NAME----------CLASS----------

SUBJECT: BIOLOGY **CLASS: SS 2**

SCHEME OF WORK

WEEK TOPICS

1. Classification of Plants: (a) Botanical classification(i) Thallophytes (ii) Spermatophytes (b)Agricultural classification (i) Cereal (ii) Legumes etc (c) plants classified on their life cycle.
2. Digestive System: (a) Types of Alimentary Tracts (b) Description and functions of parts of the alimentary canal (c) Modifications of alimentary canal (i) Modification of parts to effect their digestive functions.
3. Digestive System: (d) Feeding habits: categories and mechanisms. (e) Modification in the feeding habit of: (i) filter feeders (ii) fluid feeders (iii) insect feeders (iv) parasitic and saprophytic feeders (f) feeding in protozoa, hydra and mammals.
4. Transport System: (a) Definition of diffusion and osmosis and principle behind them (b) Need for diffusion (c) Transport system in large organisms (d) Need for substances to move over greater distances (e)Materials for transportation (f) Structure of arteries, veins, capillaries, vascular bundles.
5. Transport System: (g) Media of transportation (i) Fluid as medium of transportation-structure and function of blood (ii) Cytoplasm in small organisms (iii) Cell sap or latex in most plants (iv) Closed and open circulation (h) Mechanism of transportation: (i) Unicellular organisms (ii)n Multicellular organisms (iv) Higher animals (v) Higher plants (vi) Absorption of water and mineral salt.
6. Respiratory System: (a) Types of respiratory systems: (i) Body surface respiration (ii) Coetaneous respiration (iii) Gills (iv) tracheal system (v) lungs.
7. Respiratory system: (b) Mechanism of respiratory system in: (i) Higher animals (ii) Lower animals (iii) plants (c) Mechanisms of gaseous exchange through the stomata of plants.
8. Excretory systems: (a) Excretory systems: (i) Contractile vacuoles (ii) Flame cells (iii) Malpighian Tubules (iv) Kidney (v) Stomata and Lenticels.
9. Excretory system (b) Excretory Mechanism in: (i) Earthworm (ii) Insects (iii) Mammals.
10. Revision.
11. Examination.

REFERENCE TEXTS

Catch-up Biology for SSCE/UME by A. Fatubarin et-al

Concise Biology for Senior Secondary Schools by B. N. Okoro

Exam Focus Biology for WASSCE and SSEC by E. Egunyomi et-al.

Lamlad's SSCE &UTME Biology by G. A. O. Arawomo et-al.

Modern Biology for Senior Secondary Schools, by Sarojini T et-al.

Nelson Biology for Senior Secondaru Schools 2, by Kola Soyibo et-al.

Senior Secondary School Biology, by S. O. ILOEJE

Nelson Functional Biology for Senior Secondary Schools by KolaSoyibo et-al.

WEEK 1
SUBJECT: BIOLOGY
CLASS: SS2 **DATE:----------**
TOPIC: CLASSIFICATION OF PLANTS
CONTENT :(a) Botanical Classification (i) Thallopytes (ii) Spermatophytes (b) Agricultural classification (i) Cereal (ii) Legumes etc. (c) Plants classified on their life cycle.
Sub-topic 1: **Botanical Classification.**
Botanical classification is a technique used in classifying plants according to their groups in the kingdom plantae.
Kindom plantae is divided into five (5) group:

1. Schizophyta (Bacteria).
2. Thallophyta (The algae and Fungi).
3. Bryophyta (The Liverworts and Mosses).
4. Pteridophyta (The Ferns).
5. Spermatophyta (These are the seed-bearing plants) spermatophyte consists of gymnosperms (Non flowering plants) and the angiosperms (Flowering plants).

<u>FEATURES OF SCHIZOPHYTA (BACTERIA)</u>

1. *They are microscopic and non-cellular.*
2. *No organized nucleus (Procaryotic cells).*
3. *The cell wall does not contain cellulose.*
4. *They reproduce by binary fussion.*
5. *Bacteria exist in various shapes.*

Common shapes of bacteria are: Cocci, Vibrios, Bacilli, and Spirilla.

<u>FEATURES OF THALLOPHYTA (ALGAE)</u>

1. *They are simple plants without root, stems and leaves.*
2. *All algae have chlorophyll. Some have blue, yellow, brown, and redpigments which mask the chlorophyll.*
3. *A majority are non-cellular, while few are multicellular. E.g. seaweeds are large.*
4. *They are mainly aquatic; few are in damp soils and shady places. E.g.Spirogyra, Anabaena, and Sargassum.*

<u>FUNGI</u>

1. *They are non-green plants.*
2. *They are simple multicellular plants.*
3. *The body is not differentiated into root, stem and leaves.*
4. *The vegetative body (hypha) is collectively known as mycelium.*
5. *Reproduction is by means of spores.*
6. *The cell wall is composed of cellulose and chitin.*
7. *Carbohydrates are stored in form of glycogen as in animal.*
8. *They are either saprophytic or parasitic. E.g. Mucor, Rhizopus, Yeast, and Fusarium, Aspergillus, Penicillium, and Mushroom.*

BRYOPHYTA (MOSSES) AND LIVERWORTS

1. *They are non-vascular multicellular organisms.*
2. *Have chlorophyll as the only photosynthetic pigment.*
3. *They are terrestrial but live in moist environment.*
4. *The body is differentiated into stem –like and leaf-like structures. They lack true roots, stem and leaves. They lack vascular tissue and therefore unable to transport food and materials round the body.*
5. *The leaves of some are spirally arranged on the stem.*
6. *Asexual reproduction is by spores, while sexual reproduction is by gametes. Water is needed in sexual reproduction hence they are regarded as alternation of generations.*
7. *Some are thalloid in form e.g. Liverworts. Examples are Marchantia sp. (liverwort) and Funaria hygrometric a (a moss).*

PTERIDOPHYTA (FERNS

1. *The body is differentiated into true roots, stem and leaves with well developed vascular bundles comprising xylem and phloem. The young leaves are coiled.*
2. *The stem is a rhizome.*
3. *Reproduction is by means of spores.*
4. *Asexual reproductive organ is a heart-shaped prothallus.*
5. *Water is needed for sexual reproduction (prothallus).*
6. *They are mainly terrestrial, with a few aquatic members. E.g. are Dryopteris, Cyclosorus, Platycerium, Phymatodes, are terrestrial while Nephrolepis, Salvinia oblongata, and Azolla are aquatic members.*

SPERMATOPHYTA (GYMNOSPERMS-NON-FLOWERING PLANTS)

1. *They are large plants with well developed vascular bundles with true roots, stem and leaves.*
2. *The leaves are green in colour, small scaly and needle-like.*
3. *They have cones where naked seeds are formed because there is no ovary. Fruit is not formed.*
4. *They are terrestrial in habitat. E.g. are whistling pine (Casuarina sp.) and Cycas.*

ANGIOSPERM (FLOWERING PLANTS)

1. *They possess true flowers for sexual reproduction.*
2. *Well developed true roots, stems and leaves are present.*
3. *Well developed vascular bundles are present.*
4. *Seeds and fruits are produced after fertilization. Seeds are enclosed in an ovary.*

5. *They are terrestrial, but few are aquatic. E.g. are Oil palm tree, Goat weed, Mango tree and Maize.*

EVALUATION

1. *Mention the five (5) groups of the kingdom plantae with one example each.*
2. *Outline two features of the thallophyta.*
3. *Write three features of the spermatophyte with two examples each.*

<u>AGRICULTURAL CLASSIFICATION</u>

Agricultural classification includes the following:

1. *Fibres: e.g. cotton, jute, hemp and sisal.*
2. *Latex: e.g. rubber.*
3. *Root crops: yams, cassava, potatoes and cocoyam.*
4. *Cereals: rice, maize, wheat, guinea corn etc.*
5. *Fruits: e.g. citrus fruits, pawpaw, mangoes, pineapples etc.*
6. *Legumes: e.g. beans, soya beans, cowpea and groundnuts.*
7. *Beverages and drugs: e.g. coffee, cocoa, sugar cane, kola nut.*
8. *Spices: e.g. pepper and ginger.*
9. *Vegetables: e.g. tomato, okro, carrot, lettuce etc.*

<u>CLASSIFICATION BASED ON LIFE CYCLE</u>

These include the following:

1. *Ephemerals: They are plants that complete their life cycle in few weeks, e.g. water leaf.*
2. *Annuals: these are plants that complete their life cycle in one year, e.g. maize, tomatoes, rice, garden egg, and yam.*
3. *Biennials: these include flowering plants that complete their life cycle in two years: e.g. onions and carrots.*
4. *Perennials: plants that complete their life cycle in three years, e.g. mangoes, and oranges, cocoa and kola nut etc.*

EVALUATION

1. *List four examples each of vegetables, legumes, cereals, and beverages and drugs..*
2. *Classify crops according to their life cycle.*

GENERAL EVALUATION

1. *Which of these is not an example of legumes? (a) Groundnut (b) rice (c) cowpea (d) beans (e) soya beans.*
2. *One of these is a perennial crop. (a) Mango tree (b) pawpaw (c) okro (d) yam (e) cassava.*

ESSAY TEST

1a. State the technique used in classifying plants.

b. Classify latex, legumes, flowering plants, non-flowering plants, bacteria, ferns, and water leaf, using the technique stated in your answer in 'a' above.

WEEKEND ASSIGNMENT

Sketch a well labeled diagram of the alimentary canal of bird

PRE-READING ASSIGNMENT
Read concise Biology by B.N Okoro (pages 65-66), and write short note on the thallophytes.

WEEKEND ACTIVITY
List five examples of flowering plants, and study any one of your choice. Write down all your findings in your assignment note book.

Concise Biology for Senior Secondary Schools, by B. N. OKORO.

New System Biology for Senior Secondary Schools, by Lam Peng Kwan et-al.

Senior Secondary Biology 1, F. O. C. Ndu et-al.

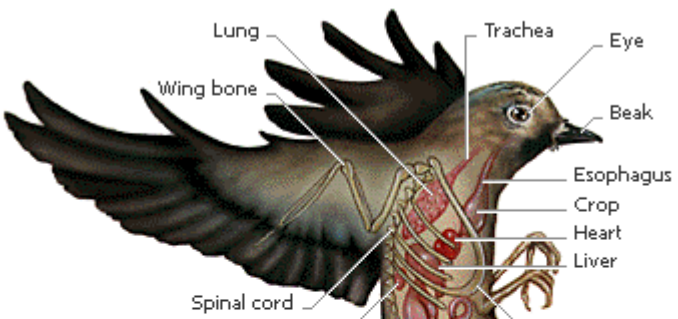
WEEK 2
SUBJECT: BIOLOGY
CLASS: SS2 **DATE:----------**
TOPIC: DIGESTIVE SYSTEM I
CONTENT: (a) Types of Alimentary tracts (b) Description and functions of parts of the alimentary canal (c) Modification of alimentary canal (d) Modification of parts to effect their digestive system

INTRODUCTION

Digestive System, series of connected organs whose purpose is to break down, or digest, the food we eat. Food is made up of large, complex molecules, which the digestive system breaks down into smaller, simple molecules that can be absorbed into the bloodstream. The simple molecules travel through the bloodstream to all of the body's cells, which use them for growth, repair, and energy.

All animals have a digestive system, a feature that distinguishes them from plants. Plants produce their own food in a process called photosynthesis, during which they use sunlight to convert water and carbon dioxide into simple sugars. But animals, including humans, must take in food in the form of organic matter, such as plants or other animals.

Digestion generally involves two phases: **a mechanical phase and a chemical phase.** In the mechanical phase, teeth or other structures physically break down large pieces of food into smaller pieces. In the chemical phase, digestive chemicals called enzymes break apart individual molecules of food to yield molecules that can be absorbed and distributed throughout the body. These enzymes are *secreted* (produced and released) by glands in the body.

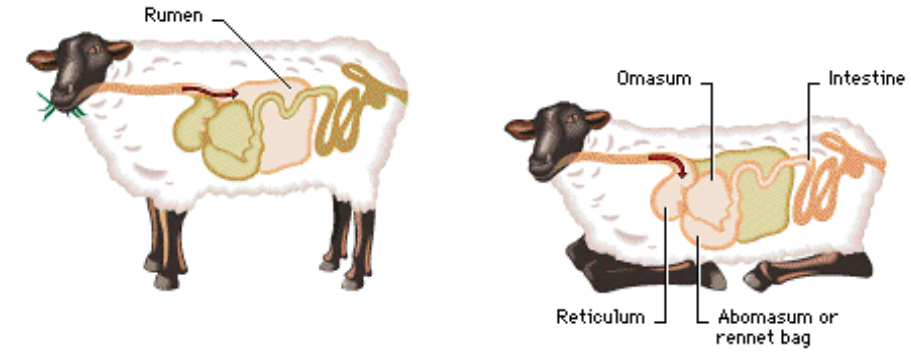


Anatomy of a Bird

This diagram illustrates some of the important anatomical structures common to birds. Many of these structures are adapted for greater efficiency in flying. The digital and wrist bones of the wing are fused to form ridged support for the flight feathers and the large sternum helps support muscles used in flying. The bones of many adult birds are hollow rather than filled with marrow, making them lighter and enabling them to disperse heat in flight.

The digestive system of most animals consists mainly of a long, continuous tube called the alimentary canal, or digestive tract. This canal has a mouth at one end, through which food is taken in, and an anus at the other end, through which digestive wastes are excreted. Muscles in the walls of the alimentary canal move the food along. Most digestive organs are part of the alimentary canal. However, two accessory digestive organs, the liver and pancreas, are located outside the alimentary canal. These organs contribute to chemical digestion by releasing digestive juices into the canal through tubes called ducts.

The stomach, located in the upper abdomen just below the diaphragm, is a saclike structure with strong, muscular walls. The stomach can expand significantly to store all the food from a meal for both mechanical and chemical processing. The stomach contracts about three times per minute, churning the food and mixing it with gastric juice. This fluid, secreted by thousands of gastric glands in the lining of the stomach, consists of water, hydrochloric acid, an enzyme called **pepsin**, and ***mucin*** (the main component of mucus). Hydrochloric acid creates the acidic environment that pepsin needs to begin breaking down proteins. It also kills microorganisms that may have been ingested in the food. **Mucin** coats the stomach, protecting it from the effects of the **acid and pepsin**. About four hours or less after a meal, food processed by the stomach, called **chyme**, begins passing a little at a time through the **pyloric sphincter** into the duodenum, the first portion of the small intestine.



Four-Chambered Stomach

Ruminant animals, including sheep, domestic cattle, goats, deer, and giraffes, have four-chambered stomachs.

TYPES OF ALIMENTARY TRACT

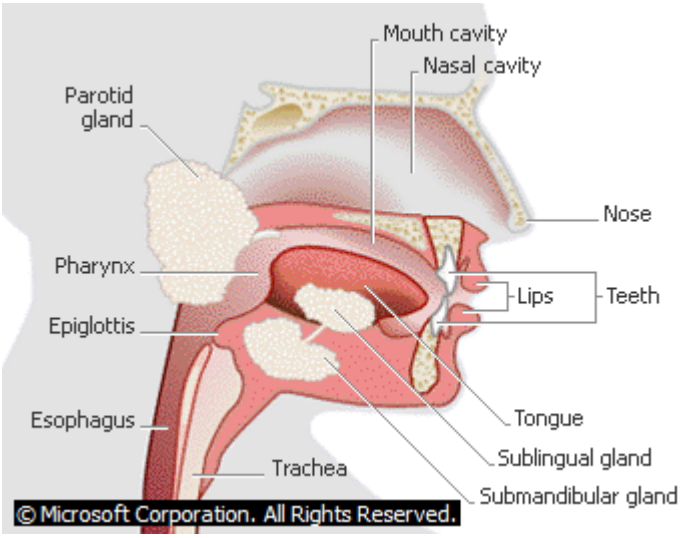
There are different types of alimentary tracts in animals. However, there is no definite alimentary canal in plant. This includes:

1. Intracellular alimentary tract for intracellular digestion. E.g. unicellular organism.
2. Extracellular alimentary tract for extracellular digestion. E.g. Hydra.
3. Simple alimentary tract for simple digestion of food. E.g. Birds.
4. Compartmentalised alimentary tract by ruminants for digestion of cellulose. E.g. ruminants like cow.
5. Complex Human alimentary tract; a long tube stretching from the mouth to the anus. Most of it is coiled up in the abdominal cavity. It is divided into several regions: mouth, oesophagus, stomach, and intestines. Each region plays a role in the digestion and /or absorption of food.

PARTS OF THE ALIMENTARY CANAL

A typical mammalian alimentary canal consists of the following parts, namely: mouth, pharynx, oesophagus, stomach, small intestine, rectum and anus. All these parts can be found in most vertebrates. However, there are modifications of the parts of the alimentary canal in various, animals. In some animals, a structure may be reduced or enlarged, while in others, some parts may be absent. The modifications reflect the various modes of feeding and types of diet.

DESCRIPTION AND FUNCTIONS OF THE PARTS OF THE ALIMENTARY CANAL



Anatomy of the Mouth
In humans, the mouth is an integral part of digestion, speech, and breathing. Food enters the mouth to be broken down both by the teeth and by enzymes secreted by three salivary glands—the sublingual gland, the submandibular gland, and the parotid

gland. The tongue pushes food down the pharynx. The tongue and nasal cavity modify sound waves to produce the sounds of speech, while the tongue and teeth work together to form words.

Mouth and Teeth: In higher animals especially in human, the incisors, canines, premolar and molar are teeth used to masticate the food into particles which expose it to large surface area for the action of the enzymes. Digestion starts in the mouth.

Tongue: the tongue tastes the food, helps in the movement of the food in the mouth to allow turning and mixing of the food with saliva and in forming food into bolus to allow swallowing.

Saliva: The saliva lubricates the food, allows easy chewing or movement of food in the mouth for swallowing, forms solvent for food, contains enzyme-ptyalin which digests cooked starch to maltose and is slightly alkaline which is medium for action of ptyalin. The chewed food in the mouth is then swallowed.

Pharynx: it next to the mouth. In some animals, such as the earthworm and Planaria, it is muscular. In man it is short and wide. The pharynx leads to the trachea and the oesophagus. It is used for passing food materials into the oesophagus or gullet.

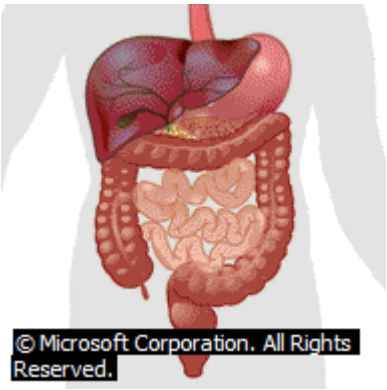
Oesophagus/gullet: this is a narrow, straight, long, tube passing through the thoracic region and the diaphragm into the stomach. Digestion does not take place here. But it is used for passing food substances into the stomach by a wave-like muscular contraction and relaxation called peristalsis. This type of movement occurs throughout the human alimentary canal. Chewed food is passed to the stomach by peristaltic movement of the oesophagus.

Stomach: In some animals, the lower part of the oesophagus may be modified to form the crop as in insects and birds. These are storage organs for the food consumed.

The stomach is primarily a storage organ. But in most mammals, it is very muscular and digestion continues in it. In birds, insects and grasshopper and earthworm, the stomach modified into a grinding organ called gizzard. The gizzard is normally muscular with small sharp stones which masticate the food before it is further digested in the intestine. Hence, gizzard is possessed by some vertebrates e.g. birds and some invertebrates e.g. insects and earthworms which lack teeth in their mouth. Ruminants stomach are modified into four chambered or compartments namely rumen, reticulum, psalterium and abomasums.

In human, the wall of the stomach secretes gastric juice. This contains hydrochloric acid which prevents the food in the stomach from being decay and two enzymes-rennin and pepsin. Rennin curdles milk, while pepsin converts protein in the food into peptones. Food may remain in the stomach for 3-4hours at the end it is converted to a semi-liquid paste called **chyme.** Note that food is regulated into the stomach from the gullet by a muscle called cardiac sphincter, while chime is regulated to the small intestine by another muscle called pyloric sphincter.

THE HUMAN DIGESTIVE SYSTEM



Human Digestive System

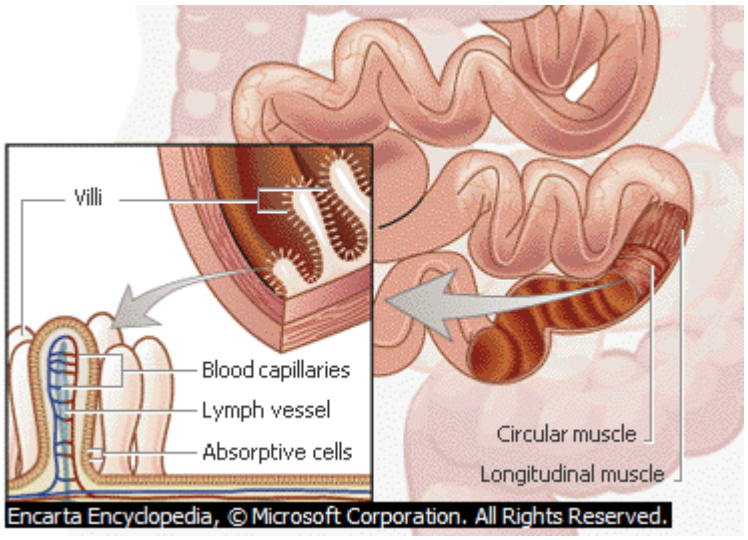
The human digestive system consists of a series of organs and structures that help break down food and absorb nutrients for use throughout the body. Food enters the digestive system through the mouth and passes through the oesophagus, stomach, small intestine, large intestine, and rectum. Other organs, such as the liver, further aid in the breakdown of food, absorption of nutrients, and elimination of undigestible materials from the body.

The Small Intestine

Most digestion, as well as absorption of digested food, occurs in the small intestine. This narrow, twisting tube, about 2.5 cm (1 in) in diameter, fills most of the lower abdomen, extending about 6 m (20 ft) in length. Over a period of three to six hours, peristalsis moves chyme through the duodenum into the next portion of the small intestine, the jejunum, and finally into the ileum, the last section of the small intestine. During this time, the liver secretes bile into the small intestine through the bile duct. Bile breaks large fat globules into small droplets, which enzymes in the small intestine can act upon. Pancreatic juice, secreted by the pancreas, enters the small intestine through the pancreatic duct. Pancreatic juice contains enzymes that break down sugars and starches into simple sugars, fats into fatty acids and glycerol, and proteins into amino acids. Glands in the intestinal walls secrete additional enzymes that break down starches and complex sugars into nutrients that the intestine absorbs. Structures called Brunner's glands secrete mucus to protect the intestinal walls from the acid effects of digestive juices.

The small intestine's capacity for absorption is increased by millions of finger-like projections called villi, which line the inner walls of the small intestine. Each villus is about 0.5 to 1.5 mm (0.02 to 0.06 in) long and covered with a single layer of cells. Even tinier finger-like projections called microvilli cover the cell surfaces. This combination of villi and microvilli increases the surface area of the small intestine's lining by about 150 times, multiplying its capacity for absorption. Beneath the villi's single layer of cells are *capillaries* (tiny vessels) of the bloodstream and the lymphatic system. These capillaries allow nutrients produced by digestion to travel to the cells of the body. Simple sugars and amino acids pass through the capillaries to enter the bloodstream. Fatty acids and glycerol pass through to the lymphatic system.

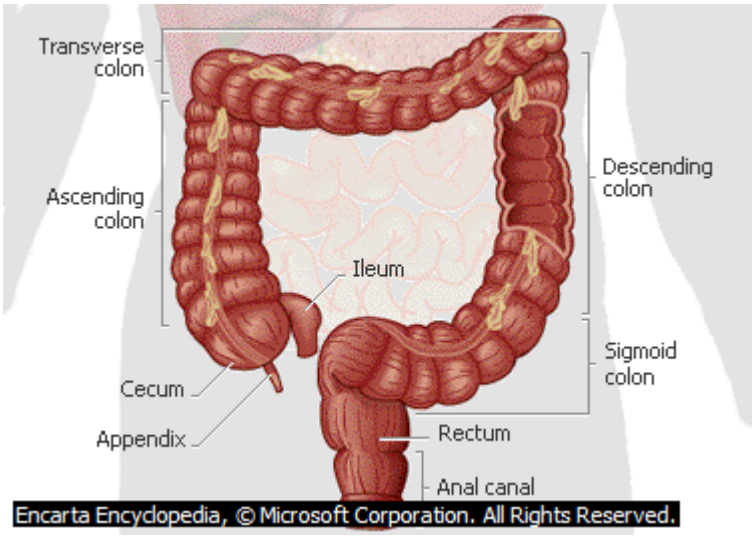
Duodenum: This is the centre of digestion.



The Large Intestine

A watery residue of indigestible food and digestive juices remains unabsorbed. This residue leaves the ileum of the small intestine and moves by peristalsis into the large intestine, where it spends 12 to 24 hours. The large intestine forms an inverted U over the coils of the small intestine. It starts on the lower right-hand side of the body and ends on the lower left-hand side. The large intestine is 1.5 to 1.8 m (5 to 6 ft) long and about 6 cm (2.5 in) in diameter.

The large intestine serves several important functions. It absorbs water—about 6 liters (1.6 gallons) daily—as well as dissolve salts from the residue passed on by the small intestine. In addition, bacteria in the large intestine promote the breakdown of undigested materials and make several vitamins, notably vitamin K, which the body needs for blood clotting. The large intestine moves its remaining contents toward the rectum, which makes up the final 15 to 20 cm (6 to 8 in) of the alimentary canal. The rectum stores the faeces—waste material that consists largely of undigested food, digestive juices, bacteria, and mucus—until elimination. Then, muscle contractions in the walls of the rectum push the faeces toward the anus. When sphincters between the rectum and anus relax, the faeces pass out of the body.



A

Section of the large intestine

EVALUATION

1. Define the term Digestion.
2. What is digestive system?
3. List ten parts of the alimentary canal.
4. Outline four types of digestive system.

GENERAL EVALUATION

1. One of the is not a part digestive system of man (a) gizzard (b) teeth (c) saliva (d) duodenum (e) oesophagus.
2. After about three to four hours the food is converted to (a) rennin (b) chyme (c) pepsin (d) polypeptide (e) pepsinogen.
3. The hormone that converts glucose to glycogen is called (a) eosin (b) adrenalin (c) insulin (d) oestrogen (e) mucin.

ESSAY TEST

1. Discuss in details the functions of the duodenum.
2. Write two functions of the hydrogen chloride in the stomach
3. Sketch annotated diagram of the alimentary canals of man, and ruminant.

WEEKEND ASSIGNMENT

Read more on digestive system in Nelson Biology for Senior Secondary School 2 by Kola Soyibo et-al (pages 78-80), and summarise Alimentary System in two pages of your note book.

PRE-READING ASSIGNMENT

Read Nelson Biology by Kola Soyibo (pages 78-79), and explain peristaltic movement with a labelled diagram.

WEEKEND ACTIVITY

1a. what is dentition?

b. Explain dental formula.

2a. List types of teeth.

b. Write the dental formula of man, dog, and cow.

REFERENCE TEXTS

Concise Biology for Senior Secondary Schools by B. N. Okoro.

Modern Biology for Senior Secondary School by Sarojini T. Et-al.

Nelson Biology for Senior Secondary School 2 by Kola Soyibo.

WEEK 3
SUBJECT: BIOLOGY
CLASS: SS2 **DATE:----------**
TOPIC: DIGESTIVE SYSTEM II
CONTENT: (a) Feeding Habits: Categories and mechanisms. (e) Modifications in the feeding habits of: (i) filter feeders (ii) fluid feeders (iii) insects feeders (iv) parasitic and saprophytic feeders (f) feeding in protozoa, hydra and mammals.

SUB-TOPIC 1FEEDING HABITS
There are various modification among the alimentary systems of some animals so far considered, suggest that the parts are modified according to the type of food they eat. It has also been discovered that there is a close relationship between feeding mechanism and the diet of each organism.
Animals may be categorized under herbivores, carnivores and omnivores.

CATEGORIES AND MACHANISMS OF FEEDING

Herbivores

These refer to all the animals that are plant-eating. Examples include grasshoppers, goat, cow, Grass cutter etc. They all feed on low vegetation such as grass. Giraffes and elephants feed on taller plants or shrubs. Herbivores such as rabbits and guinea pigs use very sharp incisors to cut shoots or browse, feed on roots and bark. Other animals like antelopes, cows and goats pull up grass using the lower front teeth and pad on the front of the upper jaw. The

pad is called *Diastema.* Some herbivores such as elephant use a specialised organ (the trunk) to pull leaves, bark and branches off trees.

Carnivores

These are animals that feed majorly on flesh or bones and other animals. They are referred to as the *primary consumer*s. Some examples are fishes which eat aquatic insects and other fishes, toads and reptiles (Snakes, lizards, wall gecko), cats, dogs, and lions. Mammalian carnivores are characterized by well developed dentition, large canines and a pair of carnassials teeth. These are adapted to stabbing their prey, cutting and crushing meet and bones.

Omnivores

Omnivorous animals are animals that feed on both plants and animals, cooked and uncooked food. Some of the examples include, man, wild boar, bush and domestic pig, and the domestic fowl.

Scavengers

Animals that feed on the remains of dead animals are called scavengers e.g. Vultures.

Based on the modification on the feeding mechanism of organisms, we have the following; filter feeding, and fluid feeding adaptations in animals and saprophytic and parasitic feeding in animals and plants.

EVALUATION

1. Write short note on each of the following; Herbivores, Carnivores, Omnivores and Scavengers

Caterpillar Hunter Beetle

A European caterpillar hunter beetle makes a meal out of an unlucky caterpillar. The caterpillar hunter stalks its prey at night and survives mostly on caterpillars and earthworms.

Sub-Topic 2Filter Feeding

Some aquatic organism feed on some tiny microscopic organisms (planktons) in their habitat. A great number of them are gathered, filtered and consumed at the same time, from the surface of the water. Typical examples of filter feeders include; water fleas, (Daphnia), mosquito larvae, fish such as herring, and molluscs such as oyster, and mussels. Water containing suspended plankton enters the mouth of the animal e.g. herring. Water passes between the gill rakers to the gills. Oysters and clams draw water into their shells and trap food particles on the muscles covering their gills.

Fluid Feeders

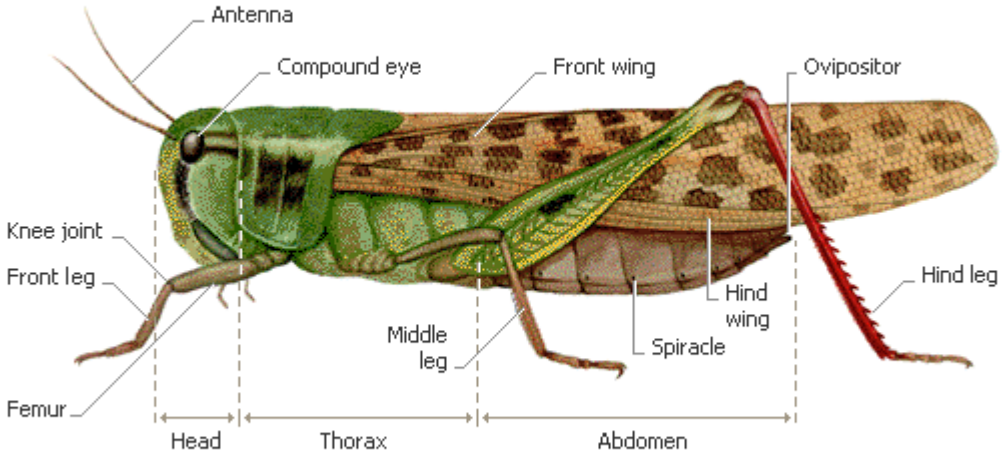
Fluid feeders are organisms that can only feed on soluble or fluid food materials from the body fluid of other animals or plants, or convert solid food into a liquid form before ingesting it.

Examples of fluid feeders are bees, wasps, aphids, housefly, mosquito, tsetse fly, and butter fly. The house fly has a proboscis which is flattened its anterior end. This consists of numerous food channels called *pseudo- tracheae. Whenever the fly is prepared to feed, it extends its proboscis and saliva is passed down salivary duct via the pseudo tracheae on to the food.*

The adult female anopheles mosquito feeds on blood. It has mouth parts which are modified into a tube like a hypodermic needle. It pierces the skin of a blood capillary; saliva containing an anti- coagulant is passed down the hypopharynx into the capillary. This prevents the blood from coagulating when it is sucked up by the tubular labrum.

Many other insects bite and/or chew their food. Examples are the ants, beetles, cockroach, locust, caterpillar, termites, and weevils. Most of these are crop pests as were taught in your Basic classes.

Orchid Bees
The orchid bee is one of the most brilliantly coloured insects, and may appear metallic green, blue, purple, gold, or red. A close relative of the bumblebee, it has a long tongue that allows it to reach nectar deep inside tropical flowers. It is found in tropical and subtropical regions of the western hemisphere.



Anatomy of a Grasshopper
This illustration of a grasshopper depicts the tiny circular openings called spiracles through which most insects obtain oxygen. From the spiracles, tubes called tracheae reach deep within the body to supply oxygen to every cell.

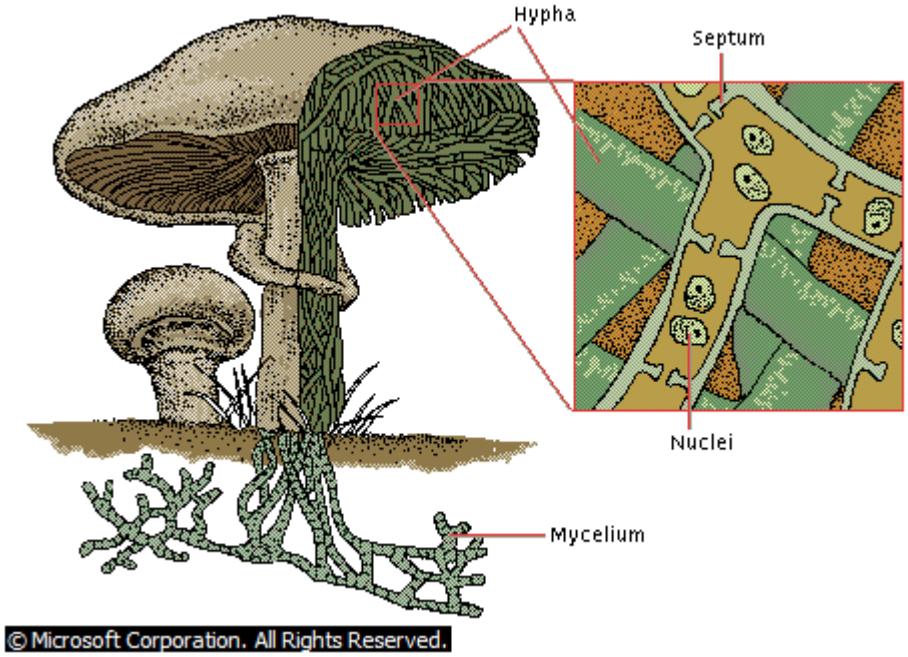
Saprophytic Feeding

These are organisms which obtain their food materials from dead or decaying food materials or dead organic matters. They non-green plants and therefore cannot carry out photosynthesis. Typical examples include: many fungi, e.g. mushroom, mucor or rhizopus,

penicillum and yeast as well as some bacteria. The rhizoids penetrate into the dead organic matter or substrate, and excrete enzymes into it, and digestion occurs extracellulary. The digested food; a soluble end products diffuse into the rhizoids and from there to the other parts of the plants.

Parasitic feeding

In parasitic feeding, parasites are plants or animals which live and feed on or in other organisms and harm the hosts at the end. Parasites which live outside the body or the surface of their hosts are called ***ectoparasites*** *e.g. tick, mites, lice and flaes. These live the skin, or hairs of mammals. Those parasites which feed and live inside their hosts are called* ***endoparasites*** *e.g. tapeworm, roundworm etc*



Structure of a Fungus
Fungi are made of filamentous tubes called hyphae. In many species, perforated walls, or septa, divide the hyphae into cells containing one or two nuclei. Protoplasm flows through the opening in the septa to provide the cells with nutrients, which are stored in the hyphal walls as glycogen. Hyphae elongate from the tip. The entire mass of hyphae is collectively called the mycelium.

EVALUATION

1. Write short notes on the following feeding habits: Filter feeding, Fluid feeding, Saprophytic feeding, and Parasitic feeding.

Sub-Topic 3 Feeding in Protozoa

Amoeba proteus is an example of a protozoan. It feeds on minute microscopic organisms. These are mainly phytoplankton, desmids and diatoms, flagellates, bacteria, and decayed parts of plants in water. The presence of the food stimulates the formation of pseudopodia towards the object. Soon, the pseudopodia encircle the food material. This is taken into the body with a drop of water and a food vacuole is formed. The cytoplasm secretes digestive enzymes on to the food and digestion occurs. Later, the digested food materials diffuse into

the **plasmasol**. The indigestible parts are left behind or allowed to pass out through the **plasmagel**. Ingestion and egestion can occur at any time through the body surface.

Feeding in Hydra

Hydra is at tissue and considered as multicellular, aquatic organism (animal). It feeds mainly on tiny crustaceans e.g. water fleas. The food is usually caught by the tentacles with the aid of ***nematocysts*** *which immobilize the prey. The tentacles draw the prey into the mouth and then into the* ***enteron*** *(digestive cavity). The digestive enzymes in the* ***enteron*** *digest the food* ***extracellularly.*** *The absorptive cells ingest the partially digested food materials food material and complete digestion* ***intracellularly.*** *The soluble materials diffuse to various part of the animal. The waste products are egested through the mouth.*

Feeding in Mammals

Mammals feed on different types of food materials. They are often classified according to the food they eat. Thus, we have herbivores- plant eaters; carnivores-flesh eaters and omnivores- plant and animal eaters.

Each group of mammals has a peculiar type of dentition related to its diet even though mammals generally have heterodont dentition. They have incisors, canines, premolars and molars. Each tooth has a different shape and function. In human, there are two sets of teeth, namely: **temporary or milk teeth and permanent teeth.** The formal are used at childhood (6months to 6-8years) while they replaced by permanent teeth at old age.

EVALUATION

1. Name four types of teeth in mammals or human.
2. What is heterodont dentition?
3. The two sets of teeth are --------- and --------.
4. What type of feeding found in hydra?
5. Discuss briefly feeding in protozoa.

GENERAL EVALUATION

1. Which of the following mammalian structures is structurally adapted for grinding flesh (a) Canine (b) Incisor (c) Molar (d) Diastema (e) Carnassial tooth.
2. Hydra catches food with the aid of the ---------- (a) tentacle (b) cilia (c) pseudopodia (d) nematocysts (e) plasmagel.
3. One of these is not a fluid feeders (a) oyster (b) mosquito (c) bees (d) house fly (e) tsetse fly.

ESSAY TEST

1. How is the dentition of a named herbivore and carnivore adapted to feeding?
2. Write down four ways of caring for the teeth.

WEEKEND ASSIGNMENT

1. Study Nelson Biology for SS2 pages 84-86,and write down the dental formula of; rabbit, dog and man.

PRE-READING ASSIGNMENT

Read Nelson Biology for Senior Secondary Schools 2 by Kola Soyibo et-al (pages 76-86), and write about the alimentary canal of cockroach and grasshopper.

WEEKEND ACTIVITY

Go to the field and study any insect of your choice; write down all your findings in your assignment book.

REFERENCE TEXT

Nelson Biology for Senior Secondary Schools 2 by Kola Soyibo et-al.

WEEK 4

SUBJECT: BIOLOGY
CLASS: SS2 **DATE:----------**
TOPIC: TRANSPORT SYSTEM 1
CONTENT: (a) Definition of Diffusion and Osmosis and principle behind them (b) Need for diffusion (c) Transport system in large organisms (d) Need for substances to move greater distances (e) Materials for transportation (f) Structure of arteries, veins, capillaries, vascular bundles.

Definition of diffusion
Diffusion is the movement of molecule from the region of higher concentration to the region of lower concentration. It can occur in liquid, but it is faster in gaseous medium.
Some examples of diffusion living membrane are: Needs for Diffusion.

1. Absorption of nutrients, e.g. mineral salts uptake in roots.
2. Exchange of gases in the cells or tissue e.g. Oxygen and Carbon (iv) oxide exchange through the stomata.
3. Materials transport within the cells
4. Excretion of waste product e.g. diffusion of carbon (iv) oxide into the alveoli.

PRINCIPLE OF DIFFUSION
Graham's law of diffusion states that the rate of diffusion of a gas is inversely proportional to the square root of the density.
Hence, lighter gases can diffuse through heavier gases, e.g. hydrogen sulphide has diffused through air.

SIGNIFICANCE OF DIFFUSION.
When molecules are unevenly distributed in the cell, diffusion tends to equalize the distribution.

Definition of Osmosis

Osmosis on the hand is directly opposite diffusion. It is defined as the movement of solvent molecules (usually water) from a solution of lower concentration to a more concentrated solution through a differentially permeable or semi-permeable membrane in order to maintain an ionic equilibrium. Osmosis is therefore a special form of diffusion.

Thus osmosis may be defined as the net movement of water from area of low D.PD. or higher water concentration through an area of high D.P.D.or low water concentration through a semi-permeable membrane.

D.P.D.: Diffusion pressure deficit, this may be defined as difference in water potential on both sides of the semi-permeable membrane.

Some examples of osmosis in living membrane (Living Cells) are:

1. Absorption of nutrients or uptake of nutrients or water.
2. Plasmolysis of cells or shrinking of cells in hypertonic solution.
3. Turgidity of cells.
4. Haemolysis of red blood cells/bursting of animal cells in hypotonic solutions.

In osmosis, water moves into a stronger solution (the sugar solution in (E) through a living material which acts as a semi-permeable membrane.

Examples of Osmosis in Plants: Needs for Osmosis.

1. Water absorption by the roots.
2. Plasmolysis of plant cells.
3. Movement of water from one cell to another in plants.
4. Maintenance of turgor pressure in plant cells.
5. Opening and closing of stomata.

Examples of Osmosis in Animals

1. Re-absorption of water by kidney tubules.
2. Haemolysis and crenation of red blood cells.
3. Osmo-regulation in Amoeba and Paramecium.
4. Maintenance of shape of mammalian cells in the surrounding tissue fluid.

SIGNIFICANCE OF OSMOSIS: Osmosis is concerned with the transport of materials between cells.

Evaluation

1. Define diffusion and osmosis
2. Explain the principle behind osmosis and diffusion.
3. Enumerate three applications of diffusion and osmosis in living things.
4. Write four examples of osmosis and diffusion.

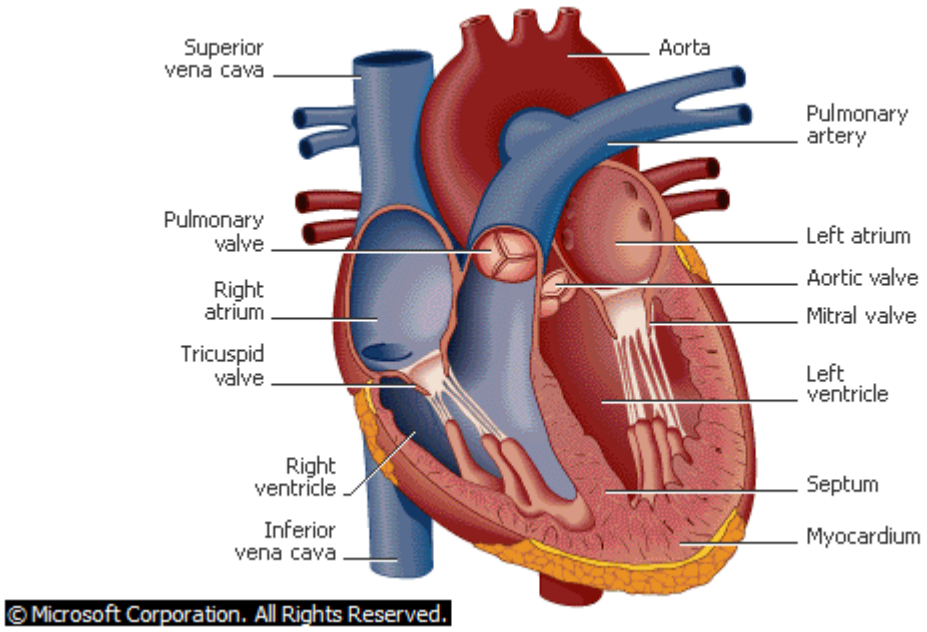
Transport System In Large Organisms

In large and more complex organisms, transport system is necessary because;

1. The ratio A/V diminishes, and so the rate at which nutrients and other substances diffuse decreases. This implies that small organisms have large surface area in relation to their volume (i.e., per unit of volume) than large organisms. This could be illustrated by considering three cubes of 1mm, 6mm, and 10mm. Using, Ratio = SA/V. You will discover that the ratio of the smallest cube is =6unit, followed by 1unit, and 0.6unit respectively.
2. Substances have to move greater distances.

In plants, materials for transportation include; water, mineral salts, manufactured food and carbon (iv) oxide.

Materials for transport **in animals** include; digested food, vitamins, mineral salts, oxygen, carbon (iv) oxide, urea, salts, hormones, water and antibodies.



Human Heart
The human heart is a hollow, pear-shaped organ about the size of a fist. The heart is made of muscle that rhythmically contracts, or beats, pumping blood throughout the body. Oxygen-poor blood from the body enters the heart from two large blood vessels, the inferior vena cava and the superior vena cava, and collects in the right atrium. When the atrium fills, it contracts, and blood passes through the tricuspid valve into the right ventricle. When the ventricle becomes full, it starts to contract, and the tricuspid valve closes to prevent blood from moving back into the atrium. As the right ventricle contracts, it forces blood into the pulmonary artery, which carries blood to the lungs to pick up fresh oxygen. When blood exits the right ventricle, the ventricle relaxes and the pulmonary valve shuts, preventing blood from passing back into the ventricle. Blood returning from the lungs to the heart collects in the left atrium. When this chamber contracts, blood flows through the mitral valve into the left ventricle. The left ventricle fills and begins to contract, and the mitral valve between the two chambers closes. In the final phase of blood flow through the heart, the left ventricle contracts and forces blood into the aorta. After the blood in the left ventricle has been forced out, the ventricle begins to relax, and the aortic valve at the opening of the aorta closes.

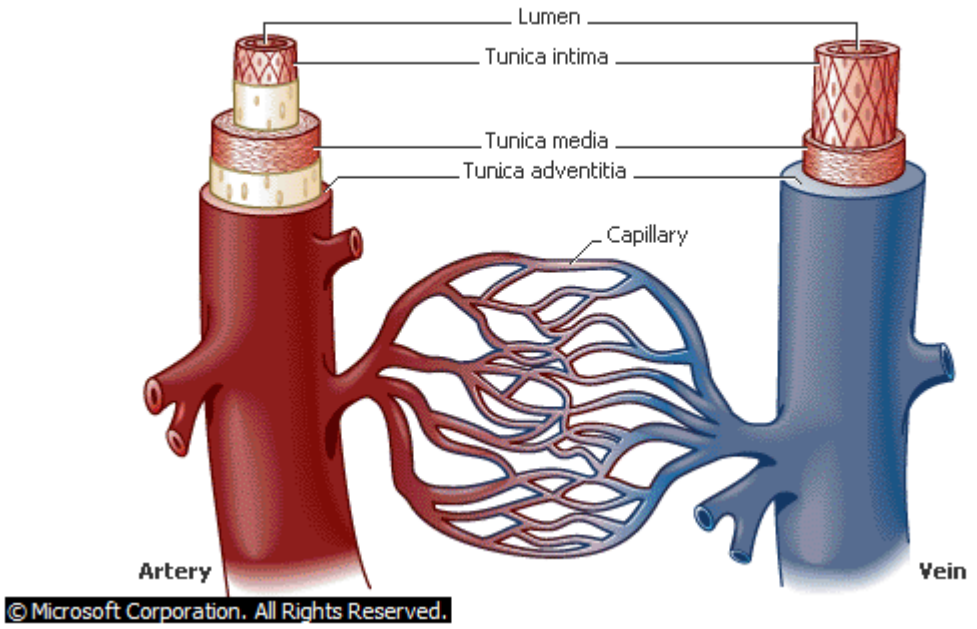
NEED FOR SUBSTANCE TO MOVE OVER GREATER DISTANCES

Following the explanation, because small organisms have large surface area to volume ratio, the movement of materials in and out of them can be done efficiently by diffusion. In multicellular organisms with a small body surface relative to their large volume, diffusion is inadequate for the exchange of metabolic materials within their body and between them and their external environment. This is because large quantities of nutrients and waste products have to be transported over long distances to and from their numerous body cells.

In order words, as the SA/V ratio in multicellular organisms decrease with increasing sizes, the rates at which substances diffuse into and out of their cells decreases. Hence, most multicellular organisms have developed transport system. The transport system in animals is very similar to the city transport or water system. There is orderliness, and everything is highly organized.

MATERIALS FOR TRANSPORTATION

Organs used for transportation are arteries, capillaries, veins, and vascular bundles. The materials transported in the organism include water, digested foods, gases, excretory products, hormones, auxins and other materials.



Blood Vessels
Blood vessels circulate blood through the body. The three major types of blood vessels are the arteries, veins, and capillaries. Arteries carry blood away from the heart, while veins carry blood toward the heart. Capillaries form at the junction between arteries and veins and they are the only blood vessel to come into direct contact with tissue cells. Oxygen, nutrients, and other substances transported in blood through the arteries pass through thin capillary walls into tissue cells. Wastes and other products of cellular metabolism pass from cells back through the capillary walls and into veins. The walls of arteries and veins are composed of three tunics (layers) that surround a central opening called a lumen, through which blood flows. The innermost layer is the tunica intima, composed of endothelial cells that form a slick lining that minimizes friction as blood moves through the lumen. The middle layer is the tunica media. Composed of smooth muscle cells and sheets of elastic tissue, this layer enables the lumen to narrow or widen to regulate blood flow in the body. The tunica adventitia forms a protective outer layer of the blood vessel wall and it also anchors the blood vessel to surrounding structures.

Structure of Arteries

These are wide vessels that generally transport blood from the heart to the limbs and organs. There is one artery to each of the organs of the body. They are muscular, thick walled and elastic and are able to withstand the high pressure caused by the heartbeat. The arteries branch in the organs to form arterioles. The arterioles also branch repeatedly to form a network of blood capillaries, which permeate every living cell of the body.

Structure of Capillaries

These are tiny vessels with very thin walls, which are often one cell thick. Their walls allow water and dissolved substances, except proteins, to pass in and out of them. The capillaries branch within the tissues. Through their thin walls dissolved food and excretory products are exchange with the tissues around them. The capillaries network is so dense that no living cell is far from food and oxygen supplies. The capillaries rejoin to form veins. Through the capillaries network, blood flows from the arterial end to the venous end.

Structure of Veins

Veins carry blood from the tissues to the heart. They are wider and have thinner walls than arteries. They have valves at intervals, which allow blood to flow in one direction from other organs towards the heart.

Structure of Vascular Bundles

Vascular tissues are grouped together in bundles within the plant body. The vascular tissues of plants are made up of a network of long tubes called vascular bundles. They are called veins in the leaves. Vascular bundles consist mainly of xylem and phloem tissues. But in the root and stems of dicotyledons, a layer of cambium cells exist between the xylem and phloem tissue. Hence, vascular bundles are found in the roots, stems and leaves of flowering plants.

Evaluation

1. Write short note on: Arteries, veins and capillaries.
2. List five materials for transportation.
3. Explain surface area to volume ratio.

General Evaluation

1. Which of the following statements about transport system is false? (a) large organism, large surface area (b) small organism ,small surface area (c) small organism large surface area to volume ratio (d) large organism, large surface area to volume ratio (e) small organism, small surface area to volume to volume ratio.
2. Which of the following structures are not associated with the mammalian heart? (a) Auricles and Ventricles (b) Semilunar valve (c) Spleen and cardiac sphincter (d) Arteries and Veins (e) Chordae tendineae.

Essay Test

1. Explain the following vascular bundles: Xylem, Cambium, and Phleom.

Weekend Assignment

Read Transport systems in Nelson Functional Biology chapter 3, pages 19-24, and explain the structure of the blood

Pre-reading Assignment

Read Nelson Biology for SS2 page 91, and differentiate between Diffusion and Circulatory system.

Weekend Activity

Write and explain the meaning of open and close circulatory system under transportation.

Reference texts

Concise Biology for Senior Secondary Schools by B. N. Okoro.

Nelson Functional Biology for Senior Secondary School.

Nelson Biology for Senior Secondary School.

WEEK 5

SUBJECT: BIOLOGY **DATE----------**

TOPIC: TRANSPORT SYSTEM II

CONTENT:(g) Media of transportation (i) Fluid as medium of transportation-structure and function of blood (ii) Cytoplasm in small organisms (iii) Cell sap or latex in most plants (iv) Closed and open circulation (h) Mechanism of transportation: (i) Unicellular organisms (ii) Multicellular organisms)iv)Higher animals (v) Higher plants (i) Absorption of water and mineral salt.

MEDIA OF TRANSPORTATION

In all organisms, a liquid or fluid is the medium of transportation of materials. It includes blood, lymph and tissue fluid in most animals; latex or cell sap in many plants and cytoplasmic fluid in small organisms such as protozoan, protists and coelenterates.

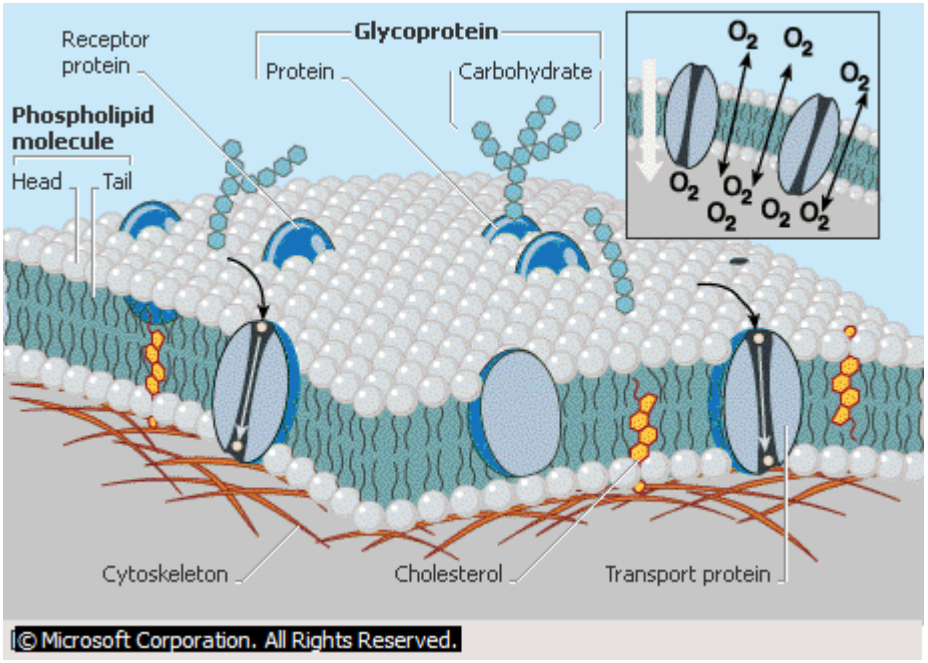
Some of the media of transportation include:

1. Blood and lymph in the vertebrates.
2. Cytoplasm in unicellular organisms.
3. Cell sap or latex in most plants.
4. Body fluid in vertebrates.
5. Closed and open circulations.

STRUCTURE AND FUNCTION OF BLOOD

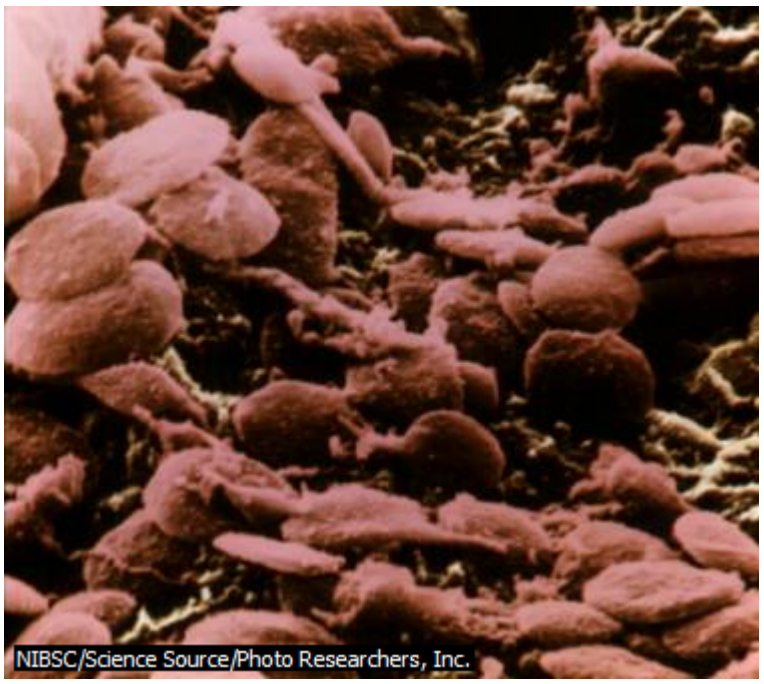
The mammalian blood comprises four main components; the plasma, red corpuscles, white corpuscles and platelets.

1. **Plasma:** The plasma is a pale yellow liquid made of mainly of water (about 90%)**,** with many substances dissolved in it. These include digested food, mineral salts, vitamins, hormones, dissolved oxygen and excretory products such as urea and carbon (iv) oxide. The plasma also contains large molecules, the plasma proteins, such as fibrinogen, which assist in the clothing of blood in damaged tissues.



Plasma Membrane
The plasma membrane that surrounds eukaryotic cells is a dynamic structure composed of two layers of phospholipid molecules interspersed with cholesterol and proteins. Phospholipids are composed of a hydrophilic, or water-loving, head and two tails, which are hydrophobic, or water-hating. The two phospholipid layers face each other in the membrane, with the heads directed outward and the tails pointing inward. The water-attracting heads anchor the membrane to the cytoplasm, the watery fluid inside the cell, and also to the water surrounding the cell. The water-hating tails block large water-soluble molecules from passing through the membrane while permitting fat-soluble molecules, including medications such as tranquilizers and sleeping pills, to freely cross the membrane. Proteins embedded in the plasma membrane carry out a variety of functions, including transport of large water soluble molecules such as sugars and certain amino acids. Glycoproteins, proteins bonded to carbohydrates, serve in part to identify the cell as belonging to a unique organism, enabling the immune system to detect foreign cells, such as invading bacteria, which carry different glycoproteins. Cholesterol molecules in the plasma membrane act as stabilizers that limit the movement of the two slippery phospholipids layers, which slide back and forth in the membrane. Tiny gaps in the membrane enable small molecules such as oxygen (upper right) to diffuse readily into and out of the cell. Since cells constantly use up oxygen, decreasing its concentration within the cell, the higher concentration of oxygen outside the cell causes a net flow of oxygen into the cell. The steady stream of oxygen into the cell enables it to carry out aerobic respiration continually, a process that provides the cell with the energy needed to carry out its functions.

Red corpuscles or erythrocytes: They are tiny, biconcave, disc-like cell without any nucleus in adult mammals. They contain a red pigment-haemoglobin, a protein that contains iron. This enables the red blood corpuscles to readily combine with oxygen in area of high oxygen concentration (i.e., the alveoli of lungs) to form oxyhaemoglobin. This is the form in which oxygen is carried to all body tissues. They also readily give oxygen in places where the oxygen concentration is low (e.g., all the tissues except those near the alveoli). Erythrocytes are synthesised in the red bone marrows of sternum, ribs and vertebrae. There are about $5_{1/2}$ million of them in a cubic centimetre of blood. They live for about 120 days and are destroyed in the liver or spleen.



Thrombocytes and Clotting
Thrombocytes, or platelets, are the smallest cellular component of blood. They circulate inactivated, about 250,000 per cubic mm of blood, until they come into contact with a damaged blood vessel. At this point, the platelets form a clump, adhering to each other and to the blood vessel wall. They secrete chemicals that alter a blood-borne protein, fibrinogen, so that it forms a mesh of fibers at the damage site. A clot forms when platelets and red and white blood cells become trapped in the fibers. Blood clotting begins within seconds of injury. The same process can produce unwelcome clots in undamaged blood vessels.

2. **White corpuscles or leucocytes:** There are many types of white corpuscles all of which have nuclei. They are made in the red bone marrow, the lymph node or the spleen. They live for many months. Those that are irregular in shape, i.e., the phagocytes, are commonest. They are large with lobed nuclei. Like the Amoeba, they have pseudopodia and are able to pass through the walls of the capillaries into the tissue fluid. In the lymphatic system, they ingest bacteria, virus and dead cells, and help in preventing diseases. The ingestion of materials is called phagocytosis and hence such white corpuscles are called phagocytes. Those that produce antibodies are called lymphocytes and are produced in the lymph glands. They produce chemicals called antibodies, which stick to the surface of germs and kill them. White corpuscles are fewer than the red corpuscles. There are about 5000 of them in a cubic millimetre of blood.
3. **Platelets:** These are tiny, irregularly-shaped particles formed in the red bone marrow. They lack nucleus. In damaged tissues, they break down and librate an enzyme, which catalyses the first of a series of reactions, fibrinogen, a blood protein, is converted to threads of fibrin, which form a mesh that plugs the wound. This stops the bleeding.

Erythrocytes
Erythrocytes, or red blood cells, are the primary carriers of oxygen to the cells and tissues of the body. The biconcave shape of the erythrocyte is an adaptation for maximizing the surface area across which oxygen is exchanged for carbon dioxide. Its shape and flexible plasma membrane allow the erythrocyte to penetrate the smallest of capillaries.

EVALUATION

1. List three media of transportation.
2. Describe the four components of the blood.

FUNCTIONS OF THE BLOOD

There are several functions performed by the mammalian blood. These functions are grouped into three viz:

1. **Transport:**
   (i). It carries oxygen from the lungs to the tissues and carbon (iv) oxide from the tissues to the lungs for excretion.
   (ii). It carries digested foods from the gut to the various parts of the body.
   (iii).it carries nitrogenous waste products from the tissues to the kidneys, which get rid of them.
   (iv). It carries hormones and antibodies from one part of the body to another.
2. **Protection:**
   (i). It protects the body from the attacks of germs, which cause diseases, by killing germs.
   (ii). It protect the body from excessive bleeding, by clotting when a body tissue is cut or wounded
3. **Regulation:**
   (i) It helps to regulate the quantity of water in the tissues (osmoregulation).
   (ii) It helps to regulate the quantities of the various chemical materials in the tissue (homoeostasis).

(iii) It helps to keep the body temperature fairly constant by distributing heat evenly around the body.

In small organisms like Amoeba, and paramecium, cytoplasm which is fluid part of the organism is used for transportation of food and other materials in and out of the organisms.

In many plants, the medium of transportation of materials is the latex or cell sap. The cell sap is made up primarily of water, dissolved materials like synthesised foods, growth substances and inorganic salts. The sap is transported to all the parts of a plant through the phloem tissue. Different plants have latex (cell sap) of different colours. For example, the latex of rubber plant cassava (manihot) is white. A few plants have red or colourless latex.

DIFFERENCES BETWEEN OPEN AND CLOSED CIRCULATORY SYSTEMS

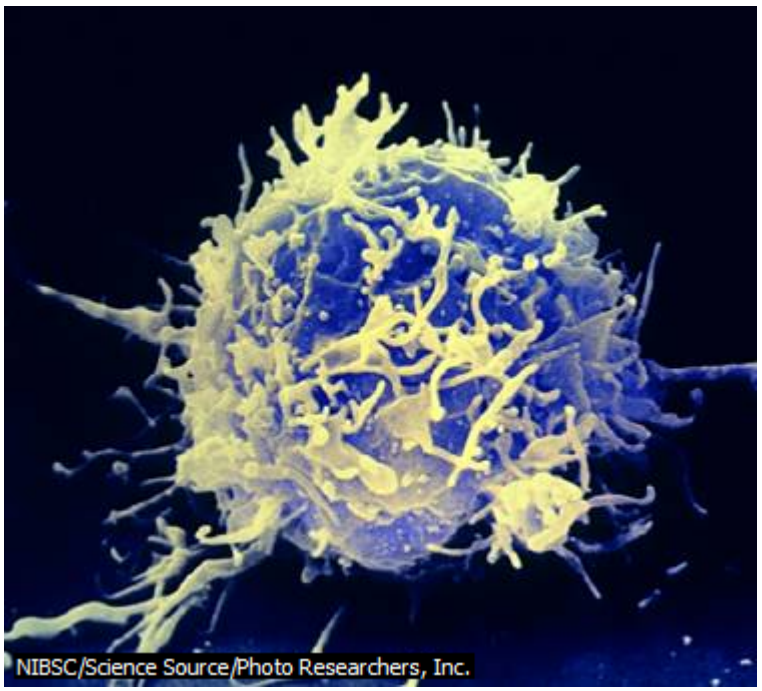
SN	OPEN SYSTEM	CLOSED SYSTEM
1.	It is found in some molluscs, arthropods and lower animals.	Found in annelids, vertebrates and some invertebrates.
2.	No small blood vessels or capillaries connecting arteries with veins.	Minute blood capillaries unite the smaller arteries with the veins.
3.	Blood ends up in blood spaces (haemocoels) within the body.	Blood flows via the arteries, veins and capillaries.
4.	Blood bathes the major organs and tissues directly.	Fluids with nutrients reach the body tissues from the capillaries as tissue fluids and lymph.
5.	Blood returns directly to the heart.	Blood returns to via the veins.

EVALUATION

1. Outline the three functions of the blood.
2. State four differences between open and closed circulatory system.

MACHANISM OF TRANSPORTATION

In many multicellular animals, materials are transported from one part of the body to another in a circulatory system. There are two main circulatory systems in animals, namely open and closed systems. In the open circulatory system, the blood vessels leave the heart but end up in blood spaces called haemocoels within the body. The blood comes in contact with the body cells after which it is sent back to the heart; example is found in arthropods and in some molluscs.



Lymphocyte
Scanning electron micrograph of a normal T lymphocyte. Lymphocytes are specialized white blood cells whose function is to identify and destroy invading organisms such as bacteria and viruses. Some T lymphocytes directly destroy invading organisms, whereas other T lymphocytes regulate the immune system by directing immune responses.

In the closed circulatory system, blood is restricted to branching blood vessels. Through them, blood is pumped to the body by one or more hearts. This is found in the annelids and vertebrates. In unicellular organisms, such as spirogyra, nutrients, gasses and metabolic wastes move in and out of their body by diffusion. In a few other unicellular organisms, such as paramecium, food substances in food vacuoles are carried along a specific route by a process called cyclosis.

In vascular plants (pteridophytes, gymnosperms and angiosperms), there is a circulatory system in which materials are carried to and from all body parts. The circulatory system consists of vascular tissues, which is a system of narrow tubes. Plants that have vascular tissues are called vascular plants. The vascular tissue consists of compact strands called vascular bundles. Each bundle consists of the xylem near the stem centre and the phloem towards the outer surface of the stem. The cambium is usually found in between the xylem and the phloem in the dicotyledonous roots and stems, and monocotyledonous plants do not have cambium. Plants also make use other mechanisms of transportation such as root pressure, transpiration stream, and protoplasmic streaming which occur in both plants and animals.

MECHANISM OF TRANSPORTATION IN HIGHER ANIMALS

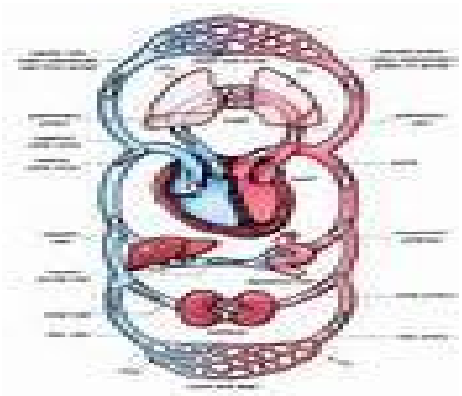
As a result of the repeated contractions of the heart, the blood circulatory system (i.e., arteries, capillaries and veins) throughout life. All mammals have double circulation. These are the systemic (body) circulation and pulmonary circulation.

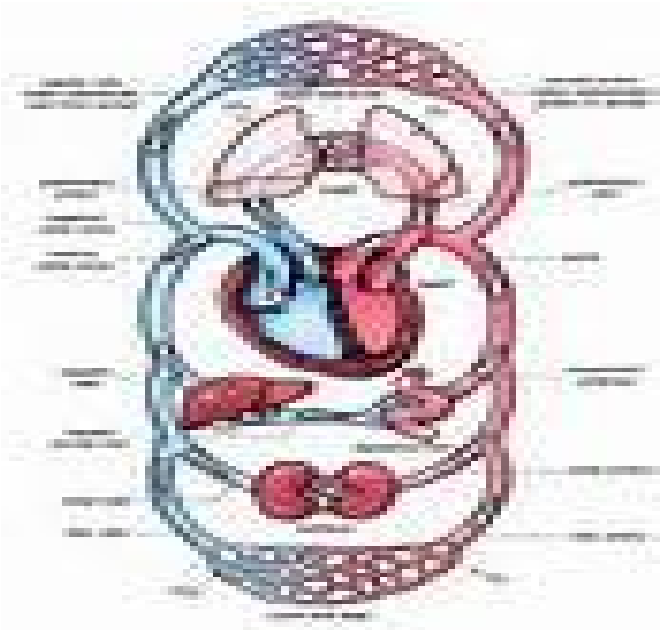
1. Systemic (body) circulation in which blood is carried from the left ventricle to all body parts except the lungs and back to the right auricle.

2. Pulmonary circulation in which blood is carried from the right ventricle to the lungs through the pulmonary veins.

The heart like other organs has a blood supply. The coronary arteries, which branch from the aorta near the heart, carry blood to the heart muscles. The flow of blood through these muscles is called coronary circulation.

The heart continues to beat repeatedly throughout the life and pump blood to the two main circulations and the coronary circulation. When the body is at rest, normal heart beats about 70 to 72 times per minute. The rate of the heart beat increases when one is very active or excited. The liver is the only organ in the body that receives blood by the hepatic artery and hepatic portal vein. The hepatic portal vein carries blood rich in digested food from the stomach and small intestines into the liver. The hepatic portal vein carries blood from the liver into the inferior vena cava.





ABSORPTION WATER IN MINERAL SALT IN HIGHER PLANTS

Plants need sufficient quantities of many materials, which are transported in them. These include water, mineral salts and manufactured foods. In aquatic, unicellular and simple multicellular plants, gases enter and leave their cells by diffusion. Water enters the cells of these plants by osmosis, whereas manufactured foods and wastes are transported by diffusion. In flowering plants, the gases are absorbed mainly through stomata in the leaves and lenticels in the stems, whereas mineral salts are absorbed through the roots system.

Inside the plants, gases move by diffusion. They are always dissolved in water of the moist cell walls before entering the cells. Water, mineral salts and soluble foods are transported in vascular tissues.

EVALUATION

1. Discuss circulatory system in vascular plants.

2. All mammals have double circulation, Explain.
3. Write a short note on circulation in higher plants.

GENERAL EVALUATION

1. In the open circulatory system, the blood vessels leave the heart but end up in blood spaces called.(a) open space (b) haemocool (c) haemocoels (d) space (e) heamocoel.
2. All the following statement about the mammalian blood is correct except. (it protects the body from germs (b) it synthesises bile and hormones (c) it carries dissolved nutrients and waste products to specific parts of the body (e) it helps to keep the amount of water in the body fairly constant.
3. The components of the blood include all these except (a) erythrocytes (b) leucocytes (c) plasma (d) fibrinogen (e) platelets.

ESSAY TEST

1a. Describe the major components of the mammalian blood.
b. Make a well labelled diagram of the mammalian heart.
2 Describe the mammalian heart without diagram.

Weekend Assignment

1. Read Nelson Functional Biology by Kola Soyibo, SS2 pages 25-32; and answer all the revision question in pages 33 and 34.

Pre-reading Assignment

1. Read pages 91 and 92 of Nelson Biology SS2, and outline the functions of the phagocytes.

Weekend Activity

Using a table, differentiate between arteries, veins and capillaries.

Reference Texts

Nelson Functional Biology for Senior Secondary Schools, by Kola Soyibo et-al.

Nelson Biology for Senior Secondary Schools, by Kola Soyibo et-al.

WEEK 6

SUBJECT: BIOLOGY **DATE----------**

TOPIC: RESPIRATORY SYSTEM I

CONTENT: (a) Types of respiratory systems: (i) Body surface respiration (ii) Coetaneous respiration (iii) Gills (iv) Trachea system (v) Lungs.

TYPES OF RESPIRATORY SYSTEMS

Note: that respiration is one of the characteristics of living things we discussed in our basics classes, in this process, oxygen is taken in while carbon iv oxide is given out. The two basic types of respiration are; aerobic and anaerobic respiration.

Respiratory system refers to all the parts or organs and cells responsible for respiration process that take place in the organism. Respiration is simply a biochemical process in which energy is liberated from food substances (mainly simple sugars) in the mitochondria of living cells with the aid of enzymes in the absence or presence of oxygen.

The production of water, carbon iv oxide, alcohol or other organic substances is just incidental to the basic process. Respiration is achieved through the mouth, nose, trachea, lungs and diaphragm. The system functions to obtain oxygen for use by the body and to eliminate the carbon iv oxide. It works in conjunction with the circulatory system.

In mammals, the structures associated with respiration include the following organs:

i. Body surface.
ii. Gills.
iii. Trachea.
iv. Lungs.

In plants, the stomata are the main respiratory structures for gas exchange by diffusion. Gas exchange in animals depends on their respiratory medium (whether it is air or water) and the nature of their respiratory surfaces. For aquatic animals, the respiratory medium is water, as for terrestrial animals, the medium is air. Amphibians and some fishes use both air and water as their media of exchange.

The exchange of gases with the respiratory medium by animals is called breathing. The respiratory surface provides a boundary between the body and respiratory medium. The cells in this surface are epithelial in nature (have thin wall) and have large surface area. This enhances diffusion.

BODY SURFACE RESPIRATION

This is the simplest type of respiration found mainly in unicellular organisms and some multicellular organisms such as Annelids (earthworms), platyhelmithes (flatworms), sponges, toads and frogs. Respiration occurs by diffusion. In unicellular organisms, exchange of gases takes place at the respiratory surfaces. Gases are dissolved in water before they are

diffused across the cell membrane. Organisms that respire through their body surface possess moist skin. As for breathing, it is a visible, mechanical, muscular action, which enables an animal to quicken the rate of gas exchange between itself and its environment.

GILLS

The gill is found in large aquatic organisms such as tadpole, aquatic snails and fishes. Gills are highly branched and vascularised, i.e., they are richly supplied with blood capillaries. Gills may be external or enclosed. External gills may be sea slugs and amphibian larvae, whereas in enclosed gills are found in water snails and crustaceans.

TRACHEAL SYSTEM

TRACHEAL SYSTEM is common in insects and many other arthropods. It ends up in tiny holes in the cuticle called spiracles. The spiracles open and close by muscular action. The tracheae branch repeatedly into fine branches called tracheoles, which are equivalent to the air sacs in the lungs. The tracheoles contain fluid in which oxygen dissolves before actually getting to the individual cells of the body.

LUNGS

In developed organisms (animals), lungs is the main respiratory organ e.g., in terrestrial vertebrates like mammals. Lungs are closely linked with the circulatory system. Lungs are found in amphibians, birds, and mammals. The mammalian respiratory system consists of the nostrils, pharynx, larynx, lungs and diaphragm.

CHARACTERISTICS OF RESPIRATORY SURFACE

The following characteristics have been identified in exchange of gases in respiratory surfaces:

1. Epithelia in nature
2. Have very thin walls which shorten the diffusion distance and increase diffusion rate.
3. Mostly moist because gases diffuse in solution through them.
4. Possess delicate cells.
5. Have a large surface area to volume ratio, which ensures exchange of large quantities of gases.

EVALUATION

1. Explain the mechanism of the gills and tracheal system.
2. Define respiration
3. What is respiratory system?
4. List five organs responsible for respiration in higher organisms.

GENERAL EVALUATION

1. One of these is not a type of respiration (a) body fluid (b) body surface (c) gills (d) lung (e) tracheal system.
2. Closed gill system is used by only one of these organisms (a) rabbit (b) goat (c) tree (d) mollusc (e) spider.

3. All these are organs of respiration except (a) mouth (b) nostrils (c) pharynx (d) larynx (e) lungs.

ESSAY TEST

1. With the aid of an annotated diagram, discuss gaseous exchange in plants.

WEEKEND ASSIGNMENT

1. Read Nelson Biology for SS2, pages 108-113, and write the gas exchange organs of the organisms below: amoeba, hydra, earthworm, insects, fish (tilapia), tadpoles, and flowering plants.
2. Sketch the respiratory system of man.

PRE-READING ASSIGNMENT

Read Nelson Biology for SS2, and write the three types of breathing mechanisms in toad.

WEEKEND ACTIVITY

Sketch the structures of the alveoli and its blood supply.

REFERENCE TEXTS

Nelson Functional Biology for Senior Secondary Schools, by Kola Soyibo.

Nelson Biology for Senior Secondary Schools, by Kola Soyibo.

WEEK 7

SUBJECT: BIOLOGY **DATE----------**

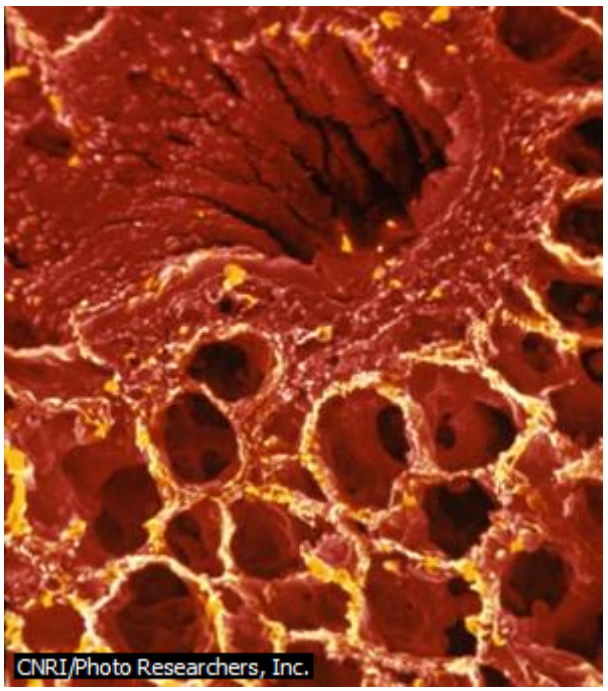
TOPIC: RESPIRATORY SYSTEM II

CONTENT: (b) Mechanisms of respiratory system: (i) Higher animals (ii) Lower animals (iii) plants (c) Mechanisms of gaseous exchange through the stomata of plants.

MECHANISMS OF RESPIRATORY SYSTEM

In plants and animals, respiration is through basic gas exchange facilitated by organs such as stomata, gills, lungs, and skin.

However, in lower animals diffusion occurs through the membranes. In higher animals the internal organs are kept away from the environment. In vertebrate animals, exchange of gases takes place by inhalation and exhalation. This is referred to the breathing in and breathing out.

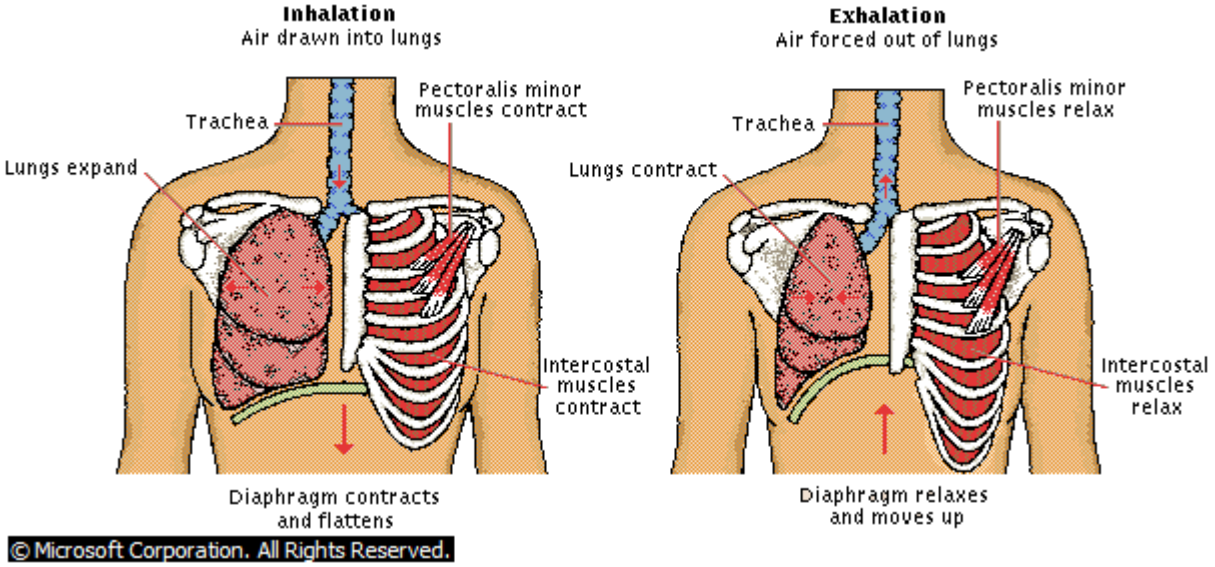


Alveoli
A scanning electron micrograph reveals the tiny sacs known as alveoli within a section of human lung tissue. Human beings have a thin layer of about 700 million alveoli within their lungs. This layer is crucial in the process called respiration, exchanging oxygen and carbon dioxide with the surrounding blood capillaries.

RESPIRATION IN HIGHER ANIMALS

This type of respiration takes place through the lungs. All mammals have a [air of lungs. lungs adaptations that allow animals to invade the terrestrial environment. Some fishes, and amphibians, reptiles, birds, and mammals, all have their lungs located internally. Mammals breathing system comprises the air passages (nostrils, pharynx, larynx, and trachea), lungs and diaphragm. Oxygen enters the nasal passage through the nostrils into the nasal cavity where it is moistened and kept warm. The nasal cavity has lining cells, which secretes mucus that traps most of the dust and microorganisms present in the air before it diffuses into the lungs.

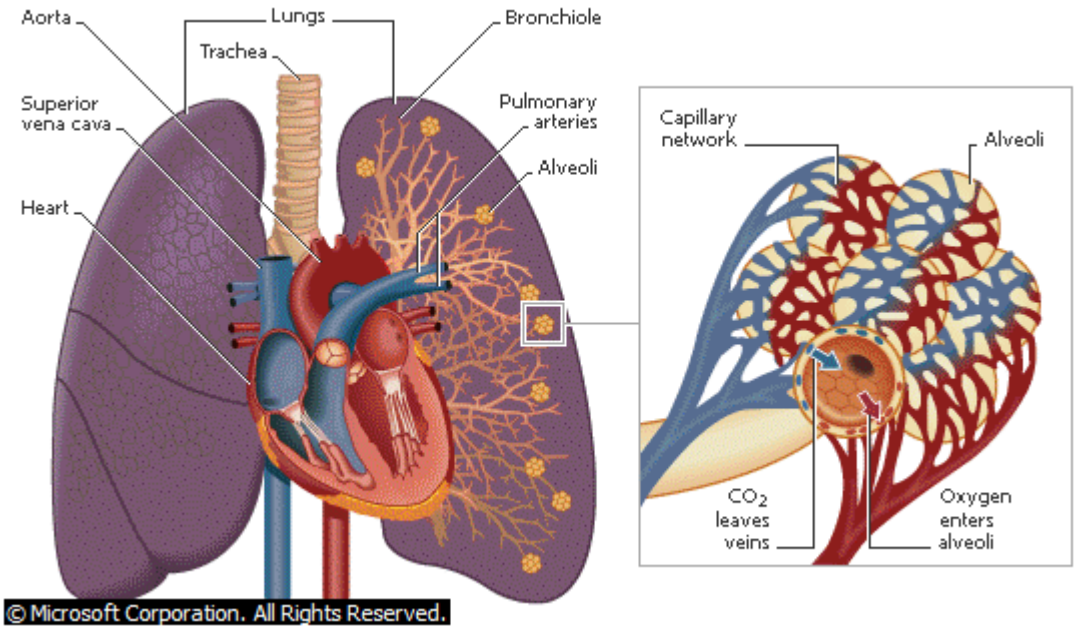
Nasal cavity leads into the pharynx, the to the trachea (wind pipe), which divides into two bronchi before it enters into the lungs; the cartilages supports the wall of the trachea and bronchus to prevent them from collapsing when the air pressure in them is reduced. Within each lung, the bronchus divides repeatedly and becomes progressively narrower forming numerous tiny tubules called bronchioles, which end in pockets of the air sacs called alveoli. Alveoli are surrounded by a dense network of capillaries, which enhances gas exchange.



Breathing in Humans

As the diaphragm contracts and moves downward, the pectoralis minor and intercostal muscles pull the rib cage outward. The chest cavity expands, and air rushes into the lungs through the trachea to fill the resulting vacuum. When the diaphragm relaxes to its normal, upwardly curving position, the lungs contract, and air is forced out.

The alveoli give the lungs a very large surface area for gas exchange. The lungs are located in the thorax or thoracic cavity, which comprises the breast bone or sternum in front, and the back bone (vertebrae) at the back. At the sides are twelve (12) pairs of ribs and intercostals muscles, which are attached to the spine and the sternum, thereby, forming a bony cage. The diaphragm is a sheet of muscle at the floor of the thorax.



Human Lungs

In humans the lungs occupy a large portion of the chest cavity from the collarbone down to the diaphragm. The right lung is divided into three sections, or lobes. The left lung, with a cleft to accommodate the heart, has only two lobes. The two branches of the trachea, called bronchi, subdivide within the lobes into smaller and smaller air vessels known as bronchioles. Bronchioles terminate in alveoli, tiny air sacs surrounded by capillaries. When the alveoli inflate with inhaled air, oxygen diffuses into the

blood in the capillaries to be pumped by the heart to the tissues of the body. At the same time carbon dioxide diffuses out of the blood into the lungs, where it is exhaled.

MECHANISM OF BREATHING IN MAMMALS

INHALATION:

a. The intercostals muscles contract, while the ribs move upward and outwards.
b. The diaphragm contracts and flattens out.
c. The thoracic cavity volume increases, while its air pressure decreases.
d. Air is then forced from outside into the lungs through the air passage.

EEXHALATION:

a. The intercostals muscles relax, while the ribs cage is lowered.
b. The diaphragm relaxes and returns to its original dome-shaped position.
c. The thoracic cavity volume decreases, while the lungs shrink.
d. The lung air pressure increases, and a lot of air is expelled from the lungs through the air passage.

EVALUATION

1. What is the meaning of respiration?
2. Mention five organs of respiration.
3. Explain the mechanism of breathing in higher animals.
4. Describe the respiratory system of mammals.

RESPIRATION IN LOWER ANIMALS

INSECT: The mechanism of breathing in insects is as follows:

1. An insect breathes through a trachea system. An insect has an impermeable cuticle but, at intervals along the sides of its body, are about ten tiny openings called spiracles, through which air enters and leaves the trachea.
2. These lead into air-filled tubes called tracheae which end in very hair-like, tiny structures in tissues called tracheoles. Hence, no body cell is far from a tracheole which contains certain fluids.
3. As the body wall of an insect contracts and expands, oxygen in the air diffuses through the spiracle into the trachea and tracheole. It then diffuses into the body cells where it is used for aerobic respiration.
4. Carbon (iv) oxide and water (water vapour) produced, diffuse out of the body through the spiracles.
5. The spiracles have valves and they are opened only when the carbon (iv) oxide concentration in the tissues is above a specific level.
6. The spiracles are closed for most of the time when an insect is inactive to reduce water loss.

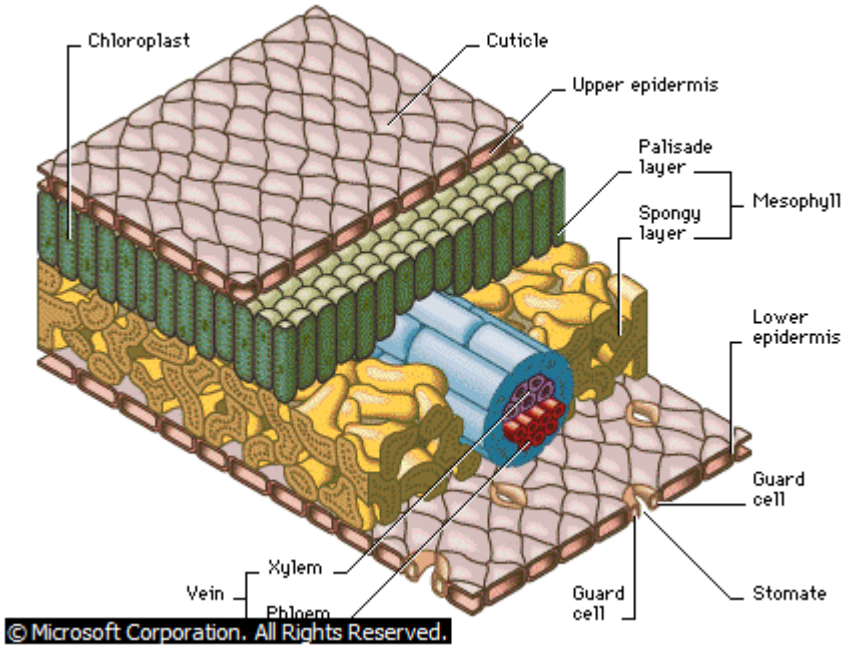
MECHANISM OF BREATHING IN FISH

1. Gaseous exchange or breathing in fishes occurs across the gill surfaces. All the gills possess a very high surface area-to-volume ratio.
2. The fish opens its mouth, and water passes over the gill surface inside the opercula which are then closed.

3. As water flows over the gills, the dissolved oxygen in the water diffuses into the thin walled blood capillaries of the gills. At the same time, carbon (iv) oxide in the blood diffuses into the water.
4. The alternate opening and closing of the mouth and operculum allow a constant flow of water over the gills.
5. Oxygen is transported by the blood into every living cell where it is used for aerobic respiration. Hence, the gills are used for gas exchange (breathing) and not just for respiration.

GASEOUS EXCHANGE IN PLANTS

As you learnt earlier, plants do not breathe like mammals, but like animals, they exchange gases because they do not have thorax and lungs like mammals, we cannot see their breathing movements which are the visible signs of gas exchange. Completely submerged aquatic plants (e.g. algae) or those floating on water surface (e.g. lettuce) exchange gases by diffusion all over their body surface or through the stomata in their leaves, lenticels in their stem, and through the roots (i.e.from the air spaces in the soil particles around the roots).



Anatomy of a Leaf
The leaf provides food for the rest of the plant through the process of photosynthesis. The outermost layer of the leaf is the epidermis, which is protected by the waxy coating of the cuticle. Guard cells implanted in the epidermis form pores, known as stomata, through which water, oxygen, and carbon dioxide pass. Embedded in the inner tissues of the leaf are chloroplasts, where photosynthesis occurs. The plant veins consist of two specialized tissues. Xylem conducts water from the plant to the leaf, while phloem carries food from the leaf to the plant.

They also occur in the stems of young herbaceous plants. A stoma (stomata-plural) is a tiny pore or opening enclosed by two bean-shaped guard cells. Unlike other epidermal cells, guard cells have chloroplasts. Each guard cell has a thick, relatively inelastic wall around the pore and a thin, elastic outer wall. The mechanism of the opening and closing of stomata is believed to be associated with light intensity and the osmotic pressure within the guard cells. When the osmotic pressure in the guard cells is high, they become turgid as a result of which the pore or stoma opens. When the pressure is low, the guard cells become flaccid and the stoma is closed. In general, the movement of

gases and water vapour into and out of leaves is controlled by the opening and closing of the stomata.

EFFECT OF LIGHT ON GAS EXCHANGE IN TE LEAF

Respiration occurs at all times in living things. During sunlight, the rate of photosynthesis is usually greater than that of respiration in green plants. Oxygen given out during photosynthesis in the day is captured by animals and man for respiration. Also, the carbon (iv) oxide produced by respiring cells is used in photosynthesis, while a lot of carbon (iv) oxide diffuses into the leaf mesophyll cells from outside. The diffusion from the inside of the leaf to the outside is short. Hence, gaseous molecules diffuse rapidly in and out of the leaf through the stomata.

However, at night, photosynthesis stops just as the sun stops shining, but respiration continues because animals must live. Then, some oxygen diffuses into the leaf from outside through the stomata and lenticels. The oxygen is used up in the respiring cells, while the carbon (iv) oxide diffuses out of the leaf and lenticels.

It is worthy to note that the vein of leaves contain vascular tissue. Water and mineral salts and some dissolved gases are distributed to the leaf parts through the xylem. Also, the manufactured food in the leaves is conducted through the phloem in the veins to all parts of the leaves and other plant parts.

EVALUATION

1. Write the mechanism of breathing in following animal: insect, and fish.
2. Explain how the stomata in green plants work in the day and night.

GENERAL EVALUATION

1. The cells responsible for the control of the opening and closing of the stomata are; (a) somata cells (b) vascular cells (c) guard cells (d) chloroplast (e) cambium cells.
2. The muscles that control the ribs especially during respiration (a) nuclear muscles (b) coastal muscles (c) rib muscles (d) intercostals muscles (e) diaphragm.
3. The organ of respiration in insects is called (a) spiracles (b) antenna (c) trachea (d) tracheole (e) anus.

ESSAY TEST

1. Write the mechanism of buccal breathing in toad. Use page 110 in Nelson Biology for SS2.

WEEKEND ASSIGNMENT

1. What you do you understand by the following terms:
   - i- Respiration.
   - ii- Respiratory system.
   - iii- Breathing.
   - iv- Gas exchange.
   - v- List four characteristics of a gas exchange organ.

PRE-READING ASSIGNMENT

Read Nelson Functional Biology for Senior Secondary Schools, by Kola Soyibo, pages 43, and sketch the respiratory system of insect.

WEEKEND ACTIVITY

1. List six animals of your choice and their respiratory organs.

REFERENCE TEXTS

Nelson Functional Biology for Senior Secondary Schools, by Kola Soyibo.

Nelson Biology for Senior Secondary Schools, by Kola Soyibo.

WEEK 8

SUBJECT: BIOLOGY **DATE----------**

TOPIC: EXCRETORY SYSTEM I

CONTENT: (a) Excretory systems (i) Contractile vacuole (ii) Flame cells (iii) Malpighian tubules (iv) Kidney (v) Stomata and Lenticels.

EXCRETORY SYSTEMS

Definition: Excretory systems refer to all the cells and organs of any living organism which enables it to eliminate harmful substances away from the body.

Excretion is therefore the removal of toxic wastes of metabolism from the body of living organisms.

NEEDS FOR EXCRETION

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

1. Waste products when not removed can interfere with normal metabolic activities of the body.
2. Excretion helps to maintain salt and water balance i.e. homeostasis in the body.
3. Some products are poisonous and must never be allowed to accumulate within the body.
4. The excretory products are harmful to the body and so must be removed.
5. All animals are heterotrophic and may eat some materials as food which is not needed by their bodies. These substances and unwanted products of the chemical activities of the body is excretion.
6. Proteins are used for growth and repair but any excess cannot be stored. The initial waste products of the biochemical processes involving protein is ammonia gas. This compound is very poisonous and must be excreted quickly.

CONTRACTILE VACUOLES

Contractile vacuole is an organelle or a device found in Amoeba and other unicellular organisms or protozoans. It is a simple device, a small sac lined with a membrane lying freely in the cytoplasm. The cell membrane surrounding the amoeba is a semi permeable to water and because the osmotic pressure inside the animal is greater than outside the animal, water enters the cell by osmosis. To counter this, water is secreted into the contractile vacuole as fast as it enters the body. As this happens, the contractile vacuole expands and bursts, thus discharging its contents to the exterior through a small pore in the cell membrane after which the whole process is repeated. The energy required by the contractile vacuole is produced by the mitochondria found near the vacuole. The contents of the contractile vacuole are; water, carbon (iv) oxide and nitrogenous wastes.

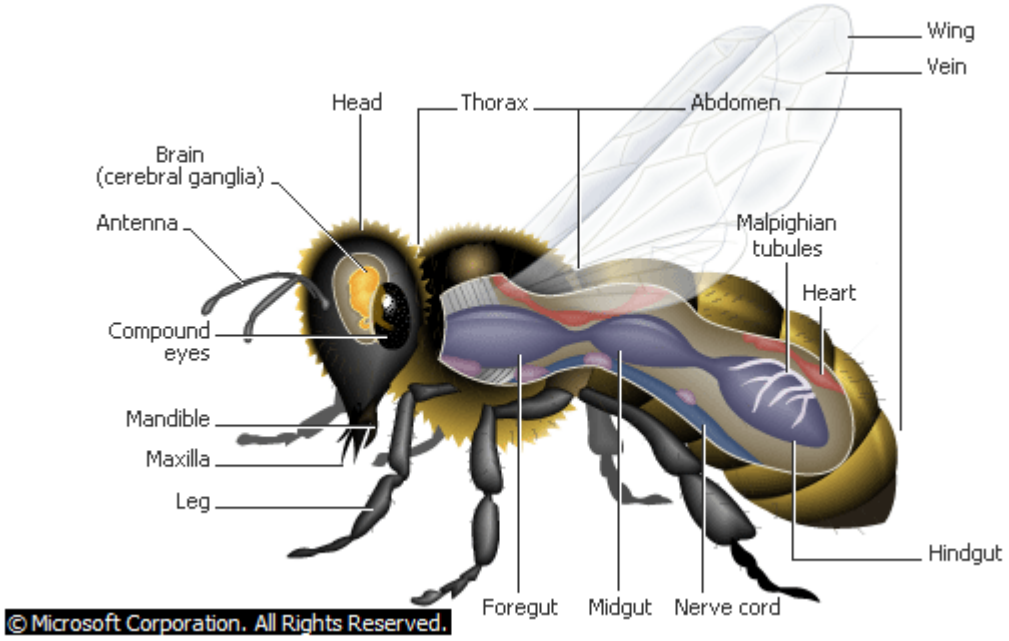
Paramecium
The paramecium is a single-celled organism that propels itself by minute, hairlike projections called cilia. Cilia also create currents that sweep food particles toward the paramecium's gullet for ingestion. The paramecium gets rid of excess water with the help of a contractile vacuole, which pumps water out of the cell.

FLAME CELLS IN FLATWORM

These are two longitudinal excretory canals, which open onto the dorsal surface of the flat worm by a number of minute pores. The main canals give off numerous branches, which ramify among the parenchyma cells. The final branches end in flame cells. These are cells, which have intracellular cavities and ducts, with numerous cytoplasmic branches penetrating between the parenchyma cells. Projecting into the cavity of the cell is a bundle of long cilia which arise from basal granules in the cytoplasm. These cilia are characterised by their flickering movement which give use to the name **'flame cells'.**

MAGPIGHIAN TUBULES IN INSECTS

Generally, insects are very successful group of animals because of their ability to conserve water, wings to fly, metamorphosis, and small body structure. On the other hand, they have an extremely efficient excretory system. The malpighian tubules are the excretory organs. They are found between the midgut and the rectum. One end of each tubule opens into the gut, while the other free end floats in the haemoloel of insects. They are long and extremely slender and penetrate among the visera over. The greater part of the horux and abdomen. In the cockroach for example, they are in six groups with about twelve tubules in each group.



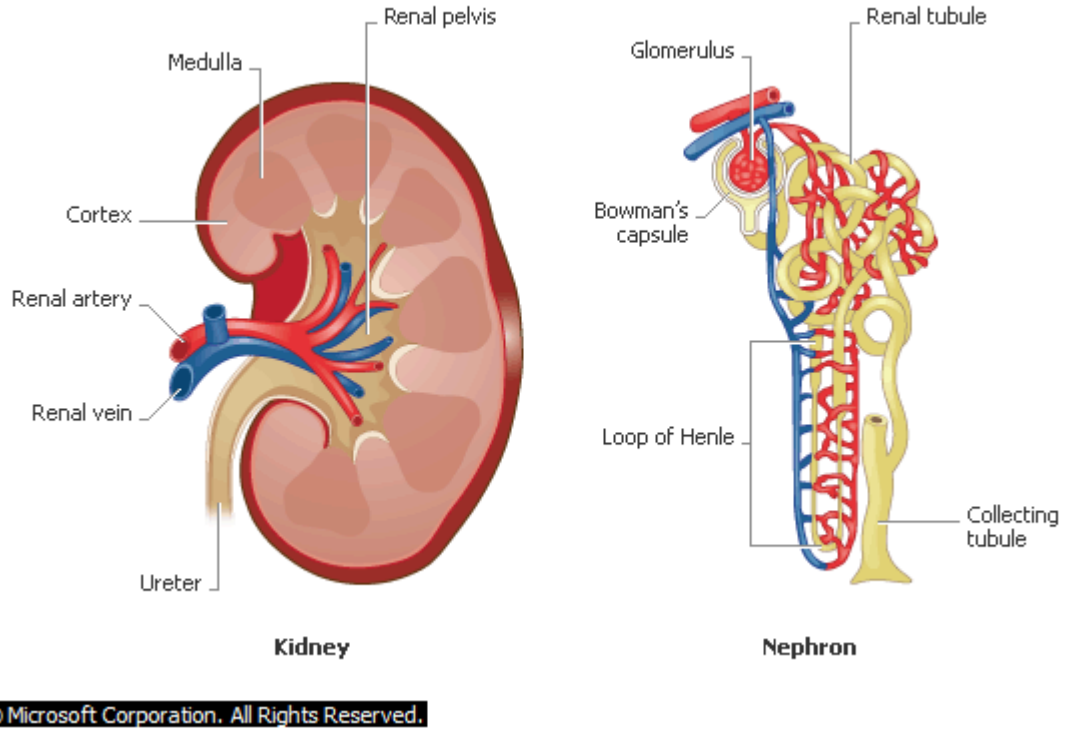
Generalized Anatomy of an Insect
All adult insects have three main body parts—the head, which holds an insect's primary sense organs; the thorax, which is the attachment site for the legs and wings; and the abdomen, which contains the organs for digestion and reproduction. All of the insect's soft inner body parts are protected by an external skeleton, or exoskeleton, made of semirigid plates and tubes.

EVALUATION

1. Write down the excretory products of insects, and paramecium.
2. Explain the excretory mechanism in Amoeba.

KIDNEYS IN INVERTEBRATES

All vertebrates have a pair of kidneys, which form a part of the excretory system. In mammals, the kidneys are bean-shaped, dark red in colour and surrounded by fat. The right kidney is slightly lower in the body than the left. If a kidney is cut longitudinally into two, it will be seen to consist of two main regions: an outer dark coloured cortex and an inner lighter coloured medulla. When viewed under a microscope, a kidney consists of blood vessels, kidney tubules or nephrons and connective tissues. Each nephron begins in the cortex as a tiny cup-shaped structure known as Bowman's capsule, which surrounds capillaries called the glomerulus. The Bowman's capsule leads into a coiled tube called the proximal tubule. This goes down to form a U-shaped structure, the Henle's loop. Finally, it coils again to form the distal tubul, which twists and empties into a collecting duct. Renal artery, which branches from the products and oxygenated blood to the kidney so that nitrogenous wastes products (urea) can be removed.



Kidney
Approximately one million nephrons (right) compose each bean-shaped kidney (left). The filtration unit of the nephron, called the glomerulus, regulates the concentration within the body of important substances such as potassium, calcium, and hydrogen, and removes substances not produced by the body such as drugs and food additives. The filtrate, urine, leaves the nephron through the long renal tubule. Chemical signals triggered by the body's need for water and salt cause the walls of the tubule to become more or less permeable to these substances, which are reabsorbed accordingly from the urine.

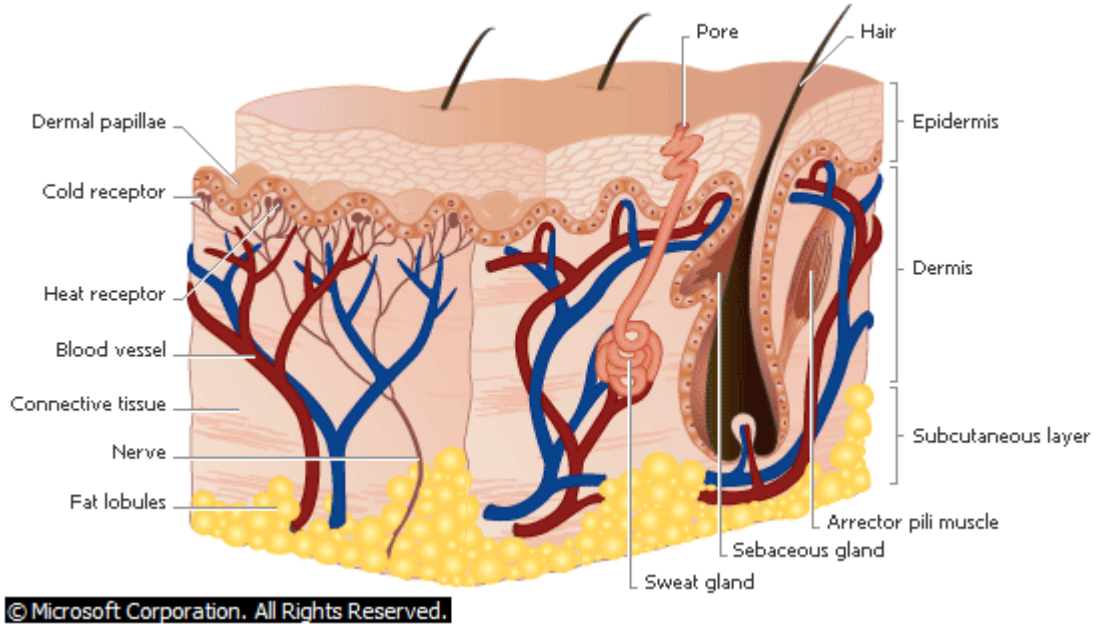
The blood that leaves the kidney is deoxygenated and is carried away by renal vein to the inferior (posterior) vena cava. The urine formed passes from each kidney into a ureter. The left and right ureters lead to a muscular sac called the bladder in which urine is stored temporarily. The bladder opens to a short tube, urethra, which leads to the exterior.

OTHER EXCRETORY ORGANS IN MAMMALS

1. The skin excretes water, salts and urea. Skin excretes wastes by means of sweat glands, which consists of coiled tubes, opening exteriorly as pores. Sweat is composed of 95% water and 3% dissolved salts (e.g. sodium chloride).
2. Lungs excrete carbon (iv) oxide and water. Carbon (iv) oxide can be harmful if it accumulates too much as it forms carbonic acid is capable of upsetting the delicate acid base balance of the body fluids.

EVALUATION

1. Sketch an annotated diagram of the Kidney in mammals.
2. Write short note on the excretory mechanism of the mammals



Structure of the Skin
Humans and other vertebrates are covered with a multilayered tissue called skin. The skin consists of an outer, protective layer (epidermis) and an inner, living layer (dermis). The top layer of the epidermis is composed of dead cells containing keratin, the horny scleroprotein that also makes up hair and nails.

STOMATA AND LENTICELS

In general, plants are much less active than animals and produce waste products at a much slower rate. Hence, they have no need for specialised excretory organs. The main excretory products, which are water, oxygen and carbon (iv) oxide, are got rid of by diffusion through the stomata and lenticels.

EXCRETION IN STOMATA: Stomata are pores in the epidermis bounded by specialised epidermal cells known as guard cells. In conjunction with the guard cells, other adjacent and distinctive epidermal cells may exist in opening and closing of the pore. These are known as accessory cells. Stomata are usually found at the aerial parts of the stems and leaves and flower parts. Underground rhizomes and some aquatic plants may possess them. They may be irregularly scattered or arranged in parallel rows. The guard cells are bean shaped and fit together with the pore between them. The size of the pore ulters according to how turgid the guard cells are. This in turns depends on the osmotic pressure within the guard cells. When the pressure is low, the guard cells are flabby and the stoma is closed. When it is high, the guard cells are turgid and the stoma opens.

EXCRETION IN LENTICELS

They are structurally differentiated parts of the periderm, which stand out because of the very loose cell arrangement and lack of suberisation. They vary greatly in size according to species but can be seen as protrusions of loose substance through cracks in the periderm. In a stem undergoing secondary thickening, the first lenticels usually arise beneath the stoma in the epidermis. The cells below the stomata lose their chlorophyll and divide repeatedly to form a losse mass. Gradually, the region of division penetrates deeper into the cortex, and the place of the division of the cells becomes regularly parallel to the surface so that a lenticels phellongen is formed. This procceds to cut off more and more loose cells towards the exterior and eventually the epidermis is ruptured.

Prominent plants excretory products are water, carbon (iv) oxide and oxygen. They are excreted through the stomata and lenticels. Green plants like tomato and potato have glands that secretes water, a process called guttation. This is seen at the apex and margin. Other waste products produced by plants are tannins, poisonous nitrogenous alkaloids and anthocyanins, which give colour to the petals of many flowers. In order not to interfere with plants activities, these waste products are converted to harmless insoluble compounds and stored within the plant body, e.g., some plant cells contain calcium oxide, glucose and alkaloid compounds.

EVALUATION

1. Explain the mechanisms of waste removal through the stomata and lenticels.
2. What is guttation?

GENERAL EVALUATION

1. The excretory organs in flatworms are called (a) nephridia (b) malpighian tubule (c) flame cells (d) kidney (e) lenticels.
2. Which of the following substances is contained in the renal artery? (a) Less water (b) Less urea (c) more glucose (d) more carbon (iv) oxide (e) oxygen.
3. Which of the following groups of animals has the greatest ability to conserve water? (a) insects (b) flatworms (c) earthworms (d) unicellular organisms (e) water lettuce.

ESSAY TEST

1. Sketch a well labelled diagram of the nephron.
   2a. Define excretion.
   b. why is excretion important in living organisms.
   3. Sketch a well labelled diagram of malpighian tubule of an insects.

WEEKEND ASSIGNMENT

Study STAN Biology forSS2 page 78, and write the excretory organs of the organisms there as it is on the table.

PRE-READING ASSIGNMENT

Read Nelson Functional Biology for SS2, pages 54 -55 and list three steps in urine formation in the kidney.

WEEKEND ACTIVITY

With your hand glove on your hands, dissect a grasshopper to see the trachea.

REFERENCE TEXTS

Nelson Functional Biology for SSS2, by Kola Soyibo.

STAN Biology for SSS2.

WEEK 9

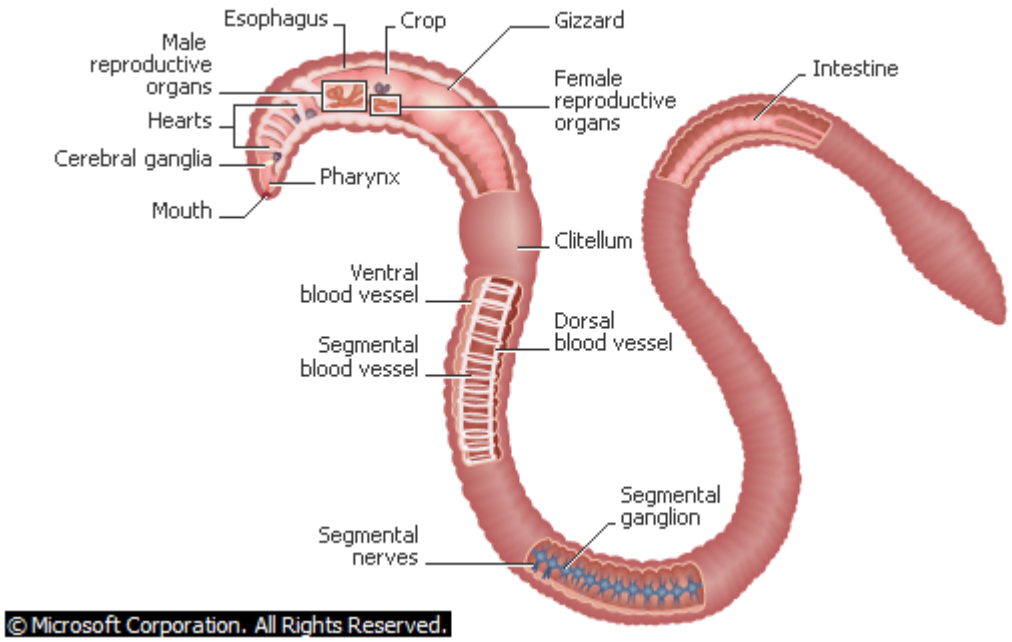
SUBJECT: BIOLOGY **DATE----------**

TOPIC: EXCRETORY SYSTEM II

CONTENT: (b) Excretory mechanism in: (i) Earthworm (ii) insects (iii) Mammals.

Nephridia is the excretory organ of earthworm. Each segment of the nephridia contains a pair of tubes. Each nephridium is a long coiled tube derived by the growth of ectoderm, and opens into the coelomic fluid of the segment anterior to the nephridodiophore. The first part is called the nepridiospore, and it has a minute flattered funnel with the upper lip large than the lower lip. The upper lip is formed mainly of a large central cell which is thickly ciliated on the inner surface of the funnel. The lower lip on the other hand consists of a thickened cluster of small cells which are not ciliated. All the cilia beat into the lumen of the tube. The nephrostome leads into an intrcellular ducts which bears two rows of lateral cilia. Beyond the septum, the tube is narrower and ciliated. It goes into several loops and then becomes the wider brown, ciliated tube which terminates at the mphridiophore. The opening of this pore is regulated by a sphincter. The nephridia of the earthworm are generally supplied with many fine capillaries which ramify among the coils.

EXCRETORY MECHANISM IN EARTHWORM



Generalized Anatomy of an Earthworm
The earthworm shows the well-developed segmentation that is characteristic of all animals in the phylum Annelida. Although the major nervous, circulatory, and digestive organs are located near the head, more posterior segments contain peripheral structures for all of these systems. These posterior segments are virtually identical to each other. Earthworms are hermaphroditic, possessing both male and female internal reproductive organs.

EXCRETORY SYSTEM IN INSECTS

Tissues in insects produce nitrogenous waste in the form of soluble potassium urate, which is librated into the blood and taken up by the cells lining the malpighian tubules. The tubules are muscular and their writhing movements facilitate the absorption of urate by stirring up the blood. In the cells of the tubule, the potassium urate reacts with water and carbon (iv) oxide (from respiration) to form potassium trioxocarbonate (iv) and uric acid. The former is reabsorbed into the blood to such an extent that the proximal end of the malpighian tubule becomes filled with solid crystals of uric acid. Water is further reabsorbed by the folded walls of the rectal glands so that by the time urine leaves the body, it is very much more concentrated than the blood.

The remarkable ability of insects to conserve water has contributed towards their success as a group. This is largely due to the action of their malpighian tubules and rectal glands. Insects conserve water more effectively than any other group of animals because they do not drink water. They pass out semisolid waste (uric acid), which contains very little quantity of water.

EXCRETORY MECHANISM IN MAMMALS

We shall focus our attention on the formation of urine. The kidneys of mammals accomplish this task by purifying the blood. Some toxic substances such as nitrogenous salt, sodium salt, potassium salt, calcium salt, and urea are removed from the body through this means.

In urine formation, three processes take place:

1. Ultra filtration
2. Selective reabsorptin, and
3. Tubular secretion.

Now, as the blood circulates round the glomerulus, ultra filtration occurs. Small molecules such as water, urea, mineral salts, sugar, and plasma solutes pass through the one-cell thick walls of the capillaries and the Bowman's capsule into the capsular space. Bigger molecules like plasma, protein and the blood cells cannot pass through the barrier which thus acts as a filter. A high pressure in the glomerulus is essential for the filtration process. This is brought about in the following ways:

- The blood entering the kidney is already at high pressure because the renal artery branches off from the dorsal aorta at only a short distance from the heart.
- The blood vessel leaving each glomerulus is narrower than the one entering it, thereby increasing the pressure of the blood in the glomerulus further.

The fluid that filters into the Bowman's capsule is known as glomerula filtrate. It flows down the tubule, and as it passes down the proximal part of the tubule and the Henle's loop, selective reabsorption take place. In this process, water and useful substances like sugar, amino acid and salts are reabsorbed into the surrounding blood capillaries. The filtrate then moves into the distal part of the tubule. Here, large waste molecules like creatinine are secreted into the tubules. If necessary, ions (hydrogen, potassium and hydrogen carbonate) are secreted into the tubules to keep the osmotic concentration of the blood constant. The fluid that eventually remains in the tubules is concentrated and is known as urine.

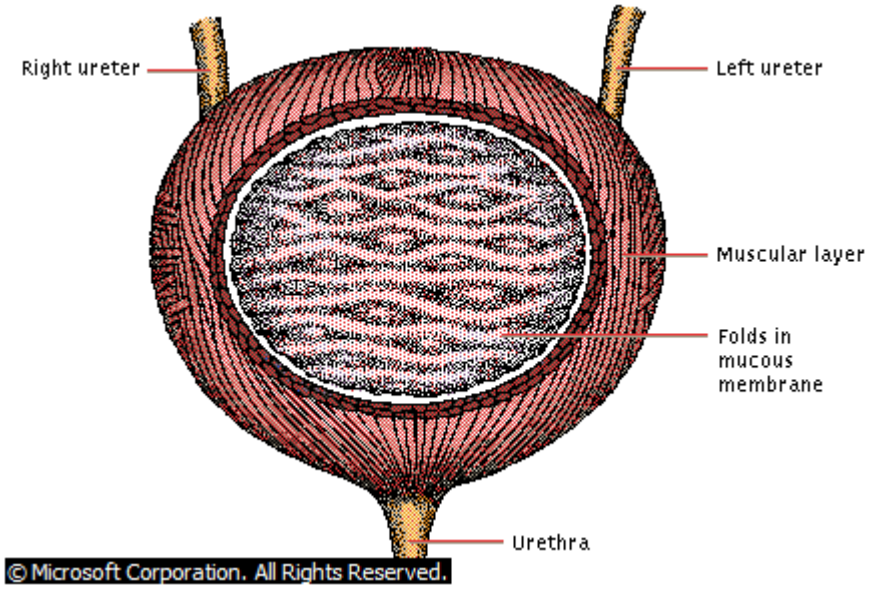
An average of 1.5litres of urine is produced daily. The amount of urea excreted will depend on the protein content of the daily diet. The filtered blood leaving the kidney by the renal vein contains:

- Less oxygen and glucose, and more carbon (iv) oxide, as a result of cellular respiration and
- Less nitrogenous wastes, salt and water as a result of excretion.

The urine formed trickles down the ureter and collects in the bladder. When the bladder is full, it contracts discharging the urine out of the body through the urethra.

The mechanism used in urine formation includes the following:

1. Active transports
2. Varying permeability of tubules and
3. Passive diffusion and osmosis.



Bladder
The bladder is a muscular storage organ for urine produced by the kidneys. The average adult bladder can hold about half a liter (about 1 pt) of liquid. Urine exits the bladder through a tube called the urethra. Emptying the bladder is a reflex reaction, one that takes children several years to learn to control.

EVALUATION

1. Write a short note on the excretory mechanism of insects.
2. The excretory organ of the earthworm is ----------
3. Mention the three processes involved in the formation of urine in woman.

GENERAL EVALUATION

1. In which of the following groups of organisms does excretion take place only by simple diffusion through the body surface. (a) Worms, toad and amoeba? (b) Paramecium, grasshopper and snake

(c) Grasshopper, toad and euglena (d) Toad, insect and Euglena (e) paramecium, amoeba, and euglena.

2. In selective reabsorption, one of these is reabsorbed back into the body (a) plasma (b) urea (c) mineral salts (d) nitrogenous salt (e) hydrogen carbonate.

ESSAY TEST

1. Explain the formation of urine in human.
2. List the mechanism used in urine formation.
3. Mention other excretory organ in human.

WEEKEND ASSIGNMENT

1. Sketch an annotated diagram of the kidney.
2. Sketch the excretory system of earthworm.

PRE-READING ASSIGNMENT

1. Read STAN Biology for SSS2, page 77, and list the percentage composition of the substances that make up the urine.

WEEKEND ACTIVITY

Read Chapter Five of STAN Biology for SSS2, and summarise it in two pages of your assignment note.

REFERENCE TEXTS

Nelson Functional Biology for SSS2, by Kola Soyibo.

STAN Biology for SSS2.