk of pregnancy complications.
- Reduce the infant's risk for complications.
- Help ensure the medications women take are safe.

Effects of STI and HIV and AIDS on Foetus and Infants

- Stillbirth
- Low birth weight
- An eye infection called conjunctivitis
- Pneumonia
- An infection in the blood called neonatal sepsis
- Neurologic damage such as brain damage or motor function disorder
- Blindness, deafness, or other congenital abnormalities
- Acute hepatitis
- Meningitis
- Chronic liver disease
- Cirrhosis

Breast Feeding

Breastfeeding is the normal way of providing young infants with the nutrients they need for healthy growth and development. Virtually all mothers can breastfeed, provided they have accurate information, and the support of their family, the health care system and society at large.

Colostrum, the yellowish, sticky breast milk produced at the end of pregnancy, is recommended by WHO as the perfect food for the newborn, and feeding should be initiated within the first hour after birth.

Exclusive breastfeeding is recommended up to 6 months of age, with continued breastfeeding along with appropriate complementary foods up to two years of age or beyond.

Importance of breastfeeding

Breastfeeding a baby exclusively for the first 6 months, and then continued breastfeeding in addition to appropriate solid foods until 12 months and beyond, has health benefits for both the mother and child.

Importance of breastfeeding for mother

Research shows that breastfeeding has significant health benefits for mothers.

Breastfeeding:

1. Assists the uterus return to its pre-pregnant state faster.
2. Can help women to lose weight after baby's birth.

iii. Reduces the risk of ovarian cancer and pre-menopausal breast cancer.

1. Reduces the risk of osteoporosis.

2. Reduces the risk of mothers with gestational diabetes developing Type 2 diabetes.

Importance of breastfeeding for baby

1. Less illness
2. Babies who are fed breast milk have a lower risk of :

- Gastro-intestinal (gut) illness
- Allergies
- Asthma
- Diabetes
- Obesity
- Some childhood cancers
- Respiratory tract (chest) infections
- Urinary tract infections
- SIDS (cot death).

3. Breastfed babies are less likely to be hospitalized.

Causes of Infants Mortality

The death of a baby before his or her first birthday is called infant mortality. The infant mortality rate is an estimate of the number of infant deaths for every 1,000 live births. Most of these babies die because they are;

- Born with a serious birth defect.
- Born too small and too early (i.e., preterm birth; birth before 37 weeks gestation).
- Victims of Sudden Infant Death Syndrome (SIDS).
- Affected by maternal complications of pregnancy.

- Victims of injuries (e.g., suffocation).

Causes of Birth Defects

Birth defects are structural or functional abnormalities present at birth that cause physical or mental disability. Some may be fatal. Birth defects have a variety of causes, such as:

- Genetic problems caused when one or more genes doesn't work properly or part of a gene is missing
- Problems with chromosomes, such as having an extra chromosome or missing part of a chromosome
- Environmental factors that a woman is exposed to during pregnancy, such as rubella or German measles while pregnant, or using drugs or alcohol during pregnancy.

Causes of Sudden Infant Death Syndrome

A combination of physical and sleep environmental factors can make an infant more vulnerable to SIDS. These factors may vary from child to child.

Physical factors
Physical factors associated with SIDS include:

- Brain abnormalities. Some infants are born with problems that make them more likely to die of SIDS. In many of these babies, the portion of the brain that controls breathing and arousal from sleep doesn't work properly.
- Low birth weight. Premature birth or being part of a multiple birth increases the likelihood that a baby's brain hasn't matured completely, so he or she has less reliable control over such automatic processes as breathing and heart rate.

- Respiratory infection. Many infants who have died of SIDS have recently experienced a cold, which may contribute to breathing problems.

Sleep environmental factors
The items in a baby's crib and his or her sleeping position can combine with a baby's physical problems to increase the risk of SIDS. Examples include:

- Sleeping on the stomach or side. Babies who are placed on their stomachs or sides to sleep may have more difficulty breathing than those placed on their backs.
- Sleeping on a soft surface. Lying face down on a fluffy comforter or a waterbed can block an infant's airway. Draping a blanket over a baby's head is also risky.
- Sleeping with parents. While the risk of SIDS is lowered if an infant sleeps in the same room as his or her parents, the risk increases if the baby sleeps in the same bed partly because there are more soft surfaces to impair breathing.

Importance of Knowledge of Genetic Disorder in Family

A genetic disorder is a disease that is caused by an abnormality in an individual's DNA. In other word, genetic disorder is an illness caused by abnormalities in genes or chromosomes. Abnormalities can range from a small mutation in a single gene to the addition or subtraction of an entire chromosome or set of chromosomes. Sickle cell disease, cystic fibrosis, cancer, obesity, mental illness, Alzheimer disease and Tay-Sachs disease are examples of genetic disorders

Knowledge of genetic disorder may assist the family by:

- Identifying the likelihood that certain diseases or conditions may develop based on genetic information, and then anticipating the timing of the expected disorder in the person's life cycle.

- Helping families prepare pragmatically and emotionally for expected challenges, such as: living with uncertainty, care giving strains, and losses associated with various genetic conditions as they may unfold.
- Helping families create meaning that sustains hope and promotes mastery.
- Identify effective treatments, or teaching coping skills for disorders with little hope for treatment.
- Can lead to better care and management of the patient and ultimately to improved quality of life

ASSESSMENT

1. What is the correct surgical method for preventing pregnancy in which the vas deferens is cut?
   (a) Ovariectomy
   (b) Hysterectomy
   (c) Vasectomy
   (d) Castration
2. Emergency contraceptives may prevent pregnancy if used within 72 hrs of _____.
   (a) Menstruation
   (b) Ovulation
   (c) Coitus
   (d) Implantation
3. Contraceptives does not
   (a) engulfs the sperm
   (b) alter the quality of cervical mucus
   (c) prevents the entry of sperm
   (d) inhibits implantation
4. An ideal contraceptives should not be
   (a) user friendly
   (b) irreversible

(c) effective with least side effects
(d) easily available

5. Ideally breastfeeding a baby should be exclusively for the first
   (a) 6 months
   (b) 4 months
   (c) 3 months
   (d) 5 months

ANSWERS

1. c
2. c
3. a
4. b
5. a

SECOND TERM NOTES ON BIOLOGY

TABLE OF CONTENTS

Topic: Excretory System

Introduction

Every organism, from the smallest protist to the largest mammal, must rid itself of the potentially harmful by-products of its own vital activities.

Excretion is the removal of waste products from the chemical reactions that occur inside all living things (organisms). In other words, excretion is the removal of harmful and unwanted toxic waste products of metabolism.

The Chemical reactions of a human are called cell metabolism. The normal waste product from mammals is urea. It is released in urine and sweat. Carbon Dioxide is also something that is excreted from mammals when breathing out. Excretion is important for living things because a build up of the waste products from these chemical reactions is very dangerous for the body because it can, in excess, be poisonous.

The process by which the water content and the ion concentration is regulated and kept constant in the cells is known as osmoregulation. This process results in maintaining the osmotic pressure in the blood and tissue fluids.

The two physiological processes, excretion and osmoregulation are interconnected as they both are responsible for bringing about homeostasis in the body. The physiological mechanisms involved are intimately bound with each other, so much so, in higher vertebrates like mammals, kidneys perform both functions, excretion and osmoregulation.

Note: The terms **secretion** and **egestion** are often confused with excretion. Hence it is important to understand clearly what they mean.

Secretion

Secretion is the production of useful chemical substances like hormones, enzymes or other molecules by the cells of glands like the bile, endocrine glands like the islets of Langerhans or unicellular glands like the epithelial mucosal lining of the large intestine.

Egestion

Egestion is expelling the undigested wastes from the body. Food which is not digested and thus is not assimilated by the body is passed to the last part of the alimentary canal called the rectum and egested out in the form of faeces or excreta.

The excretory system is a passive biological system that removes excess, unnecessary or dangerous materials from an organism, so as to help maintain homeostasis within the organism and prevent damage to the body. It is responsible for the elimination of the waste products of metabolism as well as other liquid and gaseous wastes.

Importance of Excretion

Waste products produced in the body by metabolic activities must not be allowed to remain in the body because of the following reasons:

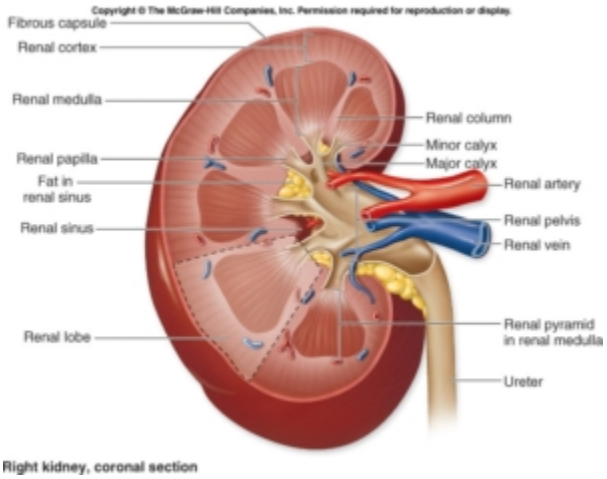
(i) The excretory products are harmful to the body and so must be removed.

(ii) Some are poisonous and must never be allowed to accumulate within the body

(iii) Excretion helps to maintain water balance in the body

(iv) Excretion also helps to maintain salt balance, i.e. homeostasis in the body

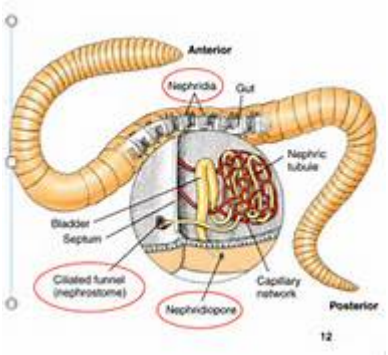
(v) Waste products when not removed can interfere with normal metabolic activities of the body.



Right kidney, coronal section

Excretory Systems or Organs of Some Organisms

Organisms	Excretory systems/organs
(i) Protozoa, e.g. Amoeba	Contractile vacuole, by diffusion
(ii) Flatworms, e.g. tapeworm	Flame cells
(iii) Annelids, e.g. earthworms	Nephridia
(iv) Insects	Malphighian tubules
(v) Crustaceans	Green glands
(vi) Fishes	Kidneys
(vii) Amphibians, e.g. toad	Kidneys
(viii) Reptiles	Kidneys
(ix) Birds	Kidneys and lungs
(x) Mammals	Kidneys, skin, liver and lungs
(xi) Flowering plants	Stomata and lenticels



Different excretory organs or systems have different excretory products they remove. This depends on the complexity of the animal concerned. The excretory organs or systems are the waste products they remove are stated in the table below.

Excretory organs or systems	Waste products excreted
(i) Contractile vacuole	Carbon dioxide, ammonia and water
(ii) Flame cells	Carbon dioxide, ammonia and water
(iii) Nephridia	Water, urea, carbon dioxide and nitrogenous wastes
(iv) Malphighian tubules	Wastes, carbon dioxide and uric acid
(v) Green glands	Water, urea, carbon dioxide and ammonia salts
(vi) Gills	Carbon dioxide, water and urea
(vii) Skin	Sweat containing urea, salts and water
(viii) Liver	Bile salts, water and urea
(ix) Lungs	Carbon dioxide and water vapour

(x) Kidneys	Urine containing urea, salts, water, hormones and uric acid
(xi) Stomata and lenticels	Water, carbon dioxide and oxygen
(xii) Bark of trees	Tannins, mucilage, gum, crystals, anthocyanin, alkaloid, resin, oil and latex.

Based on excretory product animals can be grouped into 3 major groups:

Ammonotelic animals: The organisms whose principle excreta is ammonia are called ammonotelic animals and the process of elimination of ammonia is called ammonotelism. Ammonia is highly toxic, cannot be stored in body for long time. It is readily soluble in water hence it is principle excreta in aquatic crustaceous, annelidans, molluscans, echinoderms, bony fishes and larval form of amphibians.

Uricotelic animals: Organisms whose principle excreta is uric acid are called uricotelic animals and the process of elimination of uric acid is called uricotelism. Uric acid is least toxic, a least soluble in water. Hence it is principle excreta in those organisms which conserve water. Eg:- Insects, land snail, reptiles and birds.

Ureotielic animals: Animals whose principle excreta is urea are called ureotielic animals and the process of elimination of urea is called ureotelism. Urea is less toxic than ammonia and more toxic than uric acid. In ornithine cycle ammonia reacts with Co_2 to form urea in liver. Ureotoelic animals are cartilaginous fishes, adult amphibians and all mammals.

Excretory Mechanism in Some Organisms

Contractile Vacuoles – Amoeba (Kingdom Protista)

The water content in the organism has to be regulated as there is a constant inflow of excess water. This is because the cell membrane surrounding the animal is semi permeable and as the protoplasm contains a higher concentration of salts than the water outside, water enters the cell by osmosis. This water is more than what is actually required by the animal. To counter this, excess water collects into the contractile vacuole as fast as it enters the body. The vacuole slowly grows larger until it reaches the maximum size. Then the endoplasm in the area surrounding the vacuole contracts and the fluid contents which contain traces of urea and carbon dioxide are discharged out into the surrounding pond water. Thus the contractile vacuole functions effectively as an organelle that performs both excretion and osmoregualtion.

Flame Cells in Flatworm (Phylum Platyhelminthes)

A flame cell is a specialized excretory cell found in the simplest freshwater invertebrates, including flatworms, rotifers and nemerteans. Flame cells function like a kidney, removing waste materials. Bundles of flame cells are called protonephridia.

Metabolic waste products of flat worms are excreted generally in the form of NH_3 by diffusion across the general body surface. Flatness is helpful in diffusion. However flat worms release excess water as well as some excretory products through flame cells.

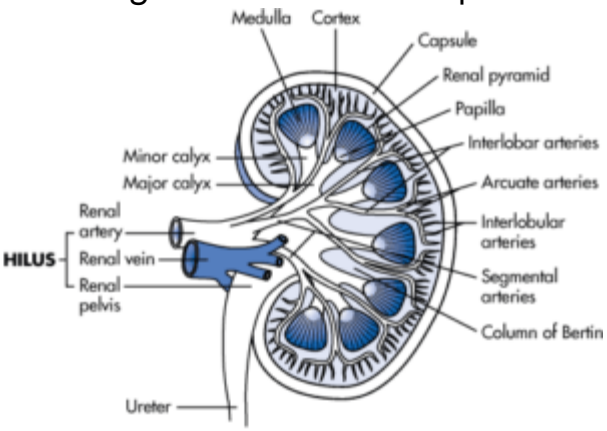
Excretion in Mammals – Human

The body excretes three main waste materials. These are Carbon Dioxide, Urea and Water. Excretion is a very important feature to us because without it toxic substances will build up in our bodies and kill us. It also helps in maintaining the composition of body fluids.

There are four types of excretory organs used by mammals. These are: lungs, skin, liver and kidneys.

The Lungs

The lungs excrete water vapour and carbon dioxide.



Source: Shargel L, Wu-Pong S, Yu ABC: *Applied Biopharmaceutics & Pharmacokinetics, 6th Edition*: www.accesspharmacy.com

The Liver

The largest internal organ in humans, the liver is also one of the most important. It has many functions, among them the synthesis of proteins, immune and clotting factors, and oxygen and fat-carrying substances. Its chief digestive function is the secretion of bile, a solution critical to fat emulsion and absorption. The liver also removes excess glucose from circulation and stores it until it is needed. It converts excess amino acids into useful forms and filters drugs and poisons from the bloodstream, neutralizing them and excreting them in bile (A bitter, neutral, or slightly alkaline fluid secreted by the liver and passed through a duct into the gallbladder, where it is stored). The LIVER excretes **BILE PIGMENTS** called **BILIRUBIN** (derived from the decomposition of haemoglobin).

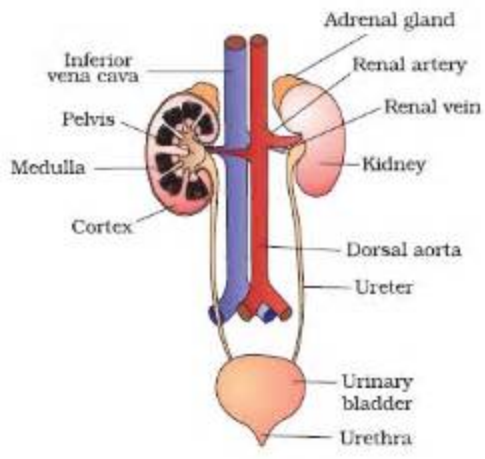


Figure 19.1 Human Urinary system

Test Questions

1. _____ is the removal of waste products from the chemical reactions that occur inside all living things (organisms).
2. The bile pigment excreted by the liver is called _____
   a) bile
   b) bilirubin
   c) pigments
   d) urea
3. Nephridia is the excretory organ found in _____
   a) annelids
   b) crustacean
   c) fish
   d) plants
4. Organisms whose principle excreta is uric acid are called _____ animals
   a) uric
   b) urinal
   c) urethra
   d) uricotelic
5. _____ is expelling the undigested wastes from the body.

6. _____ is the production of useful chemical substances like hormones, enzymes or other molecules by the cells of glands like the bile, endocrine glands like the islets of Langerhans or unicellular glands.
7. Name the excretory organ found in the following
   a) flatworm
   b) crustaceans
   c) fishes
   d) flowering plants
   e) Protozoa
   f) Insects
8. The process by which the water content and the ion concentration is regulated and kept constant in the cells is known as _____
9. The _____ is a passive biological system that removes excess, unnecessary or dangerous materials from an organism, so as to help maintain homeostasis within the organism and prevent damage to the body.
10. The normal waste product from mammals is urea. It is released in _____ and _____

Answers

1. Excretion
2. B
3. A
4. D
5. Egestion
6. Secretion
7. Flame cells
   Green glands

Kidneys
Stomata
Contractile Vacuole
Malphigian tubule

8. Osmoregulation
9. Excretory System
10. Urine and Sweat

Biology SS2 Second Term,

Week 3

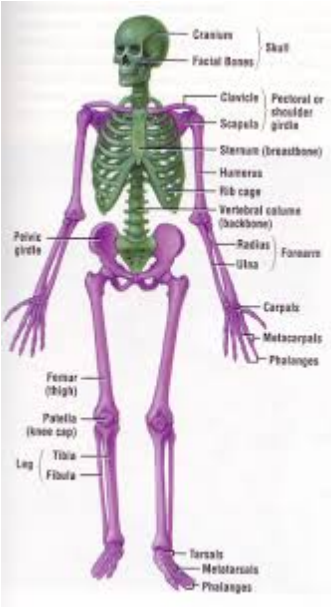
Topic: Vertebrate Skeleton

Introduction

The skeleton of vertebrates is composed primarily of bone. Cartilage covers articular surfaces between bones and connects the ribs to the sternum. The skeleton is divided into two major parts:

1. The axial skeleton includes the skull, mandible, hyoid, ribs, sternum, and vertebrae

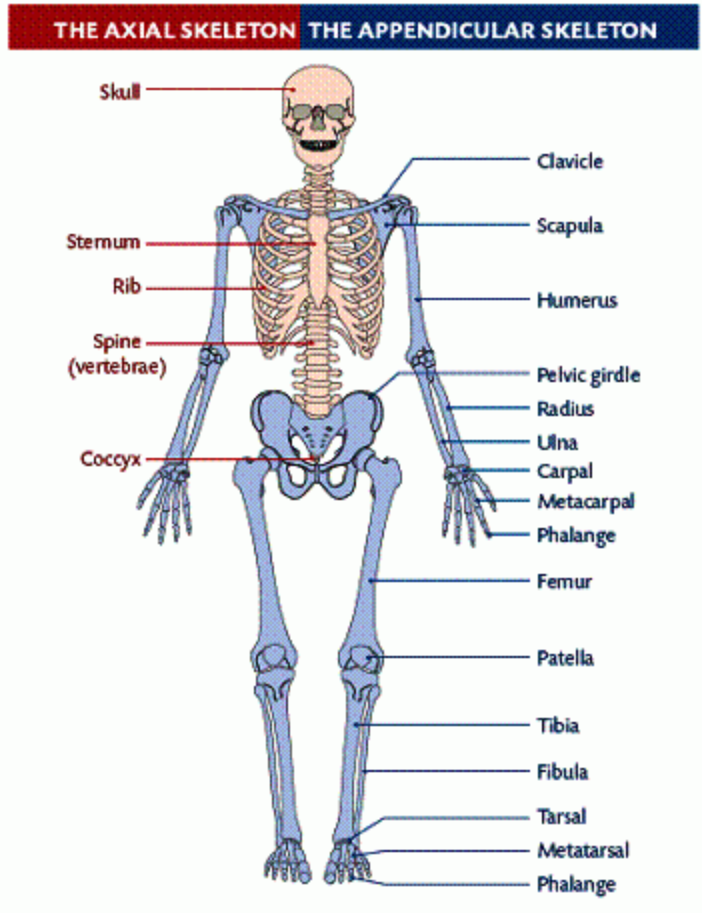
2. The appendicular skeleton includes the girdle, limb and feet bones



The Human Skeleton

The Axial Skeleton

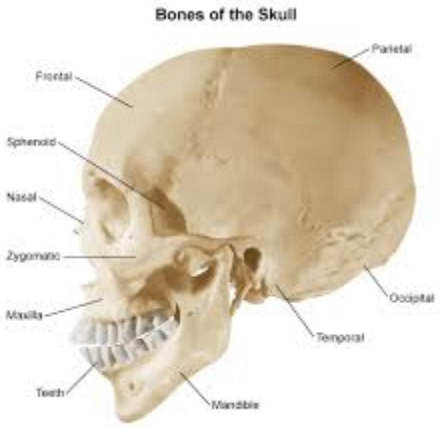
The axial skeleton forms the central axis of the body. It consists of the skull, the vertebral column, the ribs and the sternum or breastbone.



The Axial and Appendicular Skeleton

The Skull

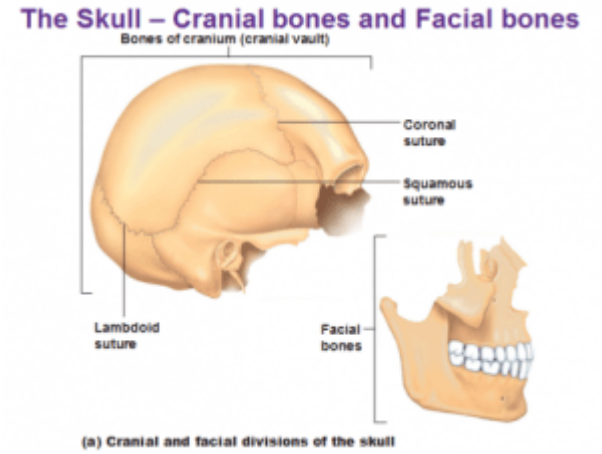
The skull consists of 28 different bones (including the ossicles of the ear). The bones of the skull can be divided into two main groups: the cranium which encloses and protects the brain and the facial bones.



The Skull

The Cranium: The cranium consists of eight flat bones which are rigidly attached to each other with dentate sutures (joints with teeth-like protrusions). They envelop and protect the brain. The frontal bone forms the forehead and portions of the eye sockets (or orbits). The occipital bone, at the base of the skull contains a large opening, called the foramen magnum, through which the spinal cord passes. On each side of the opening is the occipital condyle, by means of which the skull articulates with the first neck or cervical vertebra (the atlas). The organs of hearing are situated in the temporal bone, one on each side. The openings leading into these organs can also be seen on each side.

The Facial Bones: The facial skeleton consists of fourteen irregular bones, which are all (with the exception of the lower jawbone) firmly attached to the cranium by means of sutures. They include the nasal bones, the two jawbones and the cheek bones. The lower jaw articulates with the temporal bone part of the cheek bone, just in front of the ear. This allows for the necessary movement of the lower jaw when food is bitten off and chewed. Both upper and lower jaws have alveolar pockets into which teeth fit.



Cranial and Facial bones

The Vertebral Column

Vertebral column is also called back bone or spine and encloses the spinal cord. It is a flexible, curved, vertical rod, and consists of a row of 33 movably articulated ring like bones called vertebrae. Between each of the two bones the space is supplemented by pads of fibro-cartilage called the intervertebral discs. The vertebrae are held together by ligaments which prevent their dislocation, but permit a degree of movement, making the backbone flexible. The adult vertebral column measures 60-70 cm in length.

The vertebrae are grouped and named according to the region they occupy.

·Seven cervical vertebrae form the neck or cervical region.

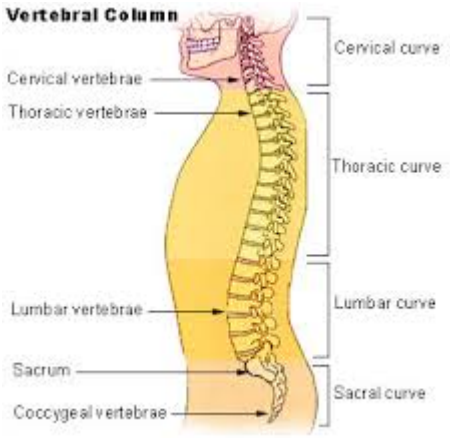
·Twelve thoracic vertebrae form the back of the thorax or chest.

·Five lumbar vertebrae form the lumbar region or loins.

·Five sacral vertebrae form the sacrum.

·Four caudal vertebrae form the coccyx or tail.

The vertebrae in the three upper regions remain separate or distinct throughout life, and are called the movable vertebrae. Those in the two lower regions, the sacrum and coccyx, are united in the adult to form two bones and are called, the fixed vertebrae.



Vertebral column

With the exception of the first two cervical vertebrae, all the movable vertebrae have similar structure; a typical vertebra is a bony ring. Its hole is called the vertebral foramen. The front border of the vertebral foramen is very thick. It is known as the body or centrum.

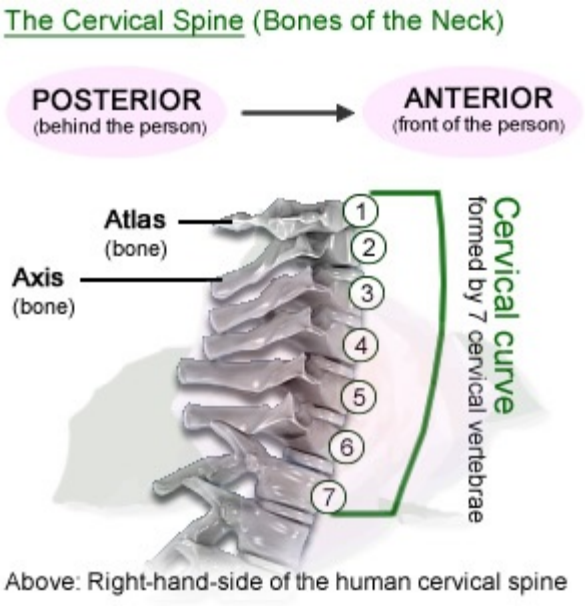
The remaining boundary of the vertebral foramen is thin. It is termed as the vertebral arch. Each half of a vertebral arch has a vertically narrow side, the pedicel, and a broader hind part, the lamina. The two laminae meet in the midline of the back. The upper and lower margins of the pedicel have concavities called the vertebral notches. When vertebrae are articulated together, adjacent notches form apertures– the intervertebral foramina, for the exit of the spinal nerves. The vertebral arch gives off processes to which the muscles are attached. The processes include a median spinous process and paired articular processes and transverse processes. The spinous process projects back and often also downward from the junction of the laminae. The articular processes of the adjacent vertebrae meet to form synovial joints. They provide limited movement between vertebrae. The vertebral foramina of all the vertebrae when intact form a vertebral canal that encloses the spinal cord.

In between the adjacent vertebrae, there are elastic pads of fibrocartilage- the intervertebral discs. This provides mobility to the vertebrae, check undue friction and take up shocks. Displacement of intervertebral disc is called slip-disc and is dangerous.

The Cervical Vertebrae

The neck region consists of 7 cervical vertebrae. The cervical vertebrae are the smallest of the bones, and except the first and the second, which are peculiar in shape, the cervical vertebrae possess the following characters in common. The first cervical vertebra is called atlas. It is almost ring like. It provides up and down or nodding movement to the skull on it. The second cervical vertebra is termed

as axis. Its centrum bears an odontoid process, which allows side to side or turning movement to the atlas and skull together on it.



Above: Right-hand-side of the human cervical spine

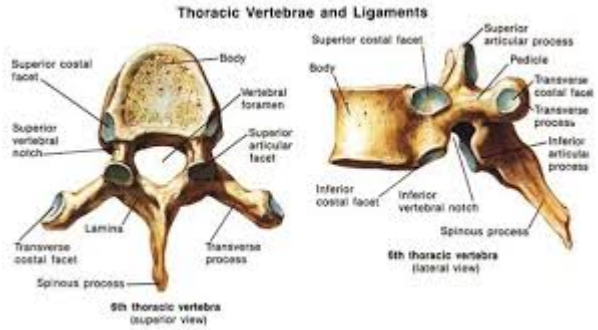
Cervical vertebrae

The bodies of other cervical vertebrae are small and oblong in shape broader from side to side than from backward. The neural arch is large. The spinous processes are divided or bifid terminally. The transverse processes are perforated by foramina for the passage of the vertebral arteries. Thus this important blood vessel is protected as it passes through the vulnerable region of the neck.

The Thoracic Vertebrae

In vertebrates, **thoracic vertebrae** compose the middle segment of the vertebral column, between the cervical vertebrae and the lumbar vertebrae. In humans, there are twelve thoracic vertebrae and they are intermediate in size between the cervical and lumbar vertebrae; they increase in size going towards the lumbar vertebrae, with the lower ones being a lot larger than the upper. They are distinguished by the presence of facets on the sides of the bodies for articulation with the heads of the ribs, and facets on

the transverse processes of all, except the eleventh and twelfth, for articulation with the tubercles of the ribs. By convention, the human thoracic vertebrae are numbered T1-T12, with the first one (T1) located closest to the skull and the others going down the spine towards the lumbar region.



Thoracic Vertebrae

Appendicular Skeleton

The appendicular skeleton is made up of the limbs and limb girdles which is directly concerned with movement in animals.

The limbs: There are two pairs of limbs in every animal, these are the forelimbs and the hind limbs. In man, the forelimbs are free and are called hands. In other animals except Ape and Gorilla, both the fore and hind limbs are used for walking. The forelimbs consists of the arm(humerus, ulna and radius) and the hands(carpals, metacarpals and phalanges) while the hind-limbs consists of the legs(femur, fibula and tibia) and the feet(tarsals, metatarsals and phalanges).

Limb Girdles: Generally, there are two limb girdles and they support the weight of the body. They are:

The Pectoral (Shoulder) Girdles: This is a group of large flat bones in the shoulder region to which the forelimbs are attached.

The Pelvic (Hip) Girdles: This is another group of large flat bones in the hip region to which hind limbs are attached.

Test Questions

1. The skull consists of ___ different bones
   a) 38
   b) 28
   c) 18
   d) 48
2. The _____ is a group of large flat bones in the shoulder region to which the forelimbs are attached.
3. The pelvic girdle is found in the ____
4. There are two pairs of limbs in animals and these are _____ and ____ limbs
5. The _____ skeleton is made up of the limbs and limb girdles which is directly concerned with movement in animals

Answers

1. B – 28
2. Pectoral Girdle
3. Hip
4. Fore and Hind
5. Appendicular

Biology, SS 2, Second Term,

Week 10

Topic: Circulatory System In Mammals

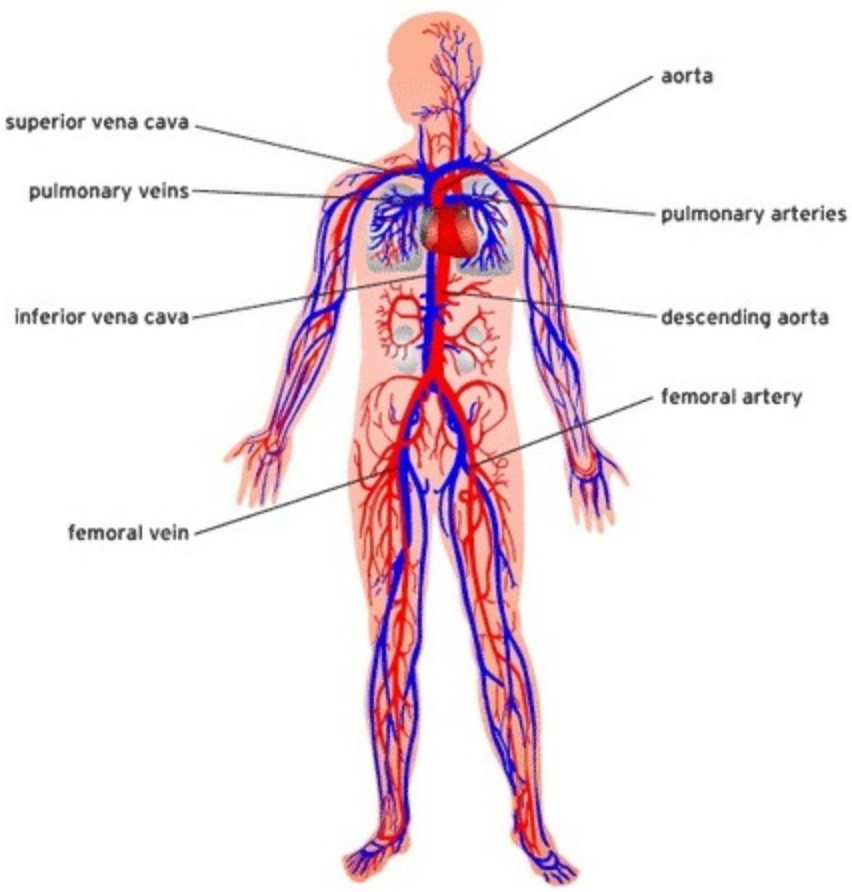
Introduction

Circulatory system refers to the continuous movement or flow of blood round the body involving the heart and the blood vessels.

Higher organisms e.g. man, require blood to carry materials to and from different parts of their body. There is need for organisms to transport oxygen from the lungs to other living cells within the organisms and also, dissolved food materials absorbed in the villi to other parts of the body which need them. Circulation is the process by which absorbed food materials are carried through arteries, capillaries and veins to all parts of the body where they are utilized for body functioning. Materials which are transported by blood in human body are water, salts, hormones, oxygen, digested food, etc. waste materials also removed from the body through blood circulation.

Parts of the Circulatory System

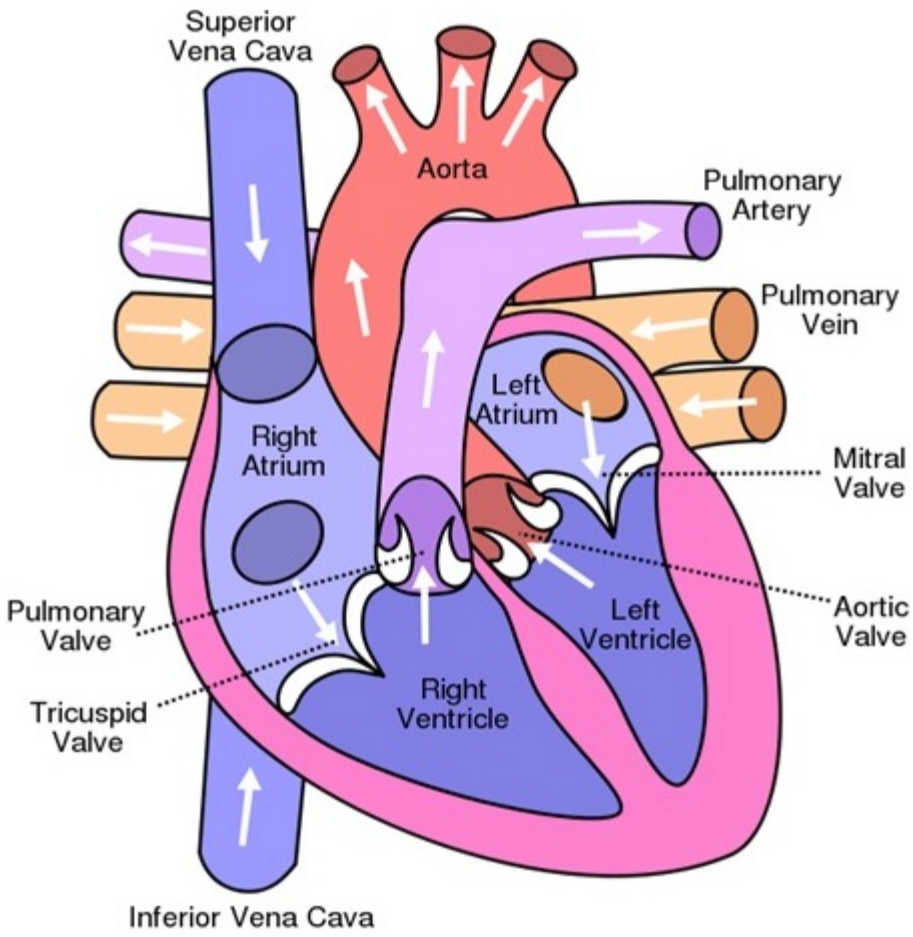
The organs that are responsible for blood circulation in the body are together called the circulatory system. The circulatory system consists of the blood vessels and the heart.



The Structure of the Circulatory System

The Heart

The heart pumps blood to all part of the body through the circulatory system. The heart is a muscular organ that lies in the chest cavity and is almost conical in shape. It is made up of four chambers. These four chambers include two upper chambers which are the right auricle and left auricle; and two lower chambers, the right ventricle and left ventricle. Blood enters the heart at the auricles and leaves from the ventricles. The heart is constantly beating, contracting and relaxing. There are about 70-75 beats per minute although this beating rate may vary with individuals. Beating rate is faster in children than in adults.



The Structure of the Heart

Blood Vessels

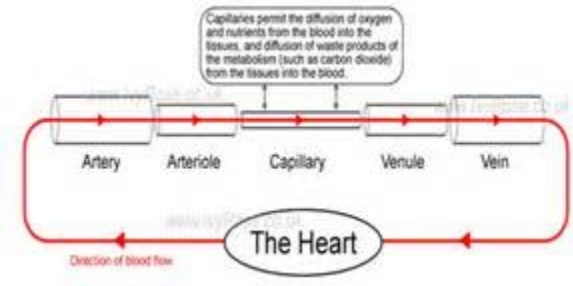
These are channels or routes through which blood passes to different parts of the body. There are three types of blood vessels; the arteries, veins and capillaries.

1. **Arteries**: These are the blood vessel that carry blood away from the heart to all parts of the body except the pulmonary artery.
2. **Veins**: These are blood vessels that carry blood to the heart from all parts of the body except the pulmonary vein.
3. **Capillaries**: These are tiny networks of blood vessels that connect arteries to veins. Blood flows out from the heart through arteries to all parts of the body, through capillaries

and then into the veins, and back to the heart where circulation continues.

Characteristics of Capillaries

1. They are small, very thin walled vessels which lie between the cells of human organs.
2. They connect the arteries with the veins
3. They allow food and oxygen to pass from the blood to the body cells
4. They also collect waste materials from cells
5. They allow the exchange of materials between the blood and cells.



Importance of Circulatory system

1. Helps in excretion of waste products from the body
2. Digested food materials like glucose, amino acids, fatty acids and glycerol are carried from the intestine to the tissues where they are stored or used up, water and oxygen are also carried by the blood.
3. Protection of the body against diseases e.g. white blood cells
4. Regulation of the body temperature: the blood helps in the distribution of heat produced in muscles and organs like liver, to other parts of the body.
5. Helps in blood clotting in wounds e.g. blood platelets

6. Sustains life by supplying nutrients to cells.

Types of Circulatory System

Circulatory system in animals can be grouped into three major categories:

a. Closed and opened circulatory systems

b. Single and double circulatory systems

c. Pulmonary and systematic circulatory systems.

Closed and Opened Circuclatory System

i. **Closed Circulatory System:**

The closed circulatory systems are made up of blood vessels called arteries from the heart which branch many times into small units called capillaries but eventually join up with other vessels called veins that are connected to the heart. By this design, blood is therefore always confined within the cavities of the vessels and the heart and never comes into direct contact with the cells of the body.

Some invertebrates like annelids and all the vertebrates have closed circulatory systems. In mammals, for example, there is no mixing of oxygenated blood in the heart. While oxygenated blood is confined to the left part of the heart, deoxygenated blood is confined to the right side.

ii. **Opened Circulatory System:** In this system, the blood vessels lead out of the heart but end in blood spaces called **haemocoels** within the body cavity. In these spaces, the blood comes into direct contact with the cells after which it is

returned to the heart, Arthropods and some molluscs have opened circulatory systems.

Single and Double Circulatory Systems

i. Single circulatory system: In a single circulatory system, the blood only passes through the heart once every time it makes one complete movement round the body. This system is common in fish which has only two-chambered heart – one auricle and one ventricle.

ii. Double circulatory system: In double circulatory system, the blood passes through the heart twice every time it makes one complete movement round the body. Each time the blood passes through the heart, it goes through a separate pathway. This is found in mammals.

The double circulation gives rise to the two pathways involved in double circulatory system called **pulmonary** and **systemic circulation.**

Pulmonary and Systemic Circulation

i. Pulmonary Circulation: The pulmonary circulation involves the movement of blood between the heart and the lungs. In other words, it involves the movement of blood from the heart to the lungs for oxygenation.

ii. Systemic Circulation: The systemic circulation involves the movement of blood between the heart and all other parts of the body besides the lungs. In one complete circulation, blood from any part of the body enters the heart for the first time, it is then sent to the lungs for oxygenation. From the lungs, it is brought back to the heart for the second time before it can be redistributed to all

parts of the body. This is the sequence involved in double circulation.

Pulmonary and systemic circulation can be represented mathematically by linear equation as:

Pulmonary circulation = Heart + Lungs

Systemic circulation = Heart + Body

The appearance of heart twice in the two equations represents the double circulation of blood in mammals.

Practice Questions

1. _____ are tiny networks of blood vessels that connect arteries to veins
2. _____ are the blood vessel that carry blood away from the heart to all parts of the body except the pulmonary artery
3. _____ refers to the continuous movement or flow of blood round the body involving the heart and the blood vessels.
4. ____ are blood vessels that carry blood to the heart from all parts of the body except the pulmonary vein.
5. In the open circulatory system, the blood vessels lead out of the heart but end in blood spaces called _____ within the body cavity

Answers

1. Capillaries
2. Arteries
3. Circulatory
4. Veins
5. Haemocoels

Biology, SS 2, Second Term

Week: 5

Topic: Digestive System

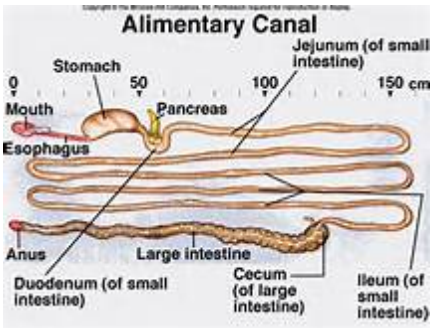
Introduction

The digestive system or alimentary canal or tract is concerned with the breakdown of complex food substances and its conversion in to simpler components, its absorption through the blood stream and assimilation in the cells and tissues producing desired effects of growth. Digestion is the breakdown of food into smaller components that can be more easily absorbed and assimilated by the body. We have two types of alimentary tracts, namely, the complete and incomplete alimentary tract.

· The incomplete tract has just an opening into the outside world which is referred to as the mouth. This serves the purpose of ingestion and egestion. An example of an organism with incomplete alimentary tract is a planarian.

· The complete alimentary tract has two openings to the outside world. It contains both the mouth and the anus. The mouth serves the purpose for ingestion while the anus serves the purpose for egestion. Example of this group is bird, earthworm, goat and human.

In complete digestive tract, each tract performs different functions and at the end each tract is specialized on what it does. For example when we put yam into our mouth, the teeth breaks it down into smaller particles and pushes it to the esophagus where peristalsis takes place; it is further transported to the stomach where the churning of the food takes place. It further goes to the small intestine, where digestion of food is completed and absorption takes place in the villi while the large intestine absorbs water from the food materials and the remnant are passed through from the Anus away from the body when food is taken in, the incoming food, does not mix with the outgoing undigested food materials.



Alimentary Canal of Planaria

The planaria is a free living flat slender small worm. The tract has a mouth, muscular pharynx and intestine, that is ventrally placed. Its pharynx protrudes from its mouth, whenever it wants to attack a prey. The pharynx leads to the intestine which has three main branches one anterior and two posterior giving rise to a lateral diverticula's that eventually forms a gastro vascular cavity which is lined with phagocyte cells, glandular storage cells and gland cells.

Planarian feeds on small crustaceans, nematodes, insects and rotifers and this makes it a carnivorous animal. It kills its prey by entangling them in mucus gland, it then sucks them in small bits into its intestine. Digestion is intracellular and food is distributed to all the body parts by a process known as diffusion.

Adaptive features of alimentary system of a flatworm and their functions

· They (e.g. planarian) have a simple alimentary canal that has just an opening to the outside world. It consists of a mouth on the ventral side of the small intestine.

· The pharynx is muscular and large. It helps to push the food inside it to the small intestine.

· The small intestine with branches enables the digested food to diffuse to all parts of the body while the undigested food is egested from the mouth which really makes it a primitive organism.

Alimentary System of an Earthworm

The alimentary system of an earthworm consists of a long straight tube that is divided two openings: the mouth-through which food enters and the anus-through which undigested food leaves the body. The alimentary canal of the earthworm includes the following parts: mouth, pharynx, oesophagus, crop, gizzard, intestine, caecum, rectum and anus.

The pharynx secretes mucus to lubricate food particles.
The oesophagus has a pair of oesophageal glands that secrete calcium arborvitae that removes excess calcium that has been absorbed in the earthworm's food. The oesophagus has a narrow tubular wall that transfers the ingested food to the crop.

The crop is a temporary place where it stores its food before they are passed into the gizzard for digestion.

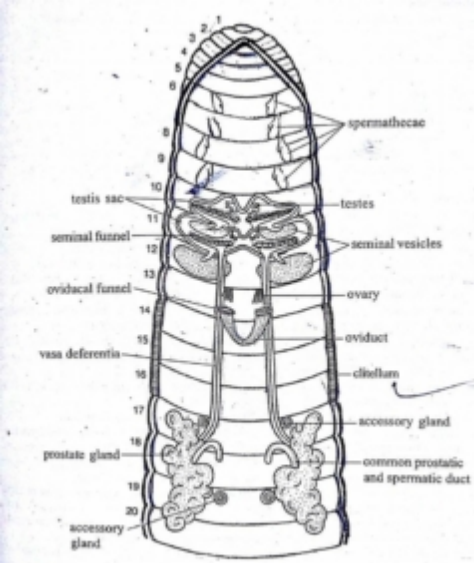
The gizzard has a thick muscular wall with stones, which aids the grinding of food particles.

The intestine is long and straight where extra cellular digestion of food takes place.

Enzymes are released to chemically breakdown the food and the soluble pieces are absorbed.

Anus: The undigested food and soil is egested through the anus as 'worm casts'.

The Alimentary Canal



Male and female reproductive organs

Advancement of the alimentary canal of Earthworm over that of planaria

·The Earthworm has a long and straight intestine, which makes it efficient for digestion and absorption of food while the planarian has diffused intestinal branches.

·The earthworm has two openings, which is the mouth and the anus, while the planarian has just one opening, which serves as the mouth.

·The earthworm has a thick muscular gizzard, which it used for the grinding of food particles during digestion which planarian lacks.

·The earthworm absorbs food in the form of blood, while planarian diffuses food after digestion has taken place.

·The crop of the earthworm serves as a temporary storage of food before digestion takes place while the planarian lacks these products.

Alimentary Canal of Grasshopper or Cockroaches

The alimentary canal is divided into three main portions:

- Foregut
- Midgut
- Hindgut

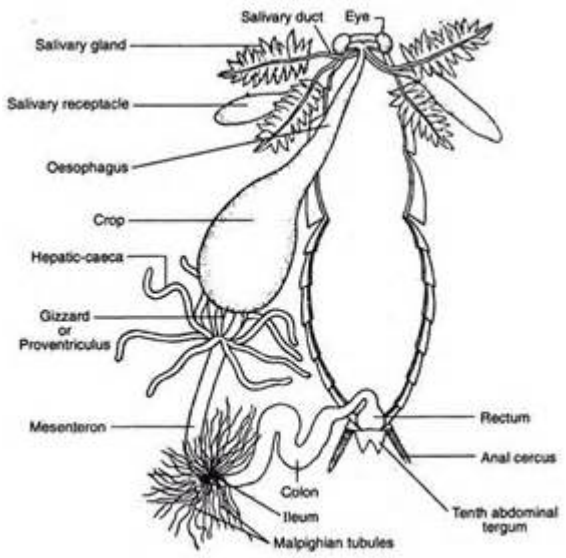


Fig. 18.54: Alimentary system of *Periplaneta americana*.

Foregut

It consists of the mouth surrounded by the mouthparts. The mouth cavity is called the pharynx. It continues as the oesophagus that is short, narrow and thin-walled. The canal then enlarges into crop which is also thin-walled. The crop opens into short, muscular organ, the gizzard or the proventriculus. A pair of Salivary glands lies outside and below the crop.

Each salivary gland is branched, the secretions of all the branches pouring into a common duct. The two ducts, one of each side, open into the mouth cavity at the labium. The entire foregut is lined with chitin. In the gizzard, the chitin (a polysaccharide forming the major constituent in the exoskeleton of arthropods and in the cell walls of fungi) forms teeth and plate to facilitate grinding of the food.

Midgut

Midgut consists entirely of stomach or ventriculus. At the junction of the gizzard and stomach are six pairs of gastric caecae. These are pouch-like structures arranged in a ring-like manner around the anterior end of the stomach. The anterior lobe of each pair of the caecae extends over the proventriculus and the posterior lobe extends over the ventriculus.

The caecae secrete digestive juices and pour them into the stomach. The midgut is not lined by chitin or cuticle but by a peritrophic membrane. This membrane protects the stomach wall from abrasions and is fully permeable to enzymes and digested food.

Hindgut

Hindgut is a coiled structure consisting of anterior ileum, middle colon and posterior rectum. The rectum opens to the exterior through the anus. The hindgut is lined with cuticle. At the junction of the stomach and ileum are attached numerous long tubules called the Malpighian tubules.

Mechanism of Digestion

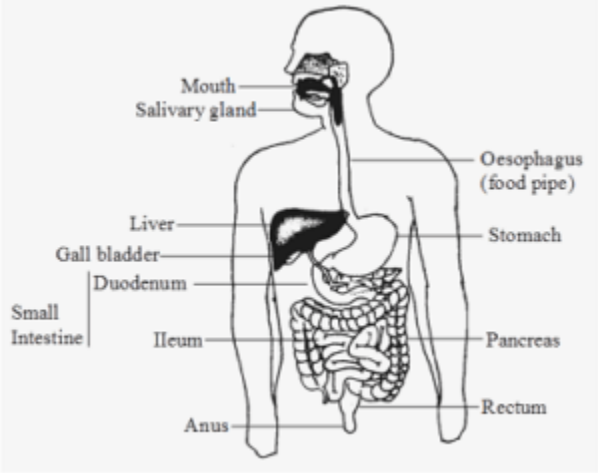
Digestion starts at the mouth with the mandibles and the maxillae chewing the food. It is also acted upon by enzymes of salivary juice, the salivary carbohydrases which partially digest the food. The food is then swallowed with the help of lubrication provided by the salivary juice.

The food then enters the oesophagus and then into the crop. Here, the masticated food is temporarily stored.

The food then passes into the gizzard which acts as the grinding chamber. At the junction of the gizzard and the stomach is a valve called the pyloric valve. It allows the passage of only the thoroughly digested food into the stomach and also, prevents the regurgitation of food from the stomach.

The grinded food then enters the stomach. The digestive enzymes secreted by the gastric caecae act upon the food in the stomach. These enzymes include amylase, maltase, invertase, tryptase and lipase. The digested food is absorbed through the stomach walls into the surrounding space which is called the haemocoel. From here, it is transported to the different body parts.

In the hindgut, absorption of water takes place and the undigested food is formed into almost dry pellets. These are excreted through the anus as faeces.



Test Questions

1. The ____ secretes mucus to lubricate food particles.
2. Digestion starts at the ____
3. The food then passes into the gizzard which acts as the _____
4. _____ is the breakdown of food into smaller components that can be more easily absorbed and assimilated by the body
5. The _____ is a temporary place where it stores its food before they are passed into the gizzard for digestion.

6. _____ is a coiled structure consisting of anterior ileum, middle colon and posterior rectum.

Answers

1. Pharynx
2. Mouth
3. Grinding chamber
4. Digestion
5. Crop
6. Hindgut

Week: 7

Topic: Feeding Habits

Introduction

Modifications and Mechanisms of Feeding in some Animals

There are five modifications and mechanisms of feeding associated with some organisms. These feeding mechanisms include:

Absorbing Mechanisms, e.g. tapeworm

The tapeworm is an endoparasite which carries out parasitic feeding on its host i.e., the man. It has no mouth but absorbs digested food from the intestine of its host. The body of the tapeworm is modified and adapted for parasitic feeding as follow:

1. The alimentary canal is absent, hence food is absorbed through its entire body surface
2. The tapeworm has hooks and suckers which are used for attachment to the intestine of the host to avoid dislodgement
3. The body has thick cuticle which resists digestive enzymes of the host
4. The flat body surface of the tapeworm provides a large surface area for the absorption of already digested food
5. The entire body surface is used also for the absorption of food

Biting and Chewing Mechanism, e.g. Grasshopper or Cockroach

The grasshopper or cockroach has mouth parts adapted for biting and chewing. These insects have four different mouth parts which are modified and adapted for biting or chewing food. These mouth parts are:

Labrum: The grasshopper has labrum or upper lip which prevents the food from falling off the mouth

Mandibles: It possesses a pair of mandibles which are heavy, toothed and jaw-like structure used for cutting and chewing food materials.

Maxillae: The grasshopper also has a pair of maxillae which is also a biting blade. This breaks down the food which the mandibles have chewed into smaller particles

Labium: The labium (lower lip) prevents the wastage of food from the mouth.

Sucking Mechanisms

There are three popular organisms which exhibit sucking mechanism. These are mosquito, butterfly and housefly. These insects have different modifications of mouth parts adapted for feeding on food through the mechanism of sucking.

Piercing & sucking mouth parts in mosquitoes

In mosquito, mouth parts are piercing & sucking type i.e. they are adapted for piercing the tissues of animal or plants to suck blood or plant juice.

The mouth parts consist of labium, labrum-epipharynx, hypopharynx, mandibles & maxillae.

Labium: The labium is modified to form a long, straight, fleshy tube called proboscis. It has a deep labial groove on its upper side. At the distal end of labium is a pair of small tactile labella which are reduced labial palps.

Function: The labial groove lodges all other mouthparts. During piercing, labella guide the mandibles & maxillae. The whole labium bends back to allow needle like mouthparts to go in the flesh.

Labrum (epipharynx): The labrum is long & needle like with ventral groove. The epipharynx is fused with the labrum forming labrum-epipharynx.

Function: It covers the labial groove dorsally from inside. This structure appears C – shaped in transverse section having a groove called food channel.

Hypopharynx: Food channel is closed below by a long, pointed & flattened plate, like a double edged sword, called hypopharynx. It possesses a salivary duct, opening at its tip.

Function: Through this duct saliva is poured to prevent coagulation of blood during sucking.

Mandibles & maxillae: Within the labial groove lies paired, long, needle shaped mandibles & maxillae. Mandibles end in sharp tiny blades, while maxillae into saw like blades bearing teeth.

Function: Mandibles & maxillae act as piercing organs.

In male the labrum-epipharynx & the labium are the same as in the female, but the mandibles & maxillae are very short & functionless & the hypopharynx is fused with the labium.

Mechanism of feeding: The normal foods of both sexes are nectar of flower & juices of plants, but the female possesses modified mouth parts for obtaining additional meals of blood of vertebrates. A female mosquito sits on a vertebrate & presses its labellae of proboscis against the skin. Labellae act as a guide for the piercing mandibles & maxillae. The labium bends back and mandibles & maxillae pierce deep into the skin in order to puncture the blood capillaries.

Saliva, acting as an anticoagulant, is injected down the hypopharynx into the wound. The labrum-epipharynx & hypopharynx together form a feeding tube to suck up blood. The suction is caused by the pharynx by which blood comes into the mouth.

Butterfly

The butterfly feeds on liquid food like nectars of flowers. It has its mouth parts modified for sucking in the following ways:

- It possesses a long coiled proboscis (galea) used for sucking nectars of flowers
- The insect is capable of recoiling the long proboscis under its head when not in use
- There is the non-functioning of the other mouth parts due to the type of food taken by the insect

Housefly

The housefly feeds on liquid food materials. It has mouth parts modified for sucking in the following ways:

- The housefly possesses enlarged labella which are sucking structures for liquid food.
- The housefly has the ability to feed on solid food, e.g. sugar by pouring out its saliva to change the food to a liquid state.
- It has a sucking mechanism called sponging in which the mouth is places on the liquid food and it will start to rush into the mouth
- The labella have fine channels which aid rapid absorption of liquid food into the mouth.

Grinding Mechanism

Grinding mechanism is common among mammals, e.g. man, cattle, sheep, goat, etc. These animals are capable of grinding the food before swallowing. This grinding is aided by the presence of hard and strong teeth made of enamel and dentine.

The animals are adapted to the grinding mechanism by the following features:

- They possess different sets of teeth
- The teeth are hard and strong to withstand biting, chewing or grinding and cracking of food
- They possess incisors which are sharp with flat edges used for cutting off bits of food
- Animals have pointed canine teeth which are used for tearing food
- There is presence of premolars and molars with undulating and wide surfaces used for grinding of food
- The absence of front teeth (incisors) in sheep (a herbivore) is a special adaptation as it helps to grip the grasses during feeding by the animal

Trapping and Absorbing Mechanism

The trapping and absorbing mechanism are common among the insectivorous or carnivorous plants such as bladderwort and sundew. Bladderwort and sundew have structures which enable them to adapt to this mode of feeding.

- Sundew, for example, traps insects by undergoing nastic movements in response to touch from the body of the insects
- The sundew leaf has long hairs which carry digestive glands
- Insect on landing on these hairs causes other hairs to curl over the insect and cover it
- The sundew is capable of secreting a fluid rich in enzyme to digest the insect externally
- The protein so synthesised is easily absorbed by the carnivorous plant into its body

Feeding Habits

Filter feeders: These are aquatic animals that use a body structure similar to a filter basket to gather plants and animals suspended in the surrounding water. The filter feeder siphons water into its mouth and then filters it to obtain small organisms to digest. The tube sponge is a filter feeder. Other examples include flamingos, tube worms, clams, barnacles, and baleen whales.

Fluid feeders: Animals which feed on any fluid materials are classified as fluid feeders. There are two major groups of fluid feeders, these are wallowers e.g. tapeworm and suckers e.g. mosquito. They obtain food by sucking or licking nutrient-rich fluids from live plants or animals. Fluid feeders have mouth parts that are adapted to pierce or rip skin or leaf tissue. The same or other mouth parts are used to suck or lick the blood or sap that is their food. Examples of fluid feeders include mosquitoes, ticks, aphids, spiders, bees, butterflies, vampire bats, and hummingbirds.

Substrate feeders: These live in or on their food source and eat their way through it. Examples of substrate feeders include caterpillars and earthworms. Caterpillars eat their way through the green tissues of leaves. Earthworms eat their way through the soil, ingesting soil particles containing partially decayed organic material as they go.

Test Questions

1. Give an example of an insect which exhibits sucking mechanism.
2. Mandibles & maxillae act as _____ organs
3. What are Substrate Feeders?
4. Grinding mechanism is common among _____
5. List three types of feeding habits

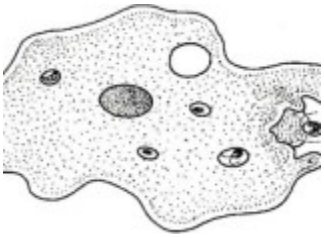
Answers

1. Mosquitoes, Butterfly
2. Piercing
3. They live in or on their food source and eat their way through it
4. Mammals
5. Filter feeders
   Substrate feeders
   Fluid Feeders

Topic: Feeding in Amoeba, Hydra and Man

Amoeba Feeding

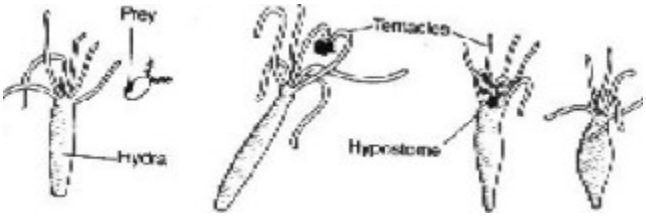
Amoeba feeds on microscopic organisms such as single-celled algae and bacteria. When the amoeba encounters a suitable organism, the cytoplasm flows round the prey and engulfs it, with a drop of water, in a food vacuole. The cytoplasm secretes enzymes into the food vacuole. The enzymes digest the soft parts of the prey and the soluble products are absorbed back into the cytoplasm. Any undissolved residue is left behind as the amoeba flows on.



Feeding in Hydra

Hydra feeds on a variety of small aquatic animals, such as Daphnia and Cyclops, which it catches by means of lots of tiny stinging cells on its tentacles. Scattered over the outer layer tentacles are a great many of these stinging cells called cnidoblasts. Smaller numbers occur on the main body. Each cnidoblast contains a capsule (nematocyst) from which projects a small “trigger” called a cnidocil. Inside each capsule is a tiny hollow thread. It is inverted

like a finger of a glove which is pushed into the hand part. These threads are the food-catching apparatus.



Feeding in Mammals

Mammals may eat animals, vegetation, or a mixture of the two. Different words are used to describe mammals and the type of feeding:

- Carnivore: A mammal that eats other animals (flesh or meat eaters).
- Herbivore: A mammal that eats plants.
- Omnivore: A mammal that can eat both plants and meat.

When mammals eat, the food is first broken down into smaller pieces in the mouth. The teeth carry out this mechanical process. There is a row of teeth in the top jaw and a row of teeth in the bottom jaw. When the jaws are moved, the teeth met in different ways so that the food the animal eats is crushed.

Dentition

Dentition refers to the number, arrangement and conformation of teeth in an organism.

Types of Dentition

There are two main types of dentition. These are:

1. **Homodont dentition:** In this type of dentition, the organisms have the same type of teeth. No set of teeth is specialised for any function. All the teeth are of the same shape, size and functions.

Examples of homodont dentition are found in fishes, amphibians and reptiles.

2. **Heterodont dentition:** In this type of dentition, the organisms possess teeth of different shapes, sizes and functions. Examples of organisms having heterodont dentition are mammals, e.g. rabbits, man, dog, cattle, etc.

There are different kinds of teeth in the mouths of mammals. These are incisors, canines, premolars and molars. The type of teeth possessed by an animal is closely related to the type of food it eats.

Mammals again have two sets of teeth. These are milk teeth and permanent teeth

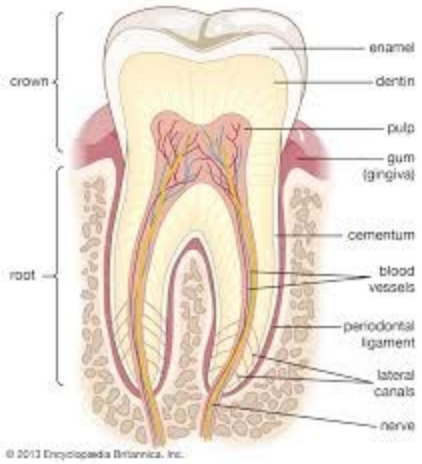
1. **Milk Teeth:** This is the set of teeth possessed by the young ones (i.e. children in the case of human) and it is made up of the incisor, canine and premolar teeth (i.e. without the molar). Milk teeth later fall off to be replaced by the permanent teeth.

2. **Permanent Teeth:** This is the set of teeth possessed by adult mammals and is usually four types. They remain till old age and may number up to 32 in man.

Types of Teeth

- The incisors are at the front of the mouth.
- The canines are behind the incisors on each side (although they are missing in some mammals).
- The premolars are at the sides of the mouth.
- The molars are right at the back of the mouth, on each side.

Structure of a Tooth



A typical tooth such as the canine or incisor is made up of three regions which are the crown, the neck and the root.

- The crown is the part of the tooth that is above the gum·
- The root is the part of the tooth that is embedded in the socket of the gum·
- The neck is the narrow junction between the crown and the root.
- Incisors and canine have one root each while premolars and molars may have two or three roots each.
- Enamel is white in colour. It is the hardest substance in the human body and covers the outer portion of the crown. It is made up of mineral salts (of calcium and magnesium) and keratin. It can withstand high pressure.
- Cement is the layer present covering the root portion of the tooth. It is made up of mineral salts and water and is almost as hard as bone.
- Periodontal membrane or ligament – It consists of fibres which extend across the cement and anchor the tooth in the bony socket. They also allow a certain degree of movement while chewing thereby acting as shock absorbers.
- Dentine is yellow and is a bone-like material which is present along the full height of the tooth. It is enclosed by the enamel

in the crown portion and cement in the root portion. Dentine can also be composed of living cells which show divisions with new cells being added to it regularly.

- Pulp cavity is the innermost region of the teeth and shows the presence of blood vessels and nerve endings. The blood vessels serve to nourish the tooth and the nerves transmit messages of heat, cold and pain to the brain and back. The pulp cavity in the root portion is also referred to as the root canal. The number of root canals may range from 1 to 3 depending on the type of tooth. The blood vessels and the nerves enter the root canal through a small hole at the tip of the root canal.

Dental Formula

The dental formula refers to the numbers and types of teeth present in the mouth of an animal. The numbers and types of teeth present in the jaw of an animal is a reflection of special adaptation of mammalian teeth for feeding.

Teeth of a carnivore – the dog

The teeth in carnivores are well designed for dealing with flesh and bones

Incisors: These are small and designed to meet together to grip the prey and pull the meat apart.

Canines: These are large, sharp and pointed. They may be used for holding and killing the prey, and also for tearing the meat apart.

Premolars and molars: These are powerful teeth that meet together and can crush flesh and bone.

Carnassials: These do not meet, but pass each other, rather like a pair of scissors, so that the meat iscut into pieces and the bones cracked.

Jaw hinge: This only allows up and down movement to provide a firm scissor action. There is nosideways movement.

The dental formula for dog:

Puppy (temporary teeth) not presents at birth – but complete by 60 days.

I – 3/3 C- 1/1 P – 3/3 M – 0/0 = 14 x 2 = 28

Adult (permanent teeth) – emerge at about 4 months of age

I – 3/3 C – 1/1 P – 4/4 M – 2/3 = 21 x 2 = 42

Teeth of a herbivore

The teeth in herbivores are well designed for dealing with plant material. It indicates that in the upper right (or left) half of the jaw there are no incisors or canines (i.e. there is a diastema), three premolars and three molars. In the lower right (or left) half of the jaw are three incisors, one canine, three premolars and three molars

The dental formula for sheep:

Temporary teeth

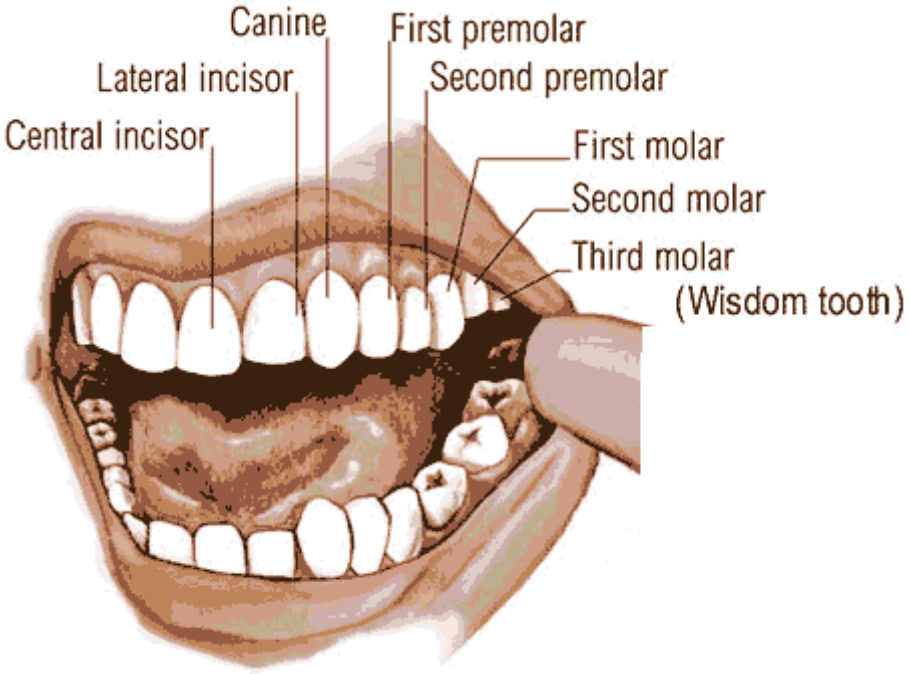
I – 0/4 C – 0/0 P – 3/3 M – 0/0 = 10 x 2 = 20

Permanent teeth

I – 0/4 C – 0/0 P – 3/3 M – 3/3 = 16 x 2 = 32

In sheep the permanent teeth are not completely erupted until 3.5 – 4 years of age

Teeth of an omnivore – the Human



Incisors: Used for biting – apples, for example.

Canines: Not as large and powerful as those of a dog, although they can be used for tearing.

Premolars and molars: Used for chewing and crushing food. These teeth slide over each other as the jaw moves from side to side.

Jaw hinge: The hinge joint in a Human skull allows some sideways movement, so the bottom jaw can move both up and down and from side to side.

The dental formula for man where I = incisors, C = canines, P = premolars and M = molars:

Man (adult): I – 2/2 C – 1/1 P – 2/2 M – 3/3 = 16 x 2 = 32

During the life span of man, he grows two sets of teeth. This condition is called diphyodont. The teeth, which appear during the infancy, number only 20 and are temporary. They start falling from around the age of 5. They are thus called deciduous teeth (also called milk teeth). In each jaw there are 10(4 incisors, 2 canines and 4 pre-molars).

The permanent teeth take the place of the milk teeth after they fall. The types of teeth remain the same. In addition to these 20 teeth, the permanent set have 12 molars which are present 3 on each side. Thus, a total of 32 teeth are present in the normal human adult.

Dental Care

Keeping your teeth and gums healthy requires good nutrition and regular brushing and flossing. The teeth can therefore be cared for in the following ways:

- Brush your teeth twice a day—in the morning and before bed—and floss once a day. This removes plaque, which can lead to damaged teeth, gums, and surrounding bone.
- Use toothpaste that contains fluoride, which helps prevent tooth decay and cavities. Ask your dentist if you need a mouthwash that contains fluoride or one with ingredients that fight plaque. Look for toothpastes that have been approved by the American Dental Association.
- Avoid foods that contain a lot of sugar. Sugar helps plaque grow.
- Avoid using tobacco products, which can cause gum disease and oral cancer. Exposure to tobacco smoke (secondhand smoke) also may cause gum disease as well as other health problems.
- Practice tongue cleaning. You can use a tongue cleaner or a soft-bristle toothbrush, stroking in a back-to-front direction.

Tongue cleaning is particularly important for people who smoke or whose tongues are coated or deeply grooved.

- Schedule regular trips to the dentist based on how often you need exams and cleaning.

Practice Questions

1. A mammal that eats other animals (flesh or meat eaters) is called _____
   a) herbivores
   b) carnivores
   c) omnivores
   d) savages
2. Permanent teeth in the normal human adult is __
   a) 22
   b) 32
   c) 42
   d) 33
3. One of the following is not a type of teeth ___
   a) Molar
   b) Premolar
   c) Cay-nine
   d) Incisor
4. The dental formulae for adult dog of 4months of age is ____
5. _____ is yellow and is a bone-like material which is present along the full height of the tooth.
   a) Dentine
   b) Dentist
   c) Dental
   d) Enamel
6. ____ is the hardest substance in the human body and covers the outer portion of the crown
   a) Dentine

b) Incisor
c) Crown
d) Enamel

7. _____ refers to the number, arrangement and conformation of teeth in an organism.
   a) Teeth
   b) Dental
   c) Dentition
   d) Tooth

8. ____ are used for chewing and crushing food.
   a) molars
   b) canine
   c) premolars
   d) a & c

9. One of the following is not a way to care for your teeth
   a) Chew gum regularly
   b) Brush your teeth twice a day
   c) Avoid foods that contain a lot of sugar
   d) Use toothpaste that contains fluoride

10. ____ is used for biting
    a) molars
    b) premolars
    c) canine
    d) incisors

Answers

1. B
2. B
3. C
4. I – 3/3 C – 1/1 P – 4/4 M – 2/3
5. A
6. D

7. C
8. D
9. A
10. D

Biology, SS 2, Second Term, Week: 9

Topic: Transport Systems

Introduction

Organisms need to be able to move materials such as respiratory gases, nutrients, waste products and heat both into and out of, and within its body.

A transport system is a means by which materials are moved from an exchange surface or exchange surfaces to cells located throughout the body system.

Specialized exchange surfaces are biological structures whose features are such that they permit the highly efficient transfer of materials e.g. respiratory gases, across them via mechanisms such as diffusion or active transport. Although many micro-organisms accept materials directly through their cell membrane.

Mass flow is the movement of a fluid in one direction, usually through a system of tube-like vessels. Examples of mass flow in mass transport systems include the movement of blood and the movement of xylem and phloem through plants.

Need for Transportation

The need for transportation in living organisms includes:

1. Transport is necessary for every cell of the organism to obtain all the essential materials for its metabolism, e.g. nutrients, oxygen, water etc.

2. It is also necessary to remove and dispose metabolic wastes, e.g. carbon dioxide, water, urea etc.

3. In plants, transport is necessary to move mineral salts and water from the roots to the stems and leaves.

4. Transport is also required to move hormones in plants and animals from where they are produced to the area of need.

5. Glucose from the leaves and storage organs are some of the substances being regularly transported in plants

Features of Transport Systems

Transport systems in many different types of organisms have lots of common features, such as:

Contains a transport medium in which materials of various sizes and shapes can be conveyed. This medium is usually water-based. Water acts as a solvent for a wide range of substances and flows easily at the temperatures of living organisms. Examples of transport media in animal transport systems include blood, lymph and hemolymph.

A structure or 'system' of vessels that contain or enclose the transport medium and extend via a branching network, to all locations to which materials carried must be transported. This doesn't apply to 'Open Circulatory Systems', which may have some vessels but the transport medium is not retained within them at all times.

A mechanism for moving the transport medium through the system, e.g. through a network of vessels. Movement of a fluid through a system requires a difference in pressure between parts of the system.

I. Animal Transport Systems sometimes include a pumping organ such as the heart in mammals, birds and some other creatures. They may also use other mechanisms such as muscular contraction of muscle tissues as well as, or instead of, a heart.

ii. Plant Transport Systems tend to rely on passive physical process e.g. evaporation of water.

· Mechanism(s) to maintain the mass flow movement of the transport medium in one direction. The pressure difference that moves the transport medium through the system is helpful but not necessarily sufficient to prevent back-flow. Some of the vessels in

the circulation systems of animals include valves that prevent black-flow of the fluid contained in the vessel.

Materials for Transportation

The following things are transported by blood:

§ **Nutrients** (e.g. glucose, amino acids, etc.)

§ **Antibodies**: Antibodies are produced by white blood corpuscles and transported by the blood to all parts of the body for tissue respiration or for storage in storage organs.

§ **Carbon dioxide**: Animals breathe in oxygen and breaths out CO_2. Metabolic process of respiration going on in the body cells constantly releases carbon (IV) Oxide and water. These diffuse in exchange of oxygen across the capillary wall into the blood stream. The release of carbon (IV) Oxide from the body of animals helps to maintain the adequate internal body temperature of animals.

§ **Hormones**: Hormone is produced by the endocrine glands of the animal body. It is transported by blood to the action sites. These action sites are where these hormones are needed and used.

§ **Oxygen**: Oxygen is the principal gas that holds the lives of animals. The red blood cells contain haemoglobin. This haemoglobin combines with oxygen to form what is called Oxyhaemoglobin. The oxyhaemoglobin assists in distributing oxygen to cells and tissues where they are needed in the body.

§ **Urea**: Waste products arising from body metabolism of animals are carried by blood to the kidney, skin and so on for excretion. In the other words, urine is transported from the kidney to the bladder and then excreted from the body through the possible part of the body.

§ **Heat** (not a molecules, unlike all the others)

§ **Excess salts**: These are also produced from cells and excreted by the skin and kidney

§ **Water**: This is a universal solvent. All living things both plants and animals needs water for survival. The total amount of water in a man of average weight (70 kilograms) is approximately 40 litres, averaging 57 percent of his total body weight. Water is transported from one part of human body to the other. Water is also released as sweat through the skin pores. It is a very important class of food needed by animals.

Media of Transportation

In all organisms, a liquid or fluid is the medium of transportation of materials. Generally, there are four major media of transportation which are:

Cytoplasm

Cytoplasm is used as the medium of transportation of materials in lower unicellular organisms such as Amoeba and Paramecium. Materials such as glucose, amino acids, oxygen, water and carbon dioxide are transported from one part of the cell to another through cytoplasm.

Cell sap or Latex

Cell sap or latex is used as the medium of transportation of materials in plants. Cell sap is a concentrated solution found in the vacuole of cells which serves as a stronger solution. As a result of this the cell sap is able to transport water and dissolved mineral salts from the soil through the root hairs to the upper parts of the plants.

Blood

The blood is a powerful medium of transportation of materials in most animals especially vertebrates. The blood in its fluid state is able to move large materials over the entire body through blood vessels like arteries, veins and capillaries from where they are produced or obtained to their point of destination.

Lymph

Lymph is one of the media of transportation in higher animals. it is a fluid similar in composition to tissue fluid, although it contains extra lymphocytes, there is no red cell present. It returns fluid to the main veins through opening in the subclavian (left jugular) vein below the neck. Example of lymph vessel is the lateal which transports fatty acids and glycerol.

Practice Questions

1. A ____ is a means by which materials are moved from an exchange surface or exchange surfaces to cells located throughout the body system.
   a) Transport system
   b) Circulatory system
   c) Respiratory system
   d) none of the above
2. ____ is the principal gas that holds the lives of animals
   a) carbon(iv)oxide
   b) oxygen
   c) nitrogen
   d) a & b
3. ____ is not a medium of transportation in Organisms
   a) lymph
   b) blood
   c) cell sap
   d) water
4. Oxygen in the blood combines with haemoglobin to form _____
5. Hormone is produced by the _____ of the animal body
6. One of the following is not a material transported by the blood
   a) urea
   b) nutrient

c) antigens
d) Oxygen

7. Excess salts is excreted by the ____
   a) skin
   b) kidney
   c) bladder
   d) a & b
8. The total amount of water in a man of average weight (70 kilograms) is approximately ___ litres
   a) 40
   b) 50
   c) 60
   d) 45
9. _____ is a concentrated solution found in the vacuole of cells which serves as a stronger solution
   a) hypoglycemic solution
   b) cell membrane
   c) cell sap
   d) nucleus
10. Another name for cell sap is ____

Answers

1. A
2. B
3. D
4. Oxyhaemoglobin
5. Endocrine glands
6. C
7. D
8. A

9. C

10. Latex

Week 2

Topic: Supporting Tissues and Systems

Introduction

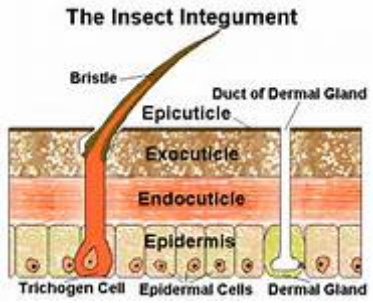
Living organisms including plants and animals need tissues to enable them carry out life processes such as movement, respiration, etc. For example, without the various bones and tissues, vertebrates may not be able to stand, respire, move and carry out their life processes.

Skeleton

Skeleton is the bony framework of the body which provides support, shape and protection to the soft tissues and tissues in animals.

The human skeleton consists of 206 bones. We are actually born with more bones (about 300), but many fuse together as a child grows up. The longest bone in our bodies is the femur (thigh bone). The smallest bone is the stirrup bone inside the ear. Each hand has 26 bones in it. Your nose and ears are not made of bone; they are made of cartilage, a flexible substance that is not as hard as bone. The bones support your body and allow you to move. Bones contain a lot of calcium (an element found in milk and other foods).

Bones manufacture blood cells and store important minerals.

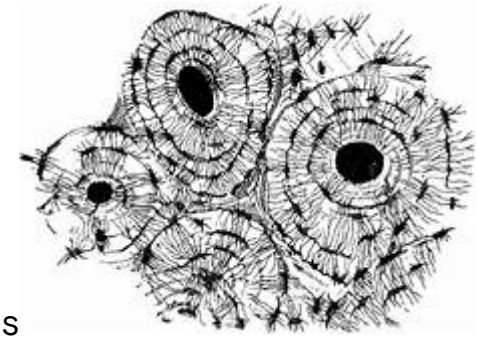


Biological Significance of Skeleton

1. **Support and Shape:** The skeleton is a support structure, providing shape to the body. It also acts as the protective framework that is needed to keep the body organs safe.
2. **Protection:** The bones of the skeleton protect the delicate internal organs and the soft tissue of the body, keeping the inner body safe from trauma due to falls or injuries.
3. **Movement:** The bones are connected to skeletal muscles that permit the body to move. Bones act as levers and when the muscles contract they pull on a bone and allow it to move.
4. **Blood Cell Production:** Haemopoiesis, or blood cell formation, takes place in the red bone marrow. Blood cells are essential to life and play a huge role in keeping the body healthy as well.
5. **Mineral Storage:** Skeletal bones are able to store phosphorous and calcium, which may then be released in the necessary amount, to keep the body at a level of homeostasis, or a state of balance.

Skeletal Components

The skeleton is composed of fibrous and mineralized connective tissues that give it firmness and flexibility. It consists of bone, cartilage, tendons, joints, and ligaments.

1. **Bone:** A bone is a type of mineralized connective tissue that contains collagen and calcium phosphate, a mineral crystal. Calcium phosphate gives bone its firmness. Bone tissue may be compact or spongy. Bones provide support and protection for body organs.
2. **Cartilage:** This is a form of fibrous connective tissue that is composed of closely packed collagenous fibers in a rubbery gelatinous substance called chondrin. Cartilage provides flexible support for certain structures in adult humans including the nose, trachea, and ears. In mammals, there are three types of cartilages:
3. **Hyaline cartilage**: This is found in trachea and bronchi which keep them open and the surface of moveable joints
4. **Fibro-cartilage:** It is tougher than hyaline cartilage and it is found in the discs between the small bones (vertebra) of the vertebral column
5. **Elastic cartilage:** This is found in the external ear (pinnae) and epiglottis 

Difference between Bones and Cartilages

Bone	Cartilage
Bones is made up of living and non-living cells	Cartilage is made up of mainly living cells
It is not flexible, especially in adult	It is very flexible both in adults and young ones

It can never be replaced by a cartilage	It can easily be replaced by bone
It is made up mainly of mineral salts	It is not made up mainly of mineral salts
It is a stronger and more rigid tissue	It is not so strong but it is a flexible tissue

1. **Tendon:** This is a fibrous band of connective tissue that is bonded to bone and connects muscle to bone.
2. **Ligament:** This is a fibrous band of connective tissue that joins bones and other connective tissues together at joints.
3. **Joint:** This is a site where two or more bones or other skeletal components are joined together.

TYPES OF SKELETON

The three types of skeleton are hydrostatic skeleton, endoskeleton and exoskeleton. Hydrostatic skeleton is found in cold-blooded animals including invertebrates. We human beings have endoskeleton. Exoskeleton is found in insects.

Hydrostatic Skeleton

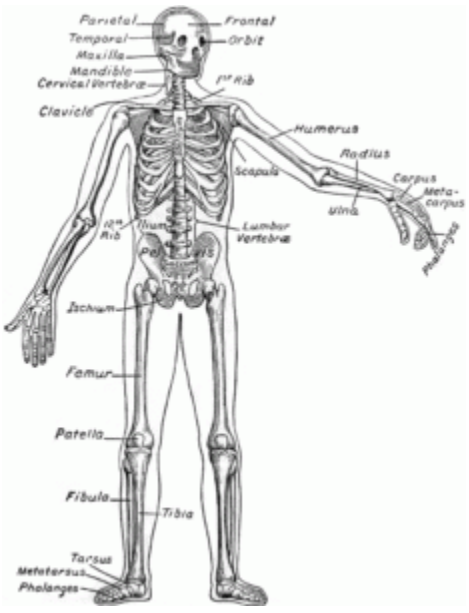
It is found in soft-bodied and cold-blooded animals. This skeleton has a coelom, which is a fluid-filled cavity. This coelom is surrounded by muscles and the rigidity caused by the fluid and the muscles serve as a supporting structure for the organisms. The fluid pressure along with the motion of the supporting muscles helps the organisms to change shape and move. Echinoderms, cnidarians, annelids, nematodes and some other organisms use the hydrostatic skeleton for movement. The Earthworm which is an annelid is boneless. With the help of hydrostatic skeleton it burrows through the ground. Examples of echinoderms are the star fish and the sea urchin. The Jelly fish is a cnidarians.

Endoskeleton

The simplest definition for endoskeleton is that it is the skeleton found inside the body. It forms the frame work for the animal. The tissues and muscles are formed around the skeletal system and the muscular forces are transmitted to this skeleton. The Endoskeleton supports the animal structure. It is composed of mineralized tissues. In Phylum Chordata, Porifera and Echinodermata endoskeleton is present. The animals that come under Phylum Chordata are all vertebrates including human beings.

Exoskeleton

These are skeletons found outside the body. It forms a protective covering for the animals. It supports as well as protects the animals. All crustaceans have exoskeleton. Crabs, spiders, lobsters, insects are all crustaceans. Most invertebrates do possess cuticle which is composed of chitin. Chitin is a non-living substance commonly found covering the outer part of the body of some animals. Animals with exoskeleton are usually small. This is because large animals could not be supported by exoskeleton and need bones to support them. Animals with exoskeleton have a head and abdomen and in some cases, a thorax. The exoskeleton is soft and thin at the joints where it has to bend. The large exoskeletons are called shells. Tortoise is one animal that has a shell and endoskeleton.



Test Questions

1. ____ is the name of the skeleton found inside the body
   a) Exoskeleton
   b) Hexoskeleton
   c) Endoskeleton
   d) Hydrostatic skeleton
2. The human skeleton consists of ___ bones
   a) 306
   b) 206
   c) 106
   d) 406
3. _____ is a non-living substance commonly found covering the outer part of the body of some animals.
   a) Chitin
   b) Keratin
   c) Cartilage
   d) Skeleton
4. _____ is a fibrous band of connective tissue that joins bones and other connective tissues together at joints.
5. _____ is a form of fibrous connective tissue that is composed of closely packed collagenous fibers in a rubbery gelatinous substance called chondrin.
6. _____ is tougher than hyaline cartilage and it is found in the discs between the small bones (vertebra) of the vertebral column
   a) Fibro – cartilage
   b) Elastic – cartilage
   c) Cartilage
   d) Bone
7. The longest bone in the body is called _____

Answers

1. C
2. B
3. A
4. Ligament
5. Cartilage
6. A
7. Femur

Week 4

Topic: Joints

Introduction

The human skeleton consists of more than 200 bones. The individual bones are attached in such a way that a large variety of co-ordinated movements are made possible in different parts of the body. These movements are made possible by skeletal muscles, the fact that the bones act as levers, cartilage which reduces friction and ligaments which prevent dislocation and the presence of movable joints. The site or place where two or more bones of the skeleton are attached to each other is called a joint or place of articulation.

A joint or place of articulation is formed where two or more bones come in close contact in the body and are attached to each other by ligaments.

Types of Joints

Joints can be classified according to the degree and type of movement they allow. The following types of joints can be recognized:

1. **Fibrous (or Immovable) Joints**

These joints are firmly held together by a thin layer of strong connective tissue. There is no movement between the bones such as the sutures of the skull and the teeth in their sockets.

2. **Cartilaginous Joints**

Cartilaginous joints are joints where the articular surfaces of the bones forming the joints are attached to each other by means of white fibro-cartilaginous discs and ligaments which allow only a limited degree of movement. Examples are the cartilaginous between the vertebrae, the cartilage in the symphysis which binds the pubic bones together at the front of the pelvic girdle and the cartilage in the joint between the sacrum and the hip bone.

A cartilaginous joint between two vertebrae

3. **Synovial Joints**

These are freely movable joints. Most of the joints in the body are of the synovial type. The following are the main characteristics of a synovial joint:

- The ends of the bones are covered with a layer of smooth hyaline cartilage, called articular cartilage in the joint regions. This reduces friction at the point.
- The joint is completely enclosed by a bag-like capsular ligament which holds the joint together and helps to contain the synovial fluid.
- The capsular ligament is lined with a synovial membrane. This membrane secretes synovial fluid into the synovial cavity and acts as a seal, waterproofing the joint. The synovial fluid lubricates the joint.

- In addition to the capsule, the bones are also attached and held together by strong, tough ligaments made of dense connective tissue. These ligaments prevent dislocation during normal movement. The articulating surfaces of adjacent bones are reciprocally shaped.
- Synovial joints can be subdivided into the following groups according to the type of movement they carry out:

4. **Ball-and-Socket Joints**

These joints are formed where the rounded head of one bone fits into the hollow, cup-shaped socket of another bone such as the shoulder joint and the hip joint. Such joints allow freedom of movement in all directions.

5. **Hinge Joints**

These joints occur where the convex surface of one bone fits into the concave surface of another bone, so making movement possible in one plane only. Examples of these joints are the knee and the elbow joints. Hinge joints have ligaments mainly at the sides of the joints.

6. **Gliding Joints**

This type of joint allows for gliding movements between flat surfaces as the surfaces slide over one another. Only a limited amount of movement is allowed such as the joints between the carpal bones, the joints between the tarsal bones and those between the articular processes (zygapophyses) of successive vertebrae.

7. **Pivot Joints**

This is the Rotation of one bone around another. A bony ring rotates round the pivot (axis) of another bone such as the ring-like atlas rotating around the odontoid process of the axis, allowing the head to turn from side to side.

Top of the neck
(atlas and axis bones)

Structure of Joints

Joints consist of bones, muscles, cartilage, tendons, ligaments and other connective tissue. Muscles keep the bones in place and also through contraction or extension help move the bones. Cartilage prevents the bone ends from rubbing directly on to each other. Cartilage is not as hard and rigid as bone, but is stiffer and less flexible than muscle. Tendons are bands of fibrous tissue that

connect muscles to bones. Ligaments are bands of fibrous tissue that connect the ends of bones together to form a joint.

The Human Joint Structure

The human joint structure

- Cartilage reduces friction. Acts as a shock absorber.
- Synovial fluid lubricates the joint.
- Synovial membrane produces synovial fluid.
- Tendon joins muscle to bone enabling movement.
- Ligament joins bone to bone, stabilising the joint.

Supporting Tissues in Plants

The development of stable supporting elements has been an important prerequisite for the evolution of large terrestrial organisms. Animals have endo- or exoskeletons that correspond in function to the woody stems or trunks of plants. The strength of tissues protects also against enemies. The hard shell of many seeds prevents a chewing to pieces or puncturing by animals and avoids that parasites like fungi or bacteria force their way into them.

Extensive specialized supporting tissues exist only in vascular plants. Vascular plants have up to four types of supporting tissue:

1. The collenchyma, a tissue of living cells,
2. The sclerenchyma, a tissue of nearly always dead cells, and
3. The vascular tissue consisting of both living and dead cells. It is responsible for the transport and dispersal of water, nutrients and assimilates.
4. Parenchyma

Parenchyma

The cells of parenchyma are large, thin-walled, and usually have a large central vacuole. They are often partially separated from each other and are usually stuffed with plastids.

In areas not exposed to light, colourless plastids predominate and food storage is the main function. The cells of the white potato are parenchyma cells.

Where light is present, e.g., in leaves, chloroplasts predominate and photosynthesis is the main function.

Sclerenchyma

The walls of these cells are very thick and built up in a uniform layer around the entire margin of the cell. Often, the cell dies after its cell wall is fully formed. Sclerenchyma cells are usually found associated with other cells types and give them mechanical support.

Sclerenchyma is found in stems and also in leaf veins. Sclerenchyma also makes up the hard outer covering of seeds and nuts.

Collenchyma

Collenchyma cells have thick walls that are especially thick at their corners. These cells provide mechanical support for the plant. They are most often found in areas that are growing rapidly and need to be strengthened. The petiole (“stalk”) of leaves is usually reinforced with collenchyma.

Vascular Tissues

Vascular tissues do not only fulfill supporting functions. Their conductive functions are more important. They consist of water-

conducting xylem and food-conducting phloem. Only the xylem has still supporting functions. Xylem and phloem are combined in a structure that is called vascular bundle.

- **Xylem:**

Xylem conducts water and dissolved minerals from the roots to all the other parts of the plant. In angiosperms, most of the water travels in the xylem vessels. These are thick-walled tubes that can extend vertically through several feet of xylem tissue. Their diameter may be as large as 0.7 mm. Their walls are thickened with secondary deposits of cellulose and are usually further strengthened by impregnation with lignin. The secondary walls of the xylem vessels are deposited in spirals and rings and are usually perforated by pits.

In woody plants, the older xylem ceases to participate in water transport and simply serves to give strength to the trunk. Wood is xylem. When counting the annual rings of a tree, one is counting rings of xylem.

- **Phloem**

The main components of phloem are

- Sieve elements and
- Companion cells.

Sieve elements are so-named because their end walls are perforated. This allows cytoplasmic connections between vertically-stacked cells. The result is a sieve tube that conducts the products of photosynthesis — sugars and amino acids — from the place where they are manufactured, e.g., leaves, to the places where they are consumed or stored; such as roots, growing tips of stems and leaves, flowers, fruits, tubers, corms, etc.

Sieve elements have no nucleus and only a sparse collection of other organelles. They depend on the adjacent companion cells for many functions.

Companion cells move sugars, amino acids and a variety of macromolecules into and out of the sieve elements, then pass on to the cells of their destination.

Uses of Fibres to the Plants

1. All fibres give strength and support to plants
2. They serve mechanical functions when they grow older such as rigidity, flexibility and elasticity
3. They protect the fragile part of the plants
4. They are sclerenchymatous in nature
5. When they are associated with wood or xylem, they are known as wood fibres.

Functions of Supporting Tissues in Plants

Supporting tissues provide the following functions to plants:

1. **Strength:** The sclerenchyma and collenchyma tissues provide the necessary strength required by plants
2. **Rigidity:** The supporting tissues like collenchyma, sclerenchyma and wood fibres provide the necessary materials to make the plant strong against any external forces.
3. **Protection:** Some supporting tissues are known to protect the delicate parts of the plants body, e.g. cambium and phloem vessel
4. **Flexibility:** Some supporting tissues also provide the necessary materials which make the plants flexible thereby preventing the plants from being broken by the bending and twisting movements caused by strong winds

5. **Conduction:** Some supporting tissues especially xylem and phloem tissues are known to also conduct water and manufacture food respectively within the plant.

Test Questions

1. _____ joints are joints where the articular surfaces of the bones forming the joints are attached to each other by means of white fibro-cartilaginous discs and ligaments which allow only a limited degree of movement.
2. What is the name of the joint found in the shoulder?
3. What parts of plant are responsible for strength?
4. _____ tissue(s) is responsible for conducting water and manufacture of foods in plants
   a) phloem
   b) collenchyma
   c) xylem
   d) a & c
5. Sieve elements and companion cells can be found in the ____
   a) xylem
   b) scelerenchyma
   c) phloem
   d) collenchyma
6. The site or place where two or more bones of the skeleton are attached to each other is called a _____
7. _____ reduces friction and acts as a shock absorber.
8. ____ fluid is used to lubricate joint.
   a) Binomial
   b) Synovial
   c) Joint
   d) Tendon

9. _____ conducts water and dissolved minerals from the roots to all the other parts of the plant.
   a) phloem
   b) xylem
   c) collenchyma
   d) scelerenchyma
10. Another name for fibrous joints are _____ joints
   a) immovable
   b) movable
   c) strong
   d) weak

Answers

1. Cartilaginous
2. Ball and socket joint
3. Scelerenchyma and Collenchyma
4. D
5. C
6. Joint
7. Cartilage
8. B
9. B
10. A

Introduction

In a simple plant like an alga, materials enter or leave the cells in the body by diffusion. In higher land plants, special conducting tissues, known as vascular tissues carry out transport.

Two main types of vascular tissue are used in transport – xylem and phloem.

·Xylem transports water and minerals.

·Phloem transports organic molecules such as the products of photosynthesis.

Xylem

There are four types of xylem cells:

Xylem vessels: Consist of dead hollow cells because the walls are lignified and the cell contents disintegrate. The lignin makes the cell wall impermeable so they are in effect waterproof. It also makes the vessels extremely strong and prevents them from collapsing. They have a wide lumen and are linked end to end to create a long, hollow tube since the end cell walls have one or many perforations in them. This allows the transport of large volumes of water. The sidewalls have bordered pits (unlignified areas) to allow lateral movement of water. Xylem vessels are found in angiosperms.

Tracheids: Similar to vessels but with narrower lumens and connected by pits. They have tapered ends so that they dovetail together. Tracheids are found in conifers.

Parenchyma: Living cells with thin cellulose walls. They can store water, which makes them turgid and so gives them a supporting role.

Fibres: They provide strength because their walls are lignified (and therefore, dead).

Movement in the root

Water enters through the root hair cells and then moves across into the xylem tissue in the centre of the root. Water moves in this

direction because the soil water has higher water potential, than the solution inside the root hair cells.

This is because the cell sap has organic and inorganic molecules dissolved in it. The root hairs provide a large surface area over which water can be absorbed.

Minerals are also absorbed but, their absorption requires energy in the form of ATP because they are absorbed by active transport. They have to be pumped against the concentration gradient.

Water taken up by the root hair moves across the cortex of the root either via the cytoplasm of the cells in between the root hair cell and the xylem (the symplast pathway) or through the cell walls of these cells (the apoplast pathway). The root hair cell will have higher water potential than the cell next to it. As always, water moves by osmosis to where the water potential is lower. In this way, as water is always being absorbed by the root hairs, water will always move towards the centre of the root.

When the water reaches a part of the root called the endodermis, it encounters a thick, waxy band of suberin in the cell walls. This is the Casparian strip and it is impenetrable. In order to cross the endodermis, the water that has been moving through the cell walls must now move into the cytoplasm.

Once it has moved across the endodermis, it continues down the water potential gradient until it reaches a pit in the xylem vessel. It enters the vessel and then moves up towards the leaves.

Movement in the Xylem

Water evaporates from the mesophyll cells into air spaces in the leaf. If the air surrounding the leaf has less water vapour than the air in the intercellular spaces, water vapour will leave the leaf through stomata.

This process is called transpiration and will continue as long as the stomata are open and the air outside is not too humid. On dry,

windy days when water vapour is continually diffusing out and being removed, transpiration will increase in rate.

Although this loss of water can cool the plant, it is essential that the plant does not lose too much water. Therefore water must be continuously supplied to the leaves. The xylem ensures that this happens. Xerophytes are plants which are well adapted to living where conditions are very dry. They may have rolled up leaves – for example, Marram grass which exposes the waterproof cuticle on the outside and the stomata open into an inner humid space. Other Xerophytes store water in their stems and reduce the surface area of their leaves, which become spines – for example, Cactus.

Water is removed from the top of xylem vessels into the mesophyll cells down the water potential gradient. This removal of water from the xylem reduces the hydrostatic pressure exerted by the liquid so the pressure at the top is less than at the bottom. This pushes the water up the tube. The surface tension of the water molecules, the thin lumen of the xylem vessels and the attraction of the water molecules for the xylem vessel wall (adhesion), helps to keep the water flowing all the time and to keep the water column intact.

Pressure to push water up can also be increased from the bottom. By actively pumping minerals from cells surrounding the xylem into the xylem itself, more water is drawn into the xylem by osmosis.

This increase in water pressure, called root pressure, certainly helps in the process but is less important than the simple movement of water down the water potential gradient, ultimately from the soil at the bottom, to the air at the top. This is because moving water this way does not require energy (it is passive).

Phloem

There are four types of phloem cells:

- **Sieve tube elements:** These are living, tubular cells that are connected end to end. The end cell walls have perforations in

them to make sieve plates. The cytoplasm is present but in small amounts and in a layer next to the cell wall. It lacks a nucleus and most organelles so there is more space for solutes to move. The cell walls are made of cellulose so solutes can move laterally a well as vertically. Next to each sieve tube element is a companion cell.

- **Companion cell:** Since the sieve tube element lacks organelles, the companion cell with its nucleus, mitochondria, ribosomes, enzymes etc., controls the movement of solutes and provides ATP for active transport in the sieve tube element. Strands of cytoplasm called plasmodesmata connect the sieve tube element and companion cell.
- **Parenchyma**: Provides support through turgidity.
- **Fibres:** Provides support for the sieve tube elements.

Movement in the Phloem

This process is called translocation and involves the movement of organic substances around the plant. It requires energy to create a pressure difference and so is considered an active process.

Sucrose is loaded into the phloem at a source, usually a photosynthesizing leaf. For this to occur, hydrogen ions are pumped out of the companion cell using ATP. This creates a high concentration of hydrogen ions outside the companion cell. Sucrose is loaded (moved into companion cells) by active transport, against the concentration gradient.

However, the protein carrier involved in the loading, has two sites, one for sucrose and one for a hydrogen ion. When it is used to pump sucrose into the companion cell, hydrogen will move in the opposite direction, back down its concentration gradient. This is why a high concentration of ions is needed outside the cell.

The sucrose can then diffuse down the concentration gradient into the sieve tube element via the plasmodesmata that connects the

companion cell with the sieve tube element. This lowers the water potential of the sieve element so water enters by osmosis.

At another point sucrose will be unloaded from the phloem into a sink (e.g. root). It is likely that the sucrose moves out by diffusion and is then converted into another substance to maintain a concentration gradient. Again, water will follow by osmosis.

The loading and unloading result in the mass flow of substances in the phloem. There is evidence to support this theory; the rate of flow in the phloem is about 10,000 times faster than it would be if it was due only to diffusion, the pH of the phloem sap is around 8 (it is alkaline due to loss of hydrogen ions), and there is an electrical potential difference across the cell surface (negative inside due to the loss of positively charged ions).

Transpiration

Transpiration is defined as the removal of excess water from plants into the atmosphere in form of water vapour. Plants are capable of loosing excess water through:

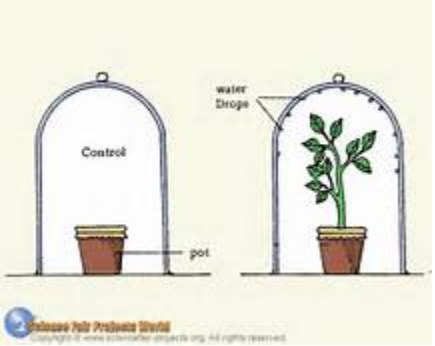
1. The stomata in the leaves and this is called stomata transpiration
2. The cuticle in the leaf surface in what is called cuticular transpiration

Conditions Affecting the Rate of Transpiration

The rate at which water vapour is lost by a plant depends on a number of factors which are:

1. The size of the stomata pores
2. Humidity
3. Temperature
4. Light

5. Wind
6. Soil water



Importance of Transpiration to plants

Transpiration has the following importance or advantages to plants:

1. It enables plants to absorb water and mineral salts from the soil
2. It facilitates the movement of soil water
3. The evaporation of water due to transpiration from the plants cools the plants
4. It helps to remove excess water from the plants

Translocation

Translocation is the process by which manufactured food substances are transported from where they are manufactured to tissues where they are needed or stored. Translocation normally begins from the leaves to other parts of the plant. Phloem is the tissue through which these manufactured food substances are translocated.

Substances or materials comm only translocated in plants include:

1. Sugar
2. Glucose

3. Oil
4. Resins
5. Proteins or amino acids
6. Alkaloids
7. Hormones

Practice Questions

1. _____ is the process by which manufactured food substances are transported from where they are manufactured to tissues where they are needed or stored.
   a) Translocation
   b) Relocation
   c) Movement
   d) immigration
2. All these cells exist in the xylem except
   a) tracheids
   b) xylem vessels
   c) roots
   d) fibres
3. One of these substances is not translocated in plants
   a) Glucose
   b) Oil
   c) Resins
   d) Water
4. Conditions affecting the rate of transpiration are
   a) humidity
   b) light
   c) soil water
   d) all of the above
5. There are two main vascular tissues used in support. They are _____ and ____

6. Why is Transpiration important to plants?

Answers

1. A
2. C
3. D
4. D
5. Xylem, Phloem
6. State the importance above

THIRD TERM NOTES ON BIOLOGY

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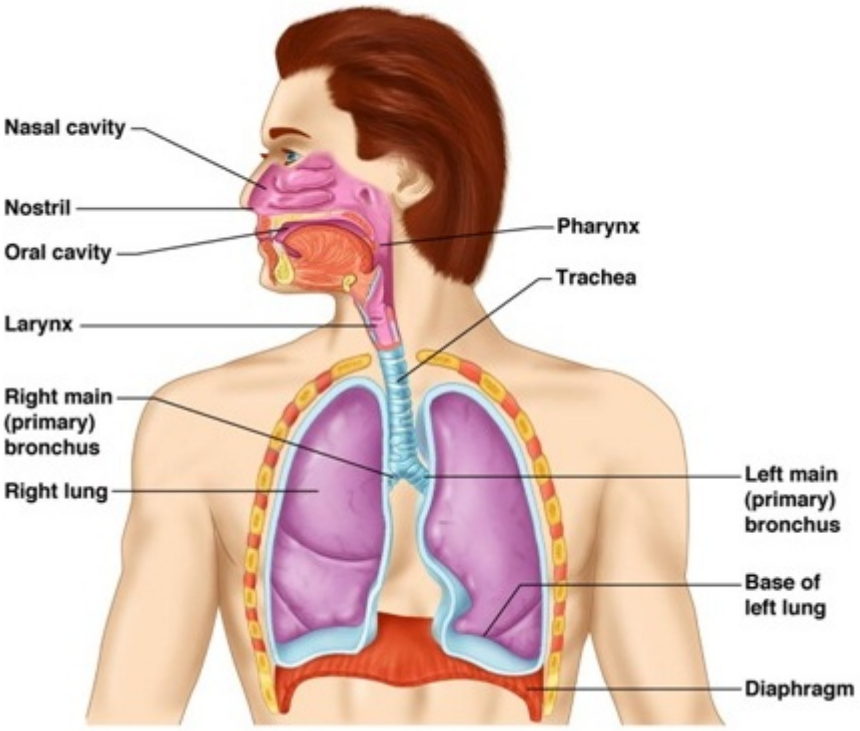
Week 1

Topic: Respiratory System

Introduction



Respiration is defined as a biochemical activity of the cell in which glucose is broken down by a series of reactions controlled by enzymes to release energy.

Your respiratory system is made up of the organs in your body that help you to breathe. Respiration means Breathing. The goal of breathing is to deliver oxygen to the body and to take away carbon dioxide. The lungs are the main organs of the respiratory system.

Oxygen is breathed in and it breaks down the food substances (glucose) to release energy, carbon dioxide and water. Carbon dioxide and water are regarded as waste products of respiration. The energy so released is used by living organisms for various life processes. This occur inside a tiny organelle called the mitochondrion.

Phases or Stages of Respiration

Respiration takes place in two phases or stages. These are external and internal (tissue) respiration

External respiration (Breathing): Is defined as the exchange of gases between the environment and the respiratory organs of living organisms. It simply involves the breathing in of air or oxygen into the respiratory organs such as lungs or gills otherwise called inspiration or inhalation and the breathing out of carbon dioxide and water vapour into the atmosphere otherwise called expiration or exhalation.

Internal (Tissue) respiration: Is defined as the oxidation of organic food substances within the cells leading to the release of energy, carbon dioxide and water. It takes place when the oxygen taken in is used up by the individual cells in the body for the oxidation of food substances. Carbon dioxide, water and energy are given out by these cells in return.

Internal, tissue or cellular respiration can be represented by the equation:

$C_6H_{12}O_6 + 6O_2 \longrightarrow 6H_2O + 6CO_2 +$ Energy

(Glucose) (Oxygen) (Water) (Carbon dioxide) ATP

In summary, the main purpose of respiration is to generate energy required by the body for various life processes.

Types of Respiratory System

The structures used by different organisms depend on their position in the evolutionary set up. The unicellular organisms tend to have simpler mode of respiration than the multicellular due to

their increased surface area relative to volume. Organisms adopt different types of respiratory systems depending on their types, complexity, size and the habitat in which they are found.

Different Organisms and their Respiratory Structures

Organisms	Respiratory system/organ
Unicellular organisms, e.g. Amoeba and Paramecium	Body surface
Hydra and tapeworm	Cell membrane
Earthworm	Wet skin or body surface
Fishes, e.g. Tilapia	Gills
Arthropod, e.g. Insects	Tracheal system
Arachnids, e.g. Spiders	Lung books
Tadpoles	Gills
Reptiles, e.g. Lizard	Lungs
Amphibians, e.g. Toads and frogs	Mouth, skin and lungs
Aves, e.g. Birds	Lungs
Mammals	Lungs
Flowering plants	Stomata and lenticels

Respiratory Surface

The respiratory surface refers to the definite surface of the body such as the surface of the lungs or a gill where gaseous exchange takes place.

Characteristics of Respiratory Surfaces

1. Respiratory surfaces, be it in plants or animals must have the following characteristics:

2. Respiratory surfaces must be moist because gases diffuse in solution through them
3. It must be permeable to allow gases to pass in and out of them
4. It must be thin-walled to shorten diffusion distance and make diffusion easier and faster
5. It must have adequate supply of transport medium, e.g. blood
6. It must have a large surface area to aid easy diffusion of gases
7. Respiratory areas must be highly vascularised, i.e., equipped with capillaries or similar network to bring in or take away diffused gases.

Practice Questions

1. ____ is defined as a biochemical activity of the cell in which glucose is broken down by a series of reactions controlled by enzymes to release energy.
2. Internal, tissue or cellular respiration can be represented by the equation. State the equation
3. Give the respiratory organs of the organisms below
   a – Aves
   b – Mammals
   c – Hydra
   d – Paramecium
   e – Arachnids
   f – Tadpoles
   g – Athropod
   h – Earthworm
4. ____ refers to the definite surface of the body such as the surface of the lungs or a gill where gaseous exchange takes place.

Answers

1. Respiration
2. $C_6H_{12}O_6$ + $6O_2$ —— > $6H_2O$ + $6CO_2$ + Energy

(Glucose) (Oxygen) (Water) (Carbon dioxide) ATP

3. Lungs
   Lungs
   Cell membrane
   Body surface
   Lung books
   Gills
   Tracheal system
   Wet Skin
4. Respiratory Surface

Week 2

Topic: Mechanism of Respiratory System

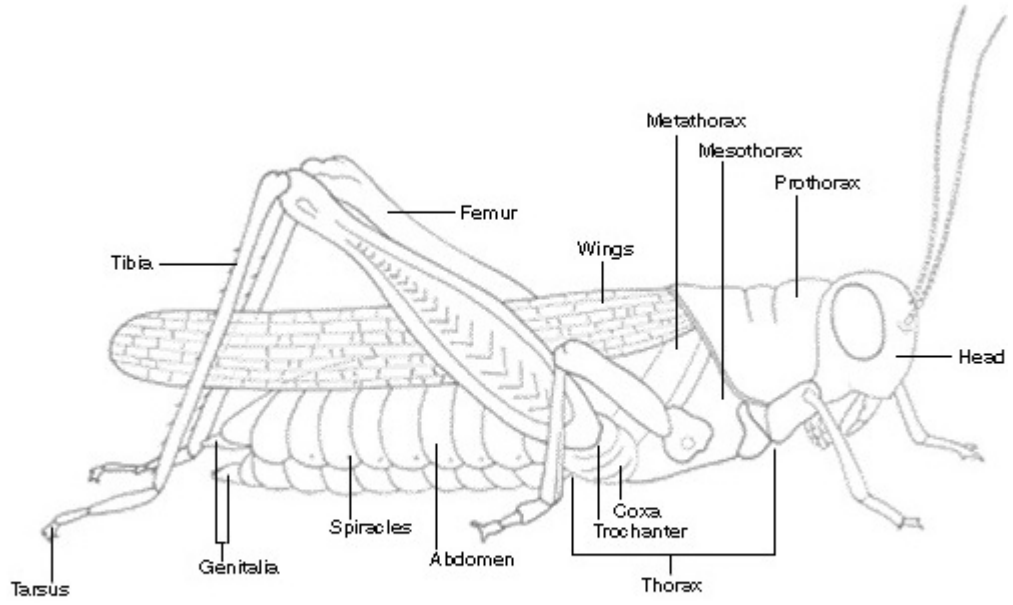
Introduction

Unicellular organisms

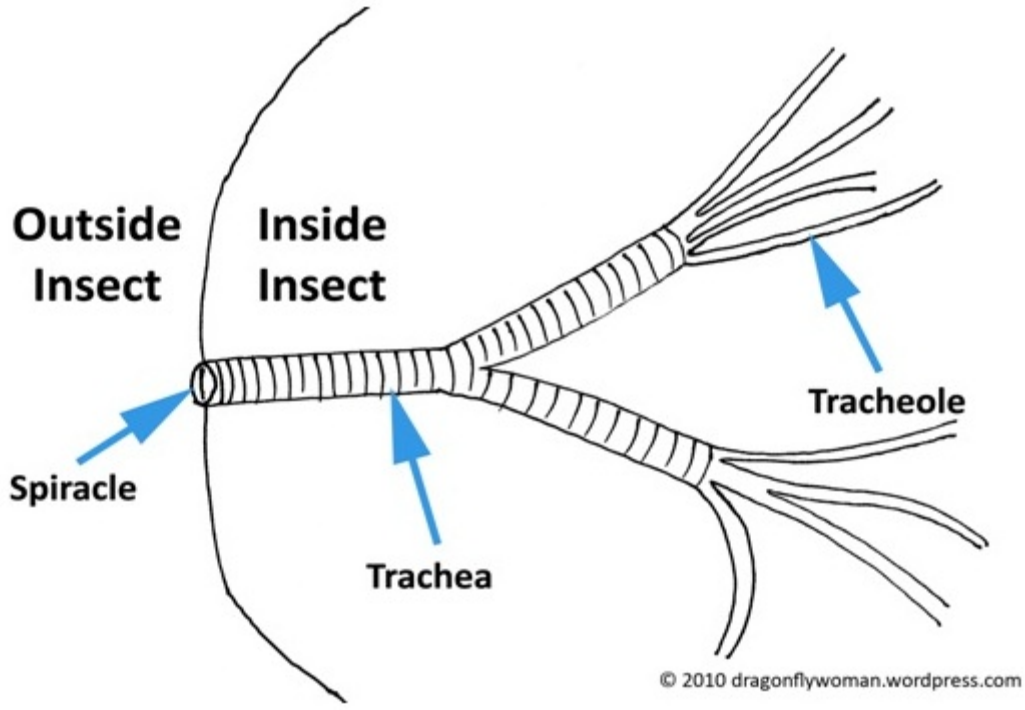
There are no special respiratory organs in unicellular and aquatic organisms such as Amoeba and Paramecium. Oxygen that dissolves in water diffuses into the body while carbon dioxide goes out of the body through the entire body surface. The cell membrane acts as the respiratory surface. The concentration of oxygen in water is higher than that inside the body, hence it is will diffuse into all parts of the body. On the other hand, carbon dioxide inside the body is higher than that of the water, hence it will diffuse out of the body. The process of gaseous exchange in unicellular organisms is made possible by simple diffusion. These organisms have large surface area to volume ratio hence diffusion through the body surface alone is enough to satisfy its gaseous exchange needs.

Insects

Insects generally use the tracheal system for gaseous exchange. The insects have tiny openings in their abdomen called spiracles through which oxygen diffuses into the body and carbon dioxide diffuses out the spiracles lead into certain tubes called tracheae (singular, trachea). These tracheae further divide into smaller tubes called tracheoles and these tiny tubes get into the tissues and cells through the body fluid



Structure of an insect showing the position of spiracles



Structure of the tracheal system of insect

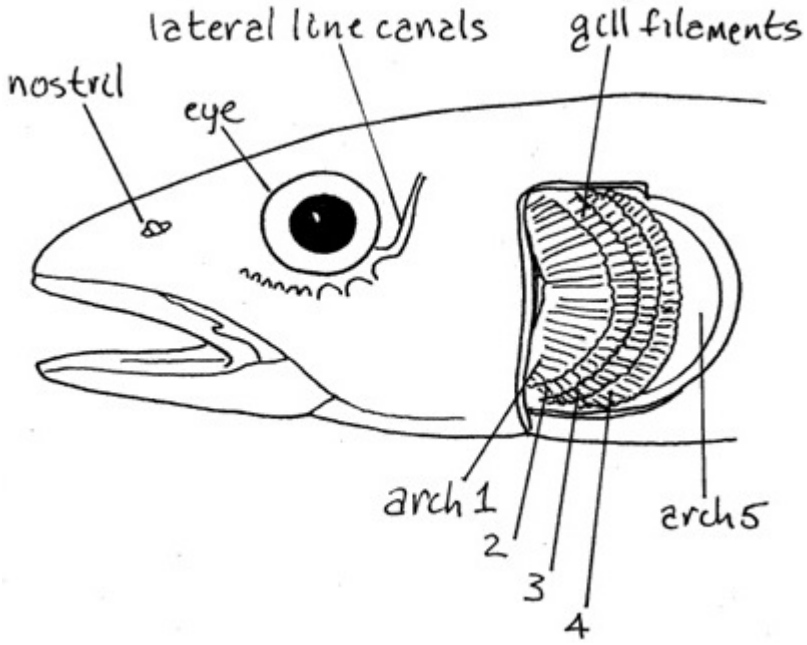
Insects such as cockroach, grasshopper, etc. use the tracheal system. The insects perform breathing movements by compressing its body dorso-ventrally (i.e. inwards from both sides along its

entire body) and then relaxes it. When it compresses its body, it becomes flattened and air is expelled from the tracheae through the spiracles. When it relaxes its body air enters into the tracheae.

During the process of compression and relaxation of the body, oxygen in the air taken in dissolves in the body fluid at the end of the tracheoles from where it enters the various cells. Carbon dioxide from the cells diffuses into the body fluid then into the tracheae and finally comes out of the insect body through the spiracles.

MECHANISM OF RESPIRATORY SYSTEM IN HIGHER ANIMALS

Fish



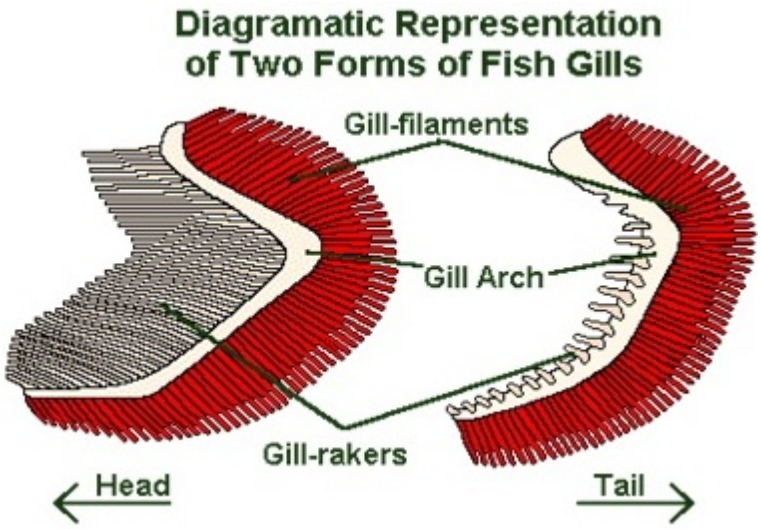
Position of gills in a bony fish

The organ for respiratory system or gaseous exchange is the gill. The gills are located at both sides of the head region. The gills which are in three or four arranged in the gill chamber. Each gill consists of a gill filament (where gaseous exchange takes place), gill raker (which helps to stop food particles from entering the gill

chamber) and the gill arch (on which the gill filaments are built). The gill chamber is closed externally by operculum.

When the fish wants to breathe, it first closes its operculum and then opens its mouth and lowers the floor of the mouth. Water which contains dissolved oxygen rush into the fish's mouth. The fish then closes its mouth, raises the floor of the mouth and the water rush into the gill chamber and move across the gill filaments. Oxygen in the water then diffuses into the gill filament while carbon dioxide diffuses out of the body into the water.

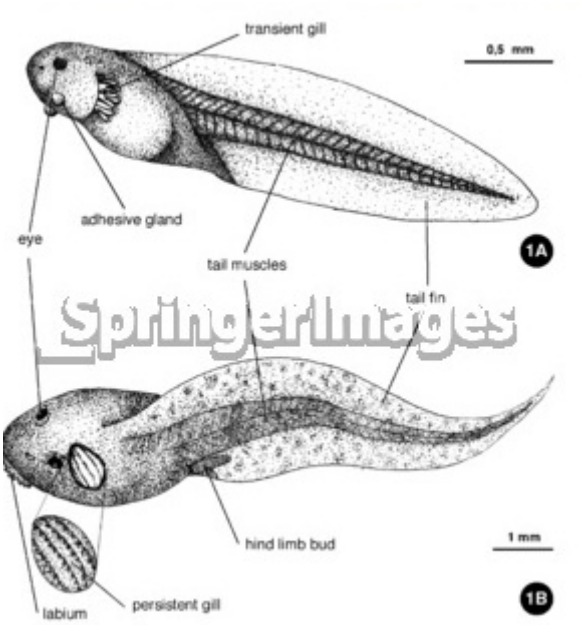
After the gaseous exchange, the fish now opens its operculum and the water containing dissolved carbon dioxide then passes out of the body into the river or ocean. For the next breathing to take place, the fish once again closes its operculum and the whole process described above are repeated.



Toad

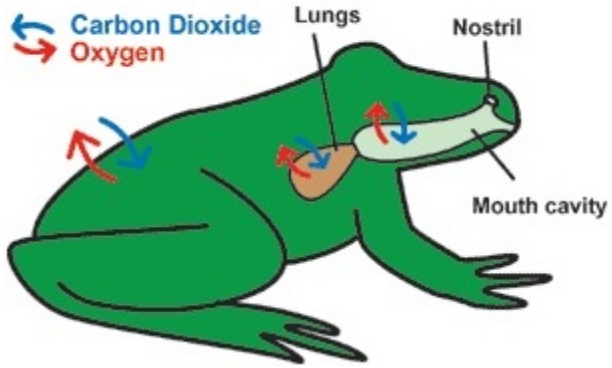
Tadpole: The young toad called tadpole uses gills for gaseous exchange. At the tadpole stage, the animal develops external gills through which direct diffusion of gases takes place between the animal (tadpole) and the respiratory medium (water). Oxygen dissolved in water can easily diffuse into the body and carbon dioxide can also easily diffuse out of the body by simple diffusion.

This is made possible because the ratio of body surface to volume is very large.



In this stage, the tadpole breaths in a manner similar to that of fish

Adult Toad: The toad has three respiratory surfaces on its body that it uses to exchange gas with the surroundings: the skin, in the lungs and on the lining of the mouth.



While completely submerged all of the toad's respiration takes place through the skin. The skin is composed of thin membranous tissue that is quite permeable to water and contains a large network of blood vessels. The thin membranous skin allows the respiratory gases to readily diffuse directly down their gradients between the blood vessels and the surroundings. When the frog is

out of the water, mucus glands in the skin keep the frog moist, which helps absorb dissolved oxygen from the air.

A toad may also breathe much like a human, by taking air in through their nostrils and down into their lungs. The mechanism of taking air into the lungs is however slightly different than in humans. Toad do not have ribs nor a diaphragm, which in humans helps serve in expand the chest and thereby decreasing the pressure in the lungs allowing outside air to flow in.

In order to draw air into its mouth the toad lowers the floor of its mouth, which causes the throat to expand. Then the nostrils open allowing air to enter the enlarged mouth. The nostrils then close and the air in the mouth is forced into the lungs by contraction of the floor of the mouth. To eliminate the carbon dioxide in the lungs the floor of the mouth moves down, drawing the air out of the lungs and into the mouth. Finally the nostrils are opened and the floor of the mouth moved up pushing the air out of the nostrils. Lungs can also help in water. Filling the lungs with air gives a toad a better buoyancy, making it float more easily.

Toads also have a respiratory surface on the lining of their mouth on which gas exchange takes place readily. While at rest or land, this process is their predominate form of breathing, only fills the lungs occasionally. This is because the lungs, which only adults have, are poorly developed.

Respiratory System In Man

The Structure of the Human Respiratory System

Nose & mouth: The air passes through nose & mouth to enter into the body. The passage of air through nose is healthier because of its adaptation

The Adaptation of the Nose:

- The nose contains blood capillaries to warm the air.
- The nose secretes mucous to moist the air.
- The nose contains heirs to filter the air

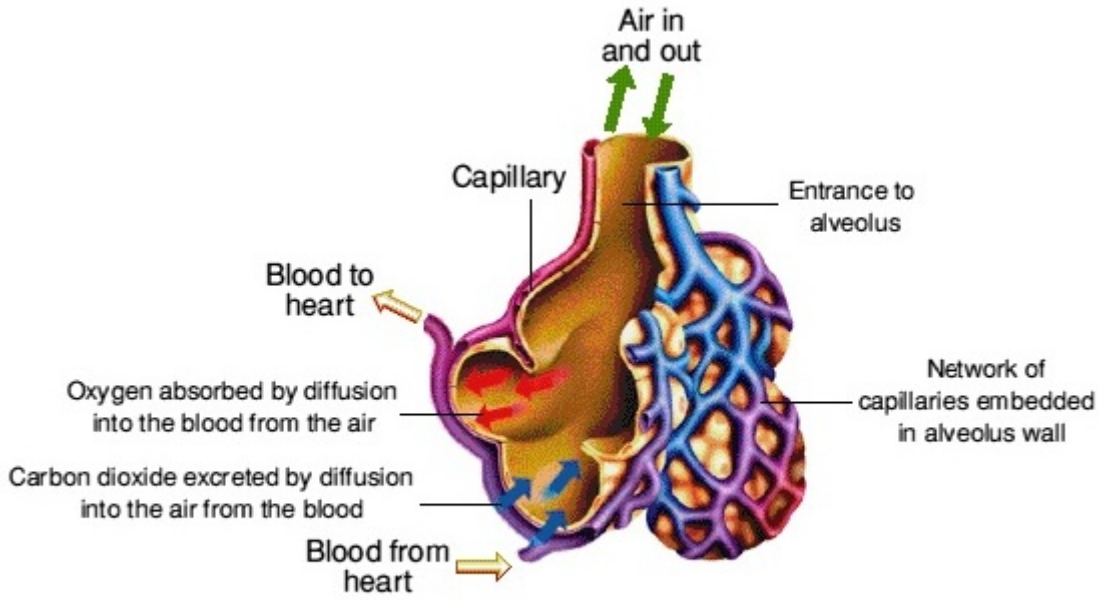
Pharynx: It is a common passage for air & food.
Larynx: This is the voice box
Trachea: It is a tube through which the air passes to enter into the lungs.

Structure and Adaptation of the Trachea

- The trachea is supported by cartilaginous rings to prevent the trachea from being collapse
- The inner surface of the trachea is lined with cilia to reject foreign bodies.
- Because the cilia move upwards make air & mucous current directed towards to the pharynx.
- The trachea is divided into two branches called bronchi which are then divided into smaller & smaller branches called bronchioles which open at air sacs called alveoli

Lungs (2 lungs, left & right): The lung is made of bronchioles, alveoli & a net work of blood capillaries. Alveoli have thin wall to allow exchange of gases between the air in the alveoli and the blood in the blood capillaries.

Each lung has about 60 millions alveoli of the lungs to increase the respiratory surface.



Alveoli and blood supplies

The Mechanism of Human Respiration (Ventilation of the Lung)

Breathing depends on the presence of two types of muscles

- The diaphragm which is a disc shaped muscle found across the human body separate the chest cavity from the abdominal cavity
- The intercostal muscles which are found between the ribs to move them

The air enters into the lungs & come out from the lungs in 2 steps:

1. Inspiration (breath in) (Inhalation) – The intercostal muscles contract where the ribs move upwards and diaphragm muscle contract downwards, this leads to increase the size of chest cavity while its internal pressure decrease, this causes air to get into the lungs through the nose
2. Exhalation or expiration – The intercostal muscles relax where the ribs move downwards and diaphragm muscle relax upward, this leads to decrease the size of chest cavity, while its internal pressure increase, this causes air to get out from lungs to outside.

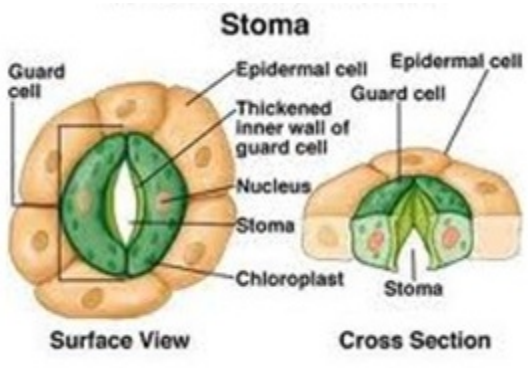
Respiratory Systems in Plants

Plants do not have special respiratory organs for gaseous exchange. However, gases move in and out of the plants through the stomata and lenticels.

Stomata

Stomata (singular: stoma) are the tiny pores present in the leaves (lower epidermis) which helps in gaseous exchange. Each stoma is surrounded by two bean-shaped cells called guard cells. Stomata

are more abundant in the lower epidermis of leaves and are very few in the upper epidermis. The closing and opening of the stomata are controlled by the guard cells.



Functions of Stomata are:

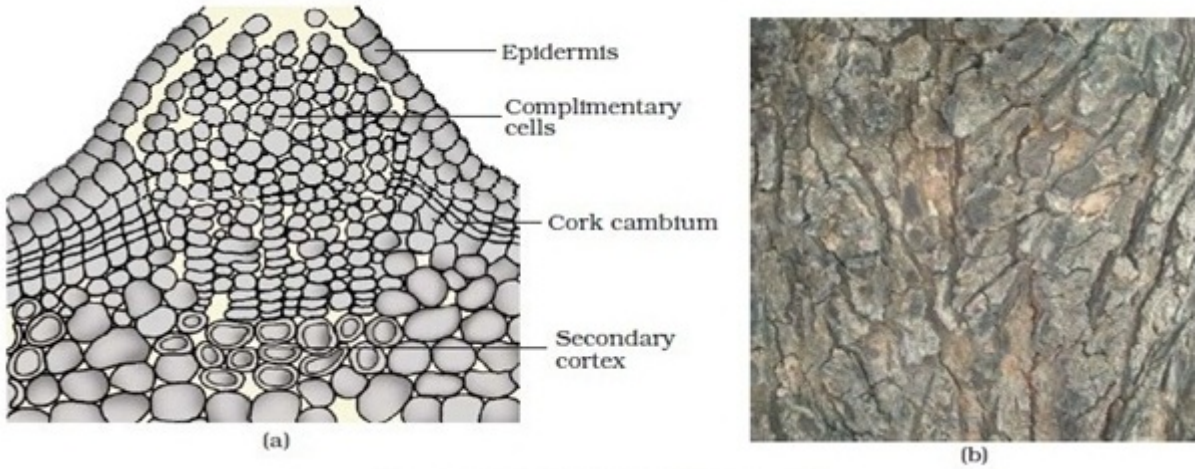
Helps in gaseous exchange that is respiration

Helps in photosynthesis

They remain closed during night due to the loss of water by transpiration

Lenticels

Lenticels are breathing pores or tiny openings found in the bark of older stems. A lenticel consists of a loose mass of small thin-walled cells which permit easy diffusion of gases in and out of the plant.



(a) – Lenticel and (b) Bark

Differences between respiration and photosynthesis

Respiration	Photosynthesis
Respiration occurs in every living cells	Photosynthesis occurs only in autotroph
It takes place at all times	It takes place only in the presence of sunlight
Food substances are broken down (i.e. catabolism)	Food substances are built up (I.e. anabolism)
High energy containing food, e.g. oxygen and carbohydrate are used	Low energy substances like carbon dioxide and water are used
Carbon dioxide and water are the by-products	Oxygen is the by-product
Respiration releases energy	Photosynthesis makes use of energy
Respiration results in a decrease in weight	It results in an increase in weight

Practice Questions

1. _____ are breathing pores or tiny openings found in the bark of older stems.
   a) Stomata
   b) Lenticels
   c) Leaves
   d) Roots
2. _____ are the tiny pores present in the leaves (lower epidermis) which helps in gaseous exchange.
   a) Stomata
   b) Lenticels
   c) Leaves
   d) Bark

3. _____ is when the intercostal muscles relax and the ribs move downwards and diaphragm muscle relax upward, this leads to decrease the size of chest cavity, while its internal pressure increase, this causes air to get out from lungs to outside.
   a) Exhalation
   b) Inhalation
   c) Respiration
   d) None of the above
4. In _____, the intercostal muscles contract where the ribs move upwards and diaphragm muscle contract downwards, this leads to increase the size of chest cavity while its internal pressure decrease, this causes air to get into the lungs through the nose
   a) Exhalation
   b) Respiration
   c) Inhalation
   d) None of the above
5. The adult toad has three respiratory organs namely ___, ____ and ____.
6. The insects have tiny openings in their abdomen called _____ through which oxygen diffuses into the body and carbon dioxide diffuses
   a) Spiral
   b) Tracheal system
   c) Lenticels
   d) Spiracles

Answers

1. B
2. B
3. A
4. C

5. Skin, Nostril and Lungs
6. D

Week 3

Topic: Aquatic Habitat

Introduction

Aquatic habitat is a body of water in which certain organisms live naturally. In other words, aquatic habitats are habitats or places that relates to lives in water. Organisms that live in water are called aquatic organisms. Examples of aquatic organisms are fish, crabs, toads, plants etc.

Types of Aquatic Habitats

There are three types of aquatic habitats. These are marine or salt water habitats, estuarine or brackish water habitats and fresh water habitats

MARINE HABITATS

Marine habitats refer to aquatic habitats which contain salt water. Marine habitats include the oceans, lakes, shores and the open seas.

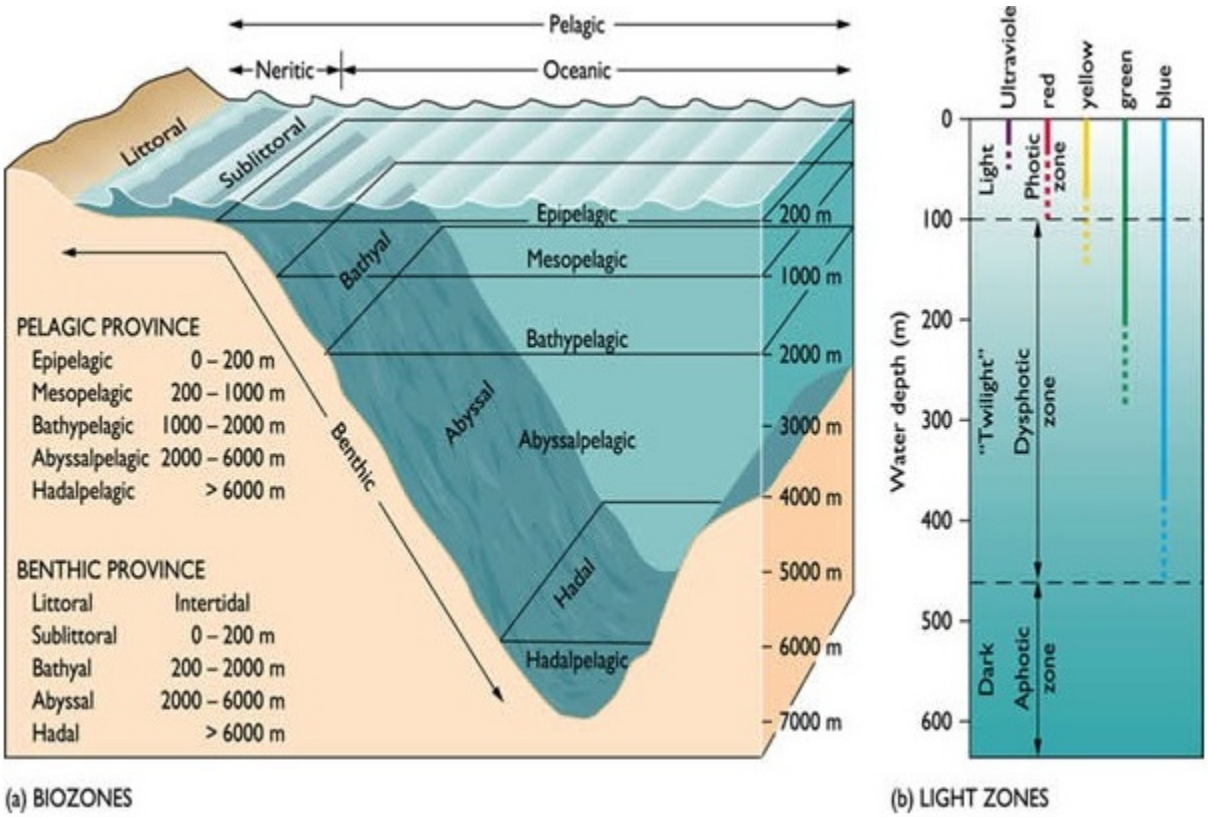
Characteristics of Marine Habitat

The marine or salt water habitat has the following characteristics:

1. Salinity: Salinity is defined as the degree of saltiness or concentration of salt solution in oceans. The marine habitats have a high salinity and its average salinity is put at 35.2 per 1000. In other words, the average salinity of the ocean is 35.2 parts of salts by weight per 1000 parts of water.
2. Density: the density of marine water is high, hence many organisms can float in it. While the density of ocean water is about 1.028, that of fresh water is 1.00. So, the density of ocean water is higher than that of fresh water.

3. Pressure: Water pressure increases in depth at the rate of one atmosphere for every ten metres. In other words, pressure varies from one atmosphere at the surface level to about 1000 atmosphere at the greatest depth. This is why animals in marine habitats have features which enable them to adapt especially at the deep level of the sea.
4. Size: Marine habitats represent the largest of all the habitats. The ocean alone occupies over 70% or 360 million square kilometers of the earth's total area of 510 million square kilometers. Examples of oceans are Atlantic ocean, Indian ocean, Pacific ocean (the largest)
5. Currents: Currents are always produced by wind at the surface of the ocean. Currents are also produced down the ocean as a result of certain variations such as salinity and changes in temperature.
6. Tides: Tides are the alternate rise and fall of the surface of the ocean approximately twice a day. This alternate rise and fall in water level is due to the gravitational effects of the moon and sun.
7. Oxygen concentration: The concentration of oxygen in the ocean is highest at the surface while it decreases with depth, and in the very deep parts of the oceans there is practically no oxygen.
8. Hydrogen ion concentration: Salt water is known to be alkaline in nature with pH of about 8.0-0.9 near the surface.
9. Waves: Waves are movement of surface waters of the oceans and it can take any direction and are caused by winds. Waves bring about the mixing of sea water especially on the surface of the ocean.
10. Light penetration: Light penetrate the ocean water only to a maximum depth of 200 metres. Therefore, plant life is limited to the upper layers of the ocean where light can penetrate. Penetration of light depends on the water turbidity.

Major Zones of the Marine Habitats



The major ecological zones of the marine habitats include:

The two major marine provinces: the benthonic (bottom) and the pelagic (water column).

- The benthonic environment is divided by depth into the:
  Littoral zone Inter tidal zone
  Sublittoral zone, 0 to 200m (continental shelf)
  Bathyal zone, 200 to 2000m (shelf wall)
  Abyssal zone, 2000 to 6000m (abyssal plains)
  Hadal zone. > 6000m (deep sea trenches)
- The pelagic environment is divided into the: Neritic Zone (water over the continental shelf, no sub divisions)
  Oceanic Zone. (water beyond the shelf break, deep ocean water)

Because of the range in depths, the oceanic zone is subdivided further into the:

- Epipelagic 0 to 200m
- Mesopelagic 200 to 1000m
- Bathypalagic 1000m to 2000m
- Abyssalpelagic 2000m to 6000m
- Hadelpelagic > 6000m

The oceanic zone can also be divided into different zones based upon depth of light penetration.

- The photic zone is the depth where light is sufficient for photosynthesis during the day. (0 to 100m)
- The dysphotic zone (twilight zone) is where illumination is too weak for photosynthesis. (100 to 450m approx)

The aphotic zone receives no light from the surface because it is all absorbed by the water above. (> 450m)

Distribution of Organisms in Marine Habitats and their Adaptive Features

The organisms in marine habitats include plants and animals

Plants in Marine Habitat

- Sea weeds: They possess hold-fast for attachment. They also possess mucilagenous cover to prevent dissociation. They have divided leaves, floating devices or air bladder for buoyancy.
- Algae, e.g. sargassus: Algae possess chlorophyll for photosynthesis activities, small size or large surface area for drifting or floating
- Sesuvium: Sesuvium possesses thick leaves or reduced leaves for water conservation

- Planktons, e.g. diatoms: They possess air spaces in their tissues, rhizoids (fake feet) for attachment to rocks and air bladder for buoyancy

Animals in Marine Habitats and their Adaptive Features

Barnacles: Barnacles have protective mantle or pad for attachment or anchorage to rock shore, cilia for feeding, shell which prevents dessication and mantle which retains water.

Cartilaginous fishes: Cartilaginous fishes like shark and dogfish have the ability to retain urea in their body to cope with high salinity

Bony fish: Fishes like tilapia and herring drink salt water to cope with high salt content of the ocean. They also possess salt secreting glands in their gills or eyes to enable them maintain osmoregulation or salt balance

Shrimps: They possess powerful claws or chelipods for seizing or holding food or prey.

Crabs: Crabs are capable of burrowing fast into the mud to protect them against predators, strong waves or tides

Periwinkles: They possess lungs for breathing and foot for attachment

Starfish: They possess tube feet which enable them to hold on to rock shores, and hard shell which prevents dessication or drying up

Factors Affecting Marine Habitats

Some of the major factors affecting marine habitats are:

Temperature

Sunlight

Wind

Density

pH

Salinity

Practice Questions

1. ____ is defined as the degree of saltiness or concentration of salt solution in oceans.
   a) Salinity
   b) Density
   c) Pressure
   d) Tides
2. List the adaptive features of the following organisms
   Barnacles
   Starfish
   Bony fish

Shrimp
Crabs
Periwinkles

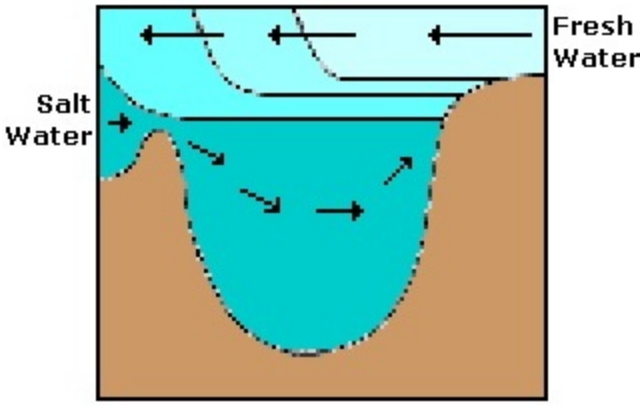
Answers

1. A
2. Check the note above

Week 4:

Topic: Estuarine Habitats

Introduction



Estuarine habitat is a body of water formed at the coast as a result of the action of tides which mix salt water from sea with fresh water from the land. The mixing of salt water and fresh water results in the formation of a brackish water. This brackish water is what is called estuarine.

Characteristics of Estuarine Habitats

The followings are the characteristics of the estuarine habitats:

Fluctuation in salinity: Salinity fluctuates in this habitat. Salinity is lower at the mouth of a river and gets higher towards the sea. Salinity is also affected by season. While rainy season reduces salinity due to addition of fresh water, dry season increases it.

Turbidity: Turbidity of estuarine habitat increases especially during the rainy season when lots of debris is brought down by rivers to the habitat. This high turbidity also reduces the rate of photosynthesis and respiration by organisms

Shallowness of water: Unlike the sea water which is deep, the water in estuarine habitat is very shallow

Low species diversity: The estuarine habitat has low diversity of species compared to marine habitat. Common plant species are phytoplanktons algae, marsh vegetation, etc. while animal species are crabs, oysters, lobsters, fishes, etc.

Water is affected by tides: Sea water usually flows rapidly into estuaries at high tides and rushes back into the ocean at low tides

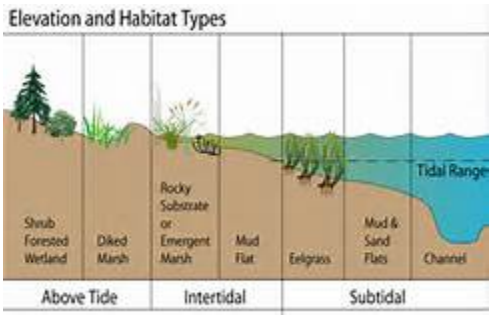
High level of nutrients: The estuarine habitat contains abundant nutrients especially the organic detritus which form the bulk of producers in the habitat

Low oxygen content: Oxygen content of estuarine habitat is generally very low and as a result, much of the microbiological activities are anaerobic.

Types of Estuaries

Estuary is found in the following bodies of water

- **Delta**: A delta is where a river divides into many channels before entry into the ocean or sea. Brackish water or estuary (delta) is formed at the mouth of a river as it enters the sea
- **Lagoon**: Lagoon is a body of ocean water that enters into the land through a canal and therefore has the opportunity of mixing with fresh water from rivers and streams
- **Bay**: Bay is a little or small portion of the sea water which enters into the land and mixes up with fresh water from rivers and streams. It should be noted that a lagoon is bigger than a bay and it may be long enough to join the sea at another end while bay is very small and not long enough to rejoin the sea in another end



Distribution of Plants and Animals in Estuarine Habitats

Plant Species and their Adaptive Features

Planktons (Diatoms): They possess air spaces in their tissues, rhizoids or false feet for attachment to rock shores and air bladder for buoyancy

Algae: They possess chlorophyll for photosynthetic activities and small size or large surface area for floating

Red mangrove (Rhizophora racemosa): It has silt roots which grow down from the stem into the soft mud and develop numerous rootlets which have air spaces for conducting air to the tissues of the roots. The roots also provide support and prevent plants from being washed away by the tides. Again the seeds of red mangrove germinate while they are still on the parent plant thereby preventing the seedlings from being carried away by water current

White mangrove (Avicennia nitida): It has pneumatophores or breathing roots for exchange of gases

Animals species and their Adaptive Features

Mosquito larvae and pupae: These organisms possess breathing trumpets for gaseous exchange

Crabs: They can burrow fast into the mud against predators, strong waves or tides

Water snails and shrimps: These animals can burrow into the mud when the tide is going out, thus escaping the periodic dilution of its external medium

Worms: They have strong protective and impermeable covering against high salinity

Mud skippers: These animals have fins adapted for crawling when on land and for swimming when in water

Fishes: Fishes like Tilapia have fins for movement and swim bladder for buoyancy

Factors Affecting Estuarine Habitats

The factors which affect estuarine habitats are common to aquatic habitats; these include:

- Temperature
- Wind
- Relative humidity
- Light
- pH, etc.

ASSESSMENT

1. Consider the following statements about the estuary
   I) Estuary is place where the river fresh waster meets with ocean water
   II) This area is highly productive
   III) This area is highly unproductive
   IV) All of the above
   Which of above the statements is/are true?
   (a) I) only
   (b) II) only

(c) I) and II)
(d) III)

2. Another word for estuarine is
   (a) brackish water
   (b) blackish water
   (c) browny water
   (d) brownish water

3. Which of these statements is false?
   (a) salinity is lower at the mouth of a river and gets higher towards the sea
   (b) salinity is affected by season
   (c) rainy season reduces salinity due to addition of salty water
   (d) dry season increases salinity due to addition of fresh water

4. A body of ocean water that enters into the land through a canal and therefore has the opportunity of mixing with fresh water from rivers and streams is
   (a) lagoon
   (b) bay
   (c) delta
   (d) river

5. Pneumatophores are
   (a) breathing roots
   (b) singing roots
   (c) crying roots
   (d) dancing roots

ANSWERS

1. c
2. a
3. c

4. a
5. a

week 5

Topic: Fresh Water Habitats

Introduction

Fresh water habitat is a body of water formed mainly from inland waters and contain very low level of salinity. Examples of fresh water habitats are rivers, ponds, streams, springs and lakes

Types of Fresh Waters

Fresh waters are classified on the basis of their mobility. Based on this, two types are identified. These are:

- Lotic fresh waters: These include all running waters which can flow continuously in a specific direction. In other words, these are flowing or running waters, e.g. rivers, springs and streams
- Lentic fresh waters: These include standing or stagnant waters. These waters do not flow nor move. Examples of lentic fresh waters are lakes, ponds, swamps and dams

Characteristics of Fresh Water Habitats

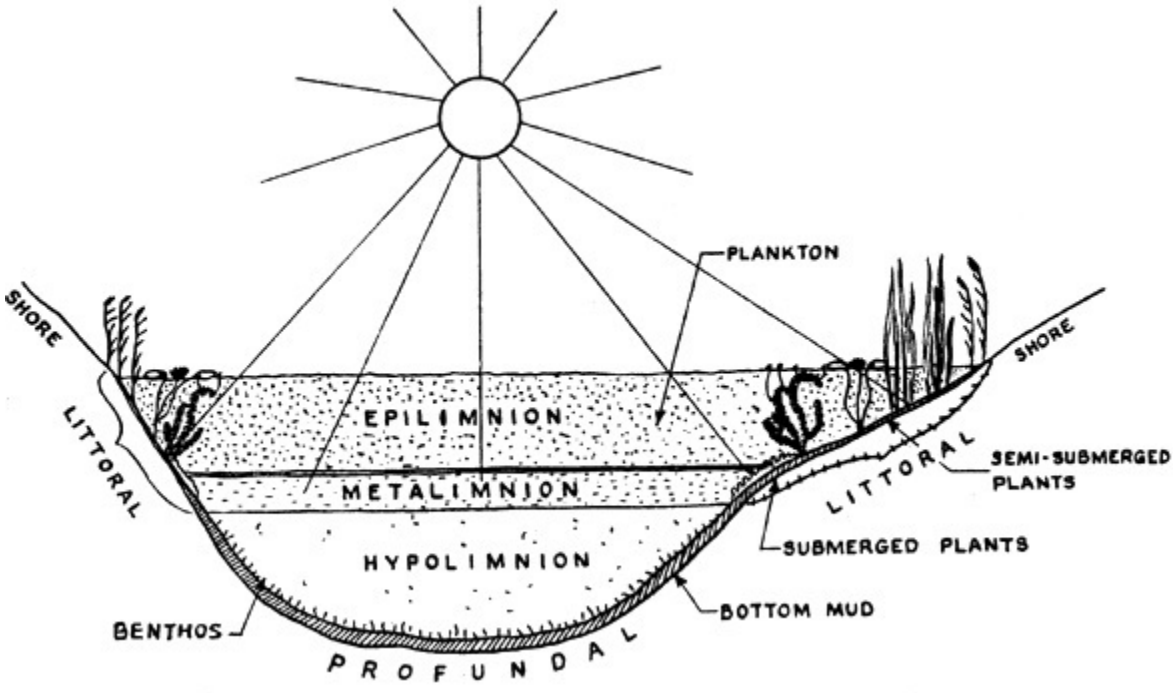
The following characteristics are associated with fresh water habitats:

- Low salinity: Fresh water habitats normally contain very low level of salts. It has about 0.5% of salt compared to about 3.5% for sea water
- Small in size: Fresh water habitat is usually very small compared to the ocean water which is about 75% of the earth surface
- Variation in temperature: The temperature of fresh water habitat usually varies with season and depth. Temperature at

the surface of the water varies slightly with that at the bottom of the water

- High concentration of oxygen content: Oxygen is usually available in all parts of the fresh water especially in the surface of the water
- Shallowness of water: Most fresh water habitats are very shallow hence sunlight can easily penetrate through the water to the bottom
- Seasonal variation: Some fresh water habitats like streams and rivers normally dry up during the dry season while others have their volume reduced. The volume of water in rivers also increases during the rainy season. Turbidity and fast flow of rivers are also high during the rainy season than in dry season
- Currents: Currents can affect the distribution of gases, salts and small organisms in fresh water habitats such as rivers and streams

Major Ecological Zones of Fresh Water Habitats



The zones of a lentic fresh water habitat, e.g. lake are similar to those of the marine habitats but there are no supratidal and intertidal zones

There are two major zones in a lentic fresh water habitat. These are littoral and benthic zones

1. Littoral zone: Littoral zone is the shallow part of fresh water habitat. It contains several plants and animals. The littoral zone has rooted vegetation at its base. It has the highest level of primary production because sunlight can easily penetrate the zone, hence photosynthetic activities are common. Plants associated with this zone include Spirogyra, Chlamydomonas, water lettuce, water fern, duck weed, diatoms and sedges. Animals associated with this zone include water fleas, water snails, flatworms, frogs, toads, water skaters, ducks, snakes, crocodiles, tadpoles, hydrae and hippopotamus
2. Benthic zone: Benthic zone is the deepest parts of the lentic fresh water habitat. The benthic zone does not have rooted vegetation like the littoral zone although flowering plants may occur at its surface. Plants associated with the benthic zone have well developed root system in the mud. These plants include water lily, water arum, ferns, crinum lily, commelina and grasses.

Animals associated with the benthic zone include protozoa, rotifers, hydrae, tilapia fish, mud fish, cat fish, leeches, caddish fly larvae, larvae and pupae of mosquito, water snail, water spider, crayfish, water scorpion, water boatman and water bugs

Lotic Fresh Water Habitat

In a lotic fresh water habitat e.g. rivers, there exist two zones. These are:

1. Pool zone: In this zone, water is relatively slow and calm

2. Rapid zone: In this zone, water is very fast. The lotic fresh water habitat is not as stratified as the lentic fresh water habitat

Adaptive Features of Some Organisms in Fresh Water Habitat

Some Plants and their Adaptive Features

- Water lily (Nymphae): The plant has air bladders, expanded shape and light weight which keep it afloat. It has long petioles attached at the centre of leaf blade which prevent them from being drawn under water by the current
- Water hyacinth (Ipomea grassipis): They have cavities and intercellular air spaces which give them the ability to float or maintain buoyancy on water
- Spirogyra: The plant has mucilaginous cover which protect them in water
- Water lettuce (pistia): Water lettuce has hairs on their leaves which help them to trap air and enable them to float
- Hornwort (Ceratophyllum): The plants have submerged or thin dissected leaves which increase their surface area to sunlight and gaseous exchange
- Water weed (Elodea): The plant has a long and flexible submerged petiole which enables it to swing with water currents

Some Animals and their Adaptive Features

- Protozoa: These animals possess contractile vacuoles which enable them to carry out osmoregulation in water
- Tilapia fish: They have swim bladders which enable them to float (buoyancy) in water. They also have gills for respiration

- Duck: It has webbed digit on its feet for easy locomotion and serrated beak for sieving food inwater into its mouth
- Lung fish (Protopterus): The animals obtain oxygen through the gills but when the water dries out during the dry season, they dig into the mud and breathe with lungs until the rain comes again
- Hydra: It has slippery surface, hooks and suckers for attachment to water particles
- Pond skaters (Gerris): This animal has long legs with which it skates on water surface
- Water boatman: This animal can carry bubbles of air with it as it goes below the water surface to the bottom and use these as their air supply (respiration) under water

Factors Affecting Fresh Water Habitats

Factors which affect fresh water habitats include:

- Temperature
- Relative humidity
- Wind
- Rainfall, etc.

ASSESSMENT

1. A fresh water habitat is defined as
   (a) having a salt concentration less than 1 percent
   (b) water systems that are clear
   (c) having a salt concentration above 5 percent
   (d) water systems that can support life
2. The freshwater habitat includes all of the following except?
   (a) oceans

(b) streams
(c) wetlands
(d) rivers

3. _____ are bodies of water moving in one direction
   (a) ponds
   (b) lakes
   (c) rivers
   (d) oceans

4. Lakes and ponds are part of the freshwater habitats
   (a) True
   (b) Frue
   (c) False
   (d) Tralse

5. In strong day light, fresh water (H2)
   (a) can be more alkaline
   (b) can be more acidic
   (c) is neutral
   (d) is salty

ANSWERS

1. a
2. a
3. c
4. a
5. a

Week 6:

Topic: Terrestrial Habitats

Introduction

Terrestrial habitats refer to life on land. The nature of soil, rain fall and temperature are the major factors affecting the nature of terrestrial habitats

Most of these habitats are shown in on the map of West Africa indicating the vegetation

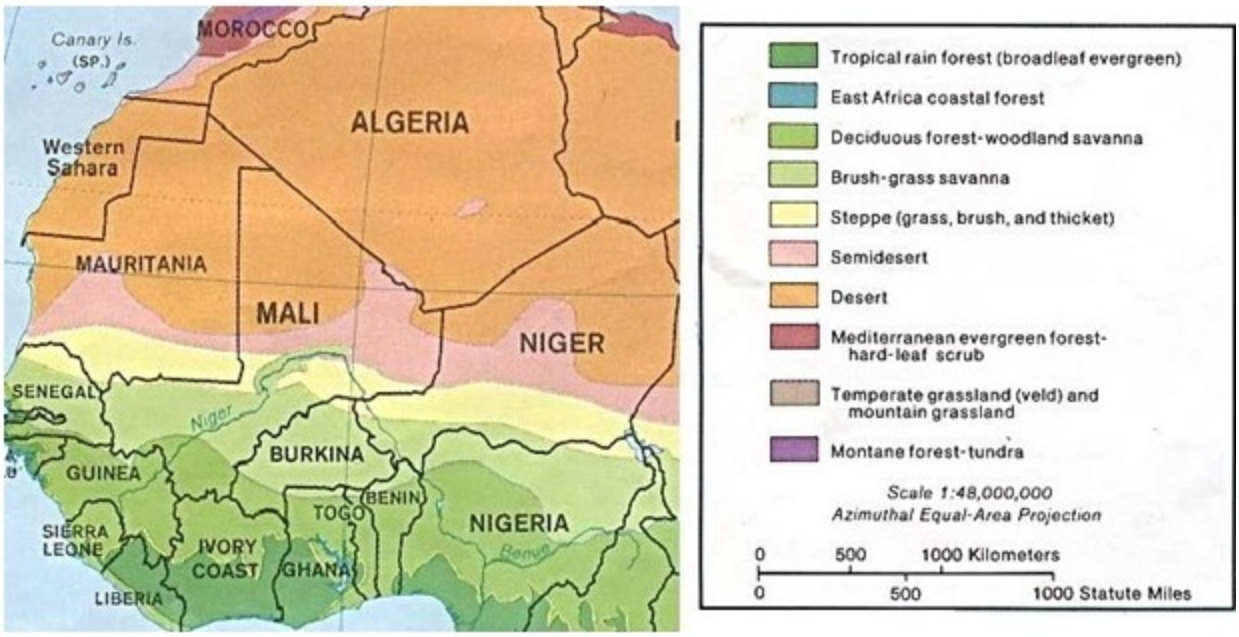


Diagram of the main vegetation zone of West Africa

The terrestrial habitat is divided into four groups. These are:

- Marsh
- Rain forest
- Savanna or Grassland
- Arid land

MARSH HABITATS

Marsh habitat is defined as a lowland habitat which is usually flooded or water-logged all the time. Naturally, grasses and shrubs grow in marsh but when trees grow there, it is called a swamp. Marsh is often regarded as a transition between the aquatic and terrestrial habitats

Formation of Marshes

Marshes occur in areas of lowlands and where drainage is poor. These areas include flood plains of rivers and river mouths with extensive deltas. Marshes may develop as a result of water overflowing its banks to accumulate on the adjoining coastal or low land area. Formation of marsh may also be enhanced with extensive rainfall which also contributes to the accumulation of water on a land surface.

The water in a lagoon may also flood the adjoining lowland, causing the formation of a marsh. Marsh can also be formed when ponds and lakes are filled up with soil from the surroundings and organics debris from [plants causing waterlogging. Marsh formation is a gradual process where an aquatic habitat is transformed into a wet land

Types of Marshes

There are two major types of marshes. These are fresh water marshes and salt water marshes

1. Fresh water marshes: Fresh water marshes occur on land, just beyond the limits of salt water marshes and beyond the areas influenced by tide. In this area, fresh water from rivers overflows the river banks to flood the adjoining lowlands resulting in the formation of fresh water marshes
2. Salt water marshes: Salt water marshes occur along the coastal areas and they are influenced by tides. Because the water along the coast is salty, it mixes up with fresh water from rivers to form brackish water. The action of tide in the ocean causes the flooding of adjoining lowlands with brackish water resulting in the formation of salt water marshes

Characteristics of a Marsh

The followings are the characteristics associated with marshes:

- Nature of soil: The soil in marshes are wet, soft, waterlogged and poorly aerated
- Lowland habitat: The marsh is usually a lowland habitat which often enhances flooding and waterlogging
- High flooding: The ground of marshes is often flooded most of the time
- Presence of stagnant water: Stagnant water is often noticed in marshes especially during the dry season. In raining season, the whole land is highly flooded
- Presence of organic matter: As a result of fallen leaves, dead plants and animals, lots of organic matter are always present in marshes
- High rate of organic decomposition: The decay of organic matter takes place in large scale in a marsh and this causes a

decrease in oxygen content of the water. Lots of foul-smelling gasas such as hydrogen sulphide and methane are usually experienced in marshes

- High relative humidity: The relative humidity of the atmosphere around the marshes is usually very high

Plants Found in Marshes

Examples of plants commonly found in marshes include Algae, water lettuce (Pistia), sword grasses, duckweed (Lemna), water lilies (Nymphaea), hornwort, sedges, white mangrove, red mangrove and raphia palm

Animals found in Marshes

Examples of animals that live in marshes include mangrove crab, hermit crab, mud skippers, fishes, bloody clam, oysters, barnacles, frogs, toads, lizards, snakes, turtles, birds, crocodiles and mammals

Factors Affecting the Marsh Habitat

Factors which affect the marsh habitat include:

- Rainfall
- Temperature
- Light
- Relative humidity
- Salinity, etc.

ASSESSMENT

1. Terrestrial habitats refer to life on /in
   (a) water

(b) land
(c) air
(d) forest

2. _____ habitat is defined as a lowland habitat which is usually flooded or water-logged all the time
   (a) estuarine
   (b) marsh
   (c) aquatic
   (d) freshwater
3. ___ is often regarded as a transition between the aquatic and terrestrial habitats
   (a) lake
   (b) river
   (c) marsh
   (d) desert
4. When trees grow in a marsh it is called
   (a) shrub
   (b) savannah
   (c) sudan
   (d) swamp
5. Pick out the odd item
   (a) lizard
   (b) hornwort
   (c) snake
   (d) turtle

ANSWERS

1. b
2. b
3. c
4. d

5. b

Week 7

Topic: Forest Habitats

Introduction

A forest is an extensive community of plants dominated by tall trees. These trees are of different species and height. The distribution of forest is mainly determined by climate especially rainfall and temperature. The rain forest is the dominant forest in Nigeria.

Picture of Forest Habitat www.passnownow.com

Characteristics of the Rain Forest

1. Presence of broad leaves: Most trees in rain forest usually possess broad leaves which enable the plants to receive abundant light and enhance transpiration

2. Presence of buttress roots: Most trees because of their large sizes often have buttress roots to support their heavy weight and height
3. Presence of tall trees: The bulk of the trees in rain forest are tall. Some are even 40 metres and above in height
4. Existence of canopies: The trees in the rain forest are shaped in such a way as to form canopies
5. Trees exists in layers or storeys: The trees in rain forest are zoned or stratified in such a way that they are arranged in layers or canopies, i.e., upper layers, middle layers and lower layers
6. Presence of fallen leaves on ground: The forest is characterised by the flooring of the ground with lots of leaves as litters
7. Trees have thin bark: Most of the trees have thin bark to enhance gaseous exchange and transpiration
8. Presence of epiphytes: The rain forest is also characterised by the presence of climbers and epiphytes on the trees which possess aerial roots for moisture absorption and respiration

Strata in the Forest

The main forest vegetation have plants which are naturally arranged in layers, strata or storeys. There are about five storeys in the forest. These are:

1. The upper layer: The upper layer or storey is made up of the tallest trees of over 40 metres tall. These trees are called emergents. The crown of the emergents do not normally touch each other. Examples of plants in this category are Iroko, Obeche, Mahogamy, African walnut, Ebony, etc.
2. The middle layer: The second layer in the rain forest is made up of fall trees of about 16-40 metres tall. Their crown

touches each other, thereby forming a continuous canopy just below the emergents

3. The lower layer: This is the third layer which is made up of small trees, less than 16m tall. They also form a continuous canopy below the middle storey
4. The shrub layer: This layer is made up of small trees, 1-5 metres in height. These are essentially small trees collectively referred to as shrubs
5. Ground layer or forest floor: This contains wet and shade loving plants which grow on the floor of the forest. These plants hardly receive sunlight due to canopies formed by bigger plants. Most plants are bryophytes and they include mosses, liverwort, lichens and thin leaved ferns

Distribution of Plants in a Forest Habitat

Varieties of plants exist in the forest. Popular examples of forest trees include African walnut, Mahogany (Khaya ivorensis), teak (Tectonia grandis), Opepe (Sarcocephalus), Obeche (Triplochiton), Iroko (Chlorophora), Oil palm (Elaeis guineensis), ferns, orchids, lianas, mosses, lichens, liverwort, fungi and mistletoe

Adaptive Features of Plants in a Forest Habitat

- Iroko and Mahogany: These plants have strong tap root system and buttress roots which aid anchorage and support for the weight of the plants
- African walnut: These plants have broad leaves which aid transpiration and photosynthesis
- Obeche: These plants have tap root system and large buttress roots for support as well as broad leaves to aid photosynthetic activities

- Orchid: These are epiphytes which have mechanism for storing water and absorbing moisture form air while growing on tree branches
- Mistletoe: These are complete plant parasites capable of developing root system that can penetrate the stem of a plant and feed directly from manufactured food by placing their roots on the phloem vessels of the host plants

Distribution of Animals in a Forest Habitat

Most animals in the forest live on trees (i.e. they are aboreal animals). The animals include bats, monkeys, snakes, squirrels, birds, lizards, tree frogs and chameleons. Some animals like earthworms and beetles live in the soil while some live among the litter on the ground, e.g. millipedes, ants and snails.

Adaptive Feature of Animals in a Forest Habitat

- Monkeys: Monkeys have prehensile tails and long limbs for climbing trees and jumping form one tree branch to another
- Bats: Bats have a way in which the forelimbs and the hind limbs are joined on each side of the body by a fold of skin to form wings used for flight
- Green snakes: These snakes have protective colouration on their skin which makes it difficult to be detected by their enemies. They also have slim elongated body with grasping scales for winding around tree branches
- Chameleon: It has prehensile tail and opposable digits for grasping. It also has protective colouration to camouflage or disguise itself form predators
- Apes: Apes move in groups or herds to protect themselves from predators. They also have high sense of sight to detect enemies

- Earthworms and snails: They have water permeable cuticle which reduces water loss and prevent drying up
- Birds: Birds have powerful wings used for flying

Factors Affecting the Forest

Climatic factors which affect the rain forest include rainfall, temperature, wind, relative humidity, sunlight, etc. rainfall and temperature are the dominant factors that affect the rain forest. High rainfall and temperature give rise to luxuriant rain forest vegetation.

ASSESSMENT

1. Forests are dominated by
   (a) grasses
   (b) tall trees
   (c) domestic animals
   (d) humans
2. The dominant forest in Nigeria is
   (a) deciduous forest
   (b) coniferous forest
   (c) rain forest
   (d) savanna forest
3. Trees in rain forest are zoned or stratified in how many layers?

(a) 2
(b) 3
(c) 4
(d) 5

4. Popular examples of forest trees include the following except
   (a) mahogany
   (b) iroko
   (c) opepe
   (d) palm
5. Climatic factors which affect the rain forest include
   (a) rainfall
   (b) temperature
   (c) wind
   (d) snow

ANSWERS

1. b
2. c
3. b
4. d
5. d

Week: 8

Topic: Grassland Or Savanna Habitats

Introduction

A grassland or savanna is a plant community in which grass species are dominant with short but scattered trees and shrubs. The grassland or savanna lies between the forest and the deserts or arid land.

Types of Grasslands

There are two major types of grasslands. These are the tropical grassland (savanna) and the temperate grassland
1. Tropical Grassland or Savanna
The tropical grassland is located around the equator, i.e., between 5o and 20o this North and South of the Equator. Areas where this grassland is found include Africa where it is called savanna, in Brazil where it is called campos, and in South America where it is called ilanos.

In Nigeria, the savanna has three major belts. These are Guinea savanna, Sudan savanna and Sahel savanna. The luxuriant nature of the grassland decreases northwards from Guinea to Sudan and finally to Sahel savanna

2. Temperate Grassland

The temperate grassland is found in the interior continents of Asia, North America, South America and South Africa where the grasses appear to be uniform

In central Europe and Russia, the grassland is called steppe, in North America, it is called prairies, in Argentina, it is called pampas, in South Africa, it is called veld and in Australia, it is called downs

Characteristics of Grassland

The grassland or savanna possesses the following characteristics:

1. **Predominance of grasses:** Grasses remain the dominant plant species in the savanna as they form over 70% of the vegetation
2. **Presence of short but scattered trees:** Most trees found in savanna are short and few. In most cases, the trees are scattered within the savanna
3. **Absence of stratified canopies:** Due to the presence of grasses and few trees, stratified canopies found in rain forest are absent in savanna
4. **Presence of fire resistant trees:** The savanna also has trees with thick bark which make them resistant to fire
5. **Small size of leaves:** Leaves of plants in the grassland are tiny and small in size to aid the plants in reducing the rate of transpiration
6. **Presence of drought resistant trees:** Most trees in the savanna as a result of reduced rainfall are capable of resisting prolonged drought

7. **Presence of underground stems:** Some plants in the savanna possess underground stems to enable them survive the harsh climatic conditions
8. **Presence of deep rooted plants:** Most plants in the savanna have deep roots which enable them to reach out for water in the soil
9. **Presence of deciduous plants:** Plants in the savanna are deciduous in nature, that is, they shed their leaves during the dry season to prevent excessive loss of water through transpiration
10. **Presence of trees with modified leaves**: Most plants modified their leaves in such a way to enable them adapt to the environment

Distribution of Plants Species in the Grassland

Plant species or varieties in grassland include acacia, elephant grass, guinea grass, shea-butter, gamba grass, baobab trees, rhizomes, isoberlina doka, euphorbia, spear grass and palm

Adaptive Features of plants in the Grassland

1. **Spear grass:** Spear grass has a rhizome (underground stem) which helps the plant to withstand intense heat, fire and dry season

2. **Baobab:** This tree has broad and succulent trunks used for storing excess water

3. **Acacia:** Acacia has long roots to search for ground water

4. **Shea-butter:** The tree has heavy and thick barks which reduce transpiration and protect them from bush fires

5. **Elephant grass:** It has succulent stem to store excess water against dry season and strong fibrous root system which helps to absorb water from the soil

6. **Palm:** This plant has thick bark which protects it from being severely burnt

Animals Species in the Grassland

The savanna seems to have a large population of animals which are of different species. Examples of animals include antelopes, elephants, giraffes, zebras, cows, goats, grasshoppers, lizards, birds, lions, tigers, leopards, snakes, termites, rats, squirrels, deer, porcupines, gazelles, grass cutters and kangaroos

Adaptive Features of Animals in the Grassland

1. **Rats:** These animals burrow into the soil to avoid excessive heat of the sun and fire
2. **Zebras and giraffes:** Due to their body colours, they can camouflage and their presence among all green-brown grasses and trees will make them undetectable
3. **Lions, tigers and leopards:** These animals have powerful jaws and teeth for attacking other animals. They also have high sense of smell to enable them detect their prey
4. **Kangaroos:** Kangaroos possess long legs to help them escape form danger. They also have pocket of flesh to shield their young ones from hot weather and attack
5. **Elephants and lions:** These animals move in group or herd which enable them to achieve strength in numbers
6. **Termites:** They live in anthills thereby protecting themselves from danger and unfavourable climate. The anthill gives them air-conditioned nests which have cooling effects on the animals

Climatic Factors Affecting Grassland habitat

1. High temperature: The grassland is affected by extremes of temperatures which range from 21 -30oC. The annual temperature range is 11oC

2. Moderate rainfall: The grassland has an annual rainfall of about 600-1500mm. It has seasonal convectional rainfall with single maximum
3. Fertile soil: Soil in grassland is always very fertile as most of the nutrients are not leached or eroded because of low rainfall
4. Low relative humidity: The relative humidity of this habitat is low because of high temperature and low rainfall
5. Light intensity: Light intensity is very high since there is little vegetation to shield its rays. Also photosynthetic activities are high in this habitat

ARID LANDS OR DESERT HABITATS

Arid lands or deserts refer to areas of very low rainfall and high evaporation rate. Arid lands are the driest habitats, receiving less than 25cm of annual rainfall

Types of Arid Lands

There are two major types of arid lands or deserts. These are hot deserts and cold deserts

1. **Hot deserts:** Hot deserts of the world are located on the western coasts of the continents within latitude 15o – 30o North and South of the equator. Examples of hot deserts are Sahara desert (North Africa), Arabian desert and Kalahari deserts (South Africa), Great Australia desert (Australia) and Atacama desert of South America
2. **Cold deserts**: Cold deserts are located or found in the interiors of the continents around 45o – 60o North and South of the equator. The desert is found in interior of Eurasia, North America and in Patagonia (South America)

Characteristics of Arid lands (Hot deserts)

The major characteristics of arid lands (hot deserts) include the following:

1. **Scarcity of water:** Rainfall in arid land is very low and it may occur in few occasions during a whole year and it is always below 25cm per annum
2. **Hot temperature:** The desert temperatures are usually very high, especially during the day but very low at night
3. **Presence of sandy soils:** The nature of soil in arid land is sandy or rocky as there is little or no vegetation to improve the soil
4. **High sunshine:** The sunshine in arid land is very high since there is little vegetation to shield its rays
5. **Predominance of strong winds:** Strong winds are often associated with hot desert since there is no vegetative cover to reduce the speed of winds
6. **Poor vegetation:** The hot deserts have scanty vegetation. It has short and scanty grasses with little and scattered trees and shrubs
7. **Low relative humidity:** The relative humidity of hot deserts is usually very low since the area is characterised by low rainfall, high temperatures and scanty vegetation
8. **Presence of drought resistant plants:** The hot desert is characterised by the presence of drought resistant (xerophytic)

plant species such as thorny bushes, bulbous cacti, dwarf acacias and oleander

Distribution of organisms (Plant Species) in Arid lands or Hot Deserts

Plants species commonly found in hot deserts include drought resistant plants like thorny bushes, bulbous cacti, scattered dwarf acacia, wiring grasses, date palm, baobab trees and euphorbia spp

Adaptive Features of Plants in Arid Lands

1. **Cactus:** Cactus is a leafless plant with prickles or thorns to reduce transpiration. It also has thick succulent stem and side branches to store water for long drought.
2. **Acacia:** This is a drought resistant plant, it has deep roots which absorb underground water deep down in the soil
3. **Baobab tree:** The leaves are waxy, hairy or needle-shaped to help reduce the rate of transpiration
4. **Wiring grass:** It has narrow and slender leaves which help to reduce the rate of transpiration in the plant
5. **Oleander:** This plant has extremely deep roots which is able to absorb underground water deep down the soil

Distribution of Organisms (Animal Species) in Arid Lands

Animals commonly found in arid lands include camel, rodents (e.g. rats), lizards, snakes, toads, zebras, desert tortoise, pocket mice, locusts, grasshoppers, ants, butterflies, moths and beetles

Adaptive Features of Animals in Arid Lands

1. **Camel:** A camel can drink a lot of water to sustain itself for several days and hence can withstand a wide range of body temperature up to 40oC during the day. It can also walk for several days without drinking water
2. **Kangaroo rat:** This animal remains in burrows during the day to avoid excessive heat thereby cutting down evaporation from its body
3. **Lizards and snakes:** These animals have scales which limit the rate of water loss from their body
4. **Locust:** It has water-proof bodies and impervious cuticles. It also produces dry waste products, e.g. uric acid and guanine to enable it conserve water

Factors Affecting Arid Lands

The major abiotic factors affecting arid land are almost the same with that of the grassland. These factors are temperature, rainfall, sunlight, wind and low relative humidity.

Practice Questions

1. The ____ is a plant community in which grass species are dominant with short but scattered trees and shrubs
   a) Grassland
   b) Arid land
   c) Hot desert
   d) Rainfall

2. List four characteristics of grasslands
3. One of the following animals can only be found in arid lands
   a) fish
   b) panda
   c) camel
   d) cockroach
4. Give three examples of grass land animals
5. ____ water-proof bodies and impervious cuticles and guanine to enable it conserve water
   a) Cockroach
   b) Camel
   c) Locust
   d) Termite

Answers

1. A
2. Absence of stratified canopies
   Presence of fire resistant trees
   Small size of leaves
   Presence of drought resistant trees
3. C
4. lizards, birds, lions, tigers, leopards, snakes, termites
5. C

Week: 9

Biology SS 2, Third Term, Week 9

Topic: Ecology of Populations

Introduction

The term “ecological succession” refers to the progression an ecosystem follows as it changes over time. Scientists refer to individual stages of an ecosystem’s growth as “seral stages,” and they refer to the entire process of succession as a “sere.” Biological succession is a natural process that occurs in all of Earth’s ecosystems. Is the gradual replacement of the community of organisms in one area or another, it may take millions of years. In other words, succession is the process by which communities colonise an ecosystem and are then replaced over time by other communities.

Pioneer species to climax communities

Pioneer species: These are the first species to occupy a new habitat, starting new communities. They have rapid reproductive strategies, enabling them to quickly occupy an uninhabited area. Many have an asexual stage to their reproduction.
The first seral stage in any instance of biological succession is called a “pioneer community.” In general, pioneer communities are harsh environments that support relatively little flora and fauna. A field, for instance, has only the ground level and underground level at which to support animal and plant life. There is little shelter from the sun, wind and rain.

Seres: These are the various stages that follow on from the pioneer species.

Climax community: This is the stable community that is reached, beyond which, no further succession occurs.

The last seral stage in a process of biological succession is called a “climax community.” Climax communities are much more stable environments than pioneer communities, and they support a much wider array of plant and animal life. A fully grown forest, for instance, has many more habitats for animals than a field does. Many types of birds can nest in the trees, as can animals such as squirrels and chipmunks. Forests provide more shelter from the elements, and they provide habitats for larger animal species as well.

Types of Succession

Primary succession

Biologists use the term “primary succession” to refer to the first time an area develops from bare rock into a fully developed ecosystem. The first step in an instance of primary succession involves lichens and physical weathering processes that break stone into soil. Only when soil is present can vegetation begin to grow in any quantity. Because the breaking down of rock into soil occurs so slowly, primary succession can take thousands of years. This occurs when the starting point is a bare ecosystem, (e.g, following a volcanic eruption or a landslide). The pioneer species are usually lichen, moss or algae. They are able to penetrate the bare surface, trap organic material and begin to form humus.
Over several generations soil begins to form. The soil can be used by a more diverse range of plants with deeper root systems. Gradually larger and larger plants occupy the ecosystem along with a diversity of animals.
Finally a climax community is reached and the species present do not change unless the environment changes in some way.
An example of primary succession forming an oak woodland:

1. Bare rock is colonised by mosses and lichen.

2. Small plants, ferns and grasses take over.
3. Larger plants with deeper roots appear.
4. Bushes and shrubs replace non-woody plants.
5. Fast growing trees form a dense, low wood.
6. Larger, slow growing oak trees create the oak woodland.

Secondary succession

Secondary succession refers to an instance of biological succession that occurs in an area where primary succession has already taken place and soil is already established. Normally, secondary succession happens when an ecosystem has suffered some catastrophe, such as a forest fire or a volcanic eruption. Secondary succession also occurs when an area has been ruined by human activities, such as clear-cutting and slash-and-burn agriculture. Because soil is already established, the process of secondary succession can be completed much more quickly than primary succession.
This occurs when the starting point is bare, existing soil, (e.g, following a fire, flood or human intervention). This type of succession proceeds in the same way as primary succession except that the pioneer species tend to be grasses and fast growing plants.
An example of secondary succession forming an oak woodland:

1. Bare soil is colonised by grasses and pioneer plants.
2. Grasses begin to predominate with time.
3. Shrubs replace the grasses.
4. Fast growing trees appear.
5. Slow growing oaks create the climax community.

Overcrowding

Overcrowding is defined as a situation which occurs when a population in a given habitat increase beyond a point where the resources in the habitat such as space and food are not enough to support all the individuals in the population.
In other words, overcrowding occurs where there is an increase in the population of a particular species beyond the carrying capacity of a particular area. This reduces the space available for each individual species in the population. For example, a space designed to accommodate only five rats can be said to be overcrowded if ten or more of the rats have to live in the place.

Population

Population is defined as the total number of organisms of the same species living together in a given area at a particular time. In an ecosystem, the community is made up of many populations of different species

Population Density

Population density is defined as the number of individual organisms per unit area or volume of the habitat. Mathematically, population density is expressed as:
Total population or population size/ Area of habitat
Population density can be used to estimate the total number of individual species of a population or population size.
Mathematically:
Population size = population density x area of habitat

Factors that May Cause Overcrowding

The following factors may be responsible for overcrowding:
• **Increase in birth rate (Natality):** When there is an increase in the rate at which a particular species gives birth in a restricted area,

overcrowding will definitely take place
• **Increase in food supply:** With increase in the supply of food to a particular habitat, there will be a corresponding increase in the population which will later result in overcrowding
• **Decrease in death rate (Mortality):** If the rate at which organisms die in a habitat is very low compared to the rate at which they are being given birth to, the population will not reduce, hence overcrowding will take place
• **Immigration:** The migration or movement of individuals or species into the habitat will increase the population which will later cause overcrowding in the habitat
• **Lack of dispersal:** The fruits or seeds of certain plants fall just under the tree and germinate there. This lack of dispersal causes overcrowding
• **Social habits:** Most social animals such as termites, ants and bees which continues to live and multiply in a colony increase the population until the area is overcrowded
• **Inadequate space:** This occurs if the space occupied by individuals (plants or animals) is such that when compared to their number is small or inadequate
• **Absence of predators:** When predators are absent, the population of some species (prey) can grow to such a level that overcrowding occurs

Effects of Overcrowding
Overcrowding do have effects on the organisms occupying the habitats. The effects of overcrowding include:

• **Shortage of space:** As a result of increase in the population of species, there would be lack of space for the organism
• **Shortage of food:** The available food in the habitat is rapidly eaten up due to overcrowding and this eventually results in overcrowding and this eventually results in the shortage of food
• **Competition:** Due to increase in the population with limited resources such as food and space, individuals have to compete among themselves to get these scarce resources. The stronger ones get these resources while the weaker ones are deprived of

them
• **Anti-social behaviour:** Most animals due to stress as a result of overcrowding resort to fighting or cannibalism
• **Spread of diseases:** Diseases can easily spread in an overcrowded environment. For instance, tuberculosis in human which is an air-borne disease can easily be spread
• **Preying on each other:** Animals in overcrowded environment have the tendency to prey or feed on each other especially when food is in short supply
• **Death of organisms:** Death of some weaker organisms may occur in an overcrowded area as a result of non-availability of food and space. The stronger ones survive while the weaker ones die off.

Adaptations to Avoid Overcrowding

Plants and animals have developed various means to avoid overcrowding. Such means and ways include:

• **Territorial behaviour:** This is a natural means to avoid overcrowding in animals. some animals especially mammals, lizards, birds etc. establish territories. Territories are resting areas which the animals carve out for themselves. They are usually possessive of these areas. They fight for and defend the territories against intruders or other members of the same species. Their ability to claim the territory successfully ensures that they have sufficient space, food, mating partners and parental care. The establishment of territories ensure that there is no overcrowding in the area

• **Dispersal of seed and fruits:** This is also a natural means of avoiding overcrowding in plants. The dispersal of seeds and fruits either by water, wind, animals, insects, explosive mechanism etc. reduces the chances of overcrowding. These seeds and fruits are carried far away from parent plants hence overcrowding is avoided or prevented

• **Emigration:** Emigration involves the movement of individuals or animals out of their locality to another place for settlement in a new

habitat. Such outward movement of animals, even human beings, prevents overcrowding

• **Swarming:** The swarming of certain social animals such as termites and bees occur when some members of an old colony separate and fly out to establish a new colony. Following this swarming, a new colony begins at a new location, hence overcrowding is avoided

• **Production of chemicals by plants:** The production of chemicals by roots of some plants sometimes prevent the growth of other plants close to them. This device prevents overcrowding

• **Production of canopies:** The production of canopies by tall plants helps them to trap enough sunlight and prevent the plants below from getting the light. These lower plants eventually die off and overcrowding is prevented or avoided.

Practice Questions

1. _____ refers to the progression an ecosystem follows as it changes over time.
   a) Biological succession
   b) Ecological succession
   c) Succession
   d) Ecology
2. _____ is defined as the number of individual organisms per unit area or volume of the habitat
   a) Population density
   b) Population size
   c) Population
   d) Ecosystem
3. _____ is defined as a situation which occurs when a population in a given habitat increase beyond a point where the resources in the habitat such as space and food are not enough to support all the individuals in the population.

a) Survival of the fittest
b) Overcrowding
c) Population
d) Predation

4. ___ is the stable community that is reached, beyond which, no further succession occurs
   a) Anti-climax
   b) Ecosystem
   c) Climax
   d) Overcrowding
5. _____ is defined as the total number of organisms of the same species living together in a given area at a particular time.
   a) Population density
   b) Population size
   c) Ecosystem
   d) Population
6. _____ involves the movement of individuals or animals out of their locality to another place for settlement in a new habitat.
   a) Immigration
   b) Migration
   c) Emigration
   d) Population

Answers

1. B
2. A
3. B
4. C
5. D
6. C

Week: 10

Topic: Topic: Food Shortage

Introduction

In all habitats, producers provide the food that support all consumers either directly or indirectly. In a well established habitat, population sizes of the various species are adjusted to the quantity of food that is available in the habitat. Certain factors can, however decrease the food supply to the habitat causing food storage.

Causes of Food Shortage

The following factors are responsible for shortage of food in a habitat:

1. **Overpopulation:** An increase in population without a corresponding increase in food supply tends to create food shortage.
2. **Poor storage facilities:** Lack of or inadequate storage facilities to store excess produce do result in losses leading to food shortage.
3. **Flood:** The occurrence of flood in a particular year may result in destruction of crops and farmlands which can also lead to food shortage.
4. **Drought:** Severe drought can lead to poor agricultural activities resulting in the production of little food. This eventually leads to food shortage.
5. **Pests:** Crops may be attacked by pests, e.g. pests like locusts, aphids, grasshoppers, weevils etc can attack crops leading to low yield. The poor harvest from such crops can lead to food shortage.

6. **Diseases:** Various diseases of plants and animals reduce production hence food shortage will occur.
7. **Bush Burning:** Bush burning also lead to the destruction of useful soil organisms, reduces soil fertility and expose the soil to erosion. These conditions of the soil can lead to poor yield and subsequent food shortage.
8. **Poor harvest:** Poor harvest or low yield of crops and animals due to one problem or the other can result in food shortage.
9. **Infertility of the soil:** Soil infertility due to erosion or bush burning lead to poor yield of crops which can also cause food shortage.
10. **War:** During wartime, attention is not given to food production and this leads to food shortage.

Factors Affecting a Population

A number of factors referred to as environmental resistance control the population of organisms in a particular habitat.

These factors are classified as abiotic and biotic factors.

Abiotic Factors

The abiotic factors comprise the following;

1. **Heat:** The degree of hotness of a place can determine the size of population. Hot environment generally is not conducive for habitation as organisms tend to run away from such areas. Heat can cause stress and death of individuals.
2. **Water:** Availability of water in a habitat determines the rate of survival of the population. While availability of water can

cause increase in population, lack of it can decrease a population.

3. **Space:** Space is very important to all organisms for normal growth and development. Lack of space leads to overcrowding and competition among organisms.
4. **Light:** Light is an important abiotic factor especially in plant community. Without light, green plants (producers) will not be able to manufacture the food needed in a habitat. Low light intensity also can result in weak plant growth and development.
5. **Nutrients:** Plants require nutrients in the soil to synthesize their various food substances. Lack of nutrients can result in stunted growth and poor yield of crops.

Biotic Factors

The biotic factors are made up of the effects of other plants and animals on a given organisms.

Examples of biotic factor are:

1. **Competitions:** Competition involves the interactions among two organisms of the same species or different species in which one neither outgrows the other nor survives while the other cannot grow nor survive.
2. **Parasitism:** This is a close association between two organisms in which one called the parasite lives in or on, and feeds at the expense of the other organisms called the host. The parasitic benefits from the association while the host usually suffers harm or even die.
3. **Commensalism:** Commensalism neither is an association between two organisms living together in which only one (the commensal) benefitted nor is harmed.

4. **Predation:** Predation is a type of association between two organisms in which the predator kills the other called the prey and feeds directly on it.
5. **Pathogens:** These are micro-organisms which can cause diseases in plants and animals leading to their reduction through death.
6. **Mortality:** Mortality is the death rate of organisms (plants or animals) in an environment. Mortality generally reduces the population of organisms in any habitat.
7. **Migration:** This is the movement of organisms either into a new habitat (immigration) or out of a habitat (emigration). These movements usually have effects on the other organisms inhibiting that habitat.
8. **Dispersal:** Dispersal is the spreading of new individuals from their parents to new habitat so as to start a new life in the new environment. Such spreading habits may affect the lives of other organisms in the new area.
9. **Natality:** This is the rate of giving birth to new offspring. Natality is generally known to increase the population of the habitat which will subsequently lead to certain problems among the organisms in that habitat.
10. **Food:** Availability of food in a habitat generally leads to increase in population while lack of food leads to starvation and dearth.
11. **Diseases:** Diseases are known to reduce the population of organisms (both plants and animals) in any habitat.
12. **Pest:** Pests are also known to affect the performance of plants in terms of yield and growth, in severe cases, the plants may even die.

iii. Edaphic factors: These consist of soil, its water, chemical and physical composition, its pH, its nutrient, profile, structure and texture.

Dynamic Equilibrium

The factors which affect population size include abiotic factors such as temperature, water, space etc and biotic factors such as food, competition, parasite etc. When these factors are favourable, growth is promoted, but when they are scarce or unfavourable, growth is retarded.

A factor which limits population growth is called **limiting factor** and the sum of all limiting factors is known as **environmental resistance.**

The net effect of these abiotic and abiotic factors is that at a point, the population size of living organisms tends towards a dynamic equilibrium known as **balance in nature.** When the population increases, the environmental resistance increases too. This means that when population is on the increase, the available food tends to decrease. This calls for competition which will later lead to death of the weaker organisms, thereby keeping the population relatively constant.

Human beings are able to control the population by family planning and birth control whereas in nature, biological equilibrium is attained by predator – prey relationship.

Family Planning/Contraception

Family planning is a device by which couples (husband and wife) determine the number of children they want and when they want them.

Birth control on the other hand refers to a method used to prevent a woman from becoming pregnant for as long as she wishes. Many parents decide to have a few number of children so they can afford to cater for their feeding, clothing, housing, education and medical care.

Without family planning, the population of a nation can rise indiscriminately and may not be able to match the available food and other resources, hence famine and death can result.

It is very important to point out that family planning is centred on prevention of pregnancy rather than termination of life (abortion). When family planning is carefully carried out, the issue of unwanted pregnancy is prevented.

Practice Questions

1. One of these is not a cause of food shortage
   a) Overpopulation
   b) Good storage facilities
   c) Diseases
   d) Flood

2. _____ neither is an association between two organisms living together in which only one benefitted nor is harmed.
   a) Commensalism
   b) Parasitism
   c) Saprophytism
   d) Holopytic

3. A factor which limits population growth is called_____ and the sum of all limiting factors is known as _____

4. _____ is a device by which couples (husband and wife) determine the number of children they want and when they want them.
   a) Family planning
   b) Succession planning
   c) Birth control
   d) Contraception

5. _____ refers to a method used to prevent a woman from becoming pregnant for as long as she wishes
   a) Family planning

b) Succession planning
c) Birth control
d) Contraception

6. All of these biotic factor affects population except _____
   a) Predator
   b) Pathogens
   c) Mortality
   d) Heat

7. All of these Abiotic factor affects population except _____
   a) Nutrient
   b) Light
   c) Competitions
   d) Space

8. All of these Edaphic factor affects population except _____
   a) Soil water
   b) Soil Pest
   c) Soil pH
   d) Soil structure

9. The factors that affect population size are ____, _____ and edaphic factors
   a) Biotic, Abiotic
   b) Biological, Economic
   c) Predator, Prey
   d) None of the above

10. The net effect of these abiotic and abiotic factors is that at a point, the population size of living organisms tends towards a dynamic equilibrium known as _____

Answers

1. B
2. A
3. Limiting factor and Environmental Resistance
4. A
5. C
6. D
7. C
8. B
9. A
10. Balance in nature