THIRD TERM: E-LEARNING NOTES

SUBJECT: BIOLOGY

CLASS: SS 2

SCHEME OF WORK

WEEKS **TOPICS**

1. **Revision of last term's work**
2. **Reproductive systems in vertebrates I**: (a) Reproductive systems in bird and mammals (i) Structures of the male and female reproductive systems (ii) Parts of the reproductive systems and their functions (iv) Structures of the male and female gamete(sperm and ovum)(v) Differences between male and female reproductive organs.
3. **Reproduction systems in vertebrates II:** (a) Structural differences in the eggs of vertebrates (b) Comparison of reproduction in fish, reptiles and mammals.
4. **Reproductive systems in plants** (a) Structures and functions of the reproductive organs of plants (b) Arrangement of reproductive organs in different plants (c)Types of flowers:(i) hypogenous (ii) perigynous (d) Kinds of placentation.
5. **Pollination in plants** (a) Pollination in plants (i) Types of pollination (ii) Features of self and cross pollinated flowers (iv) Agents of pollination.
6. **Regulation of internal environment (kidney):** (a) Homeostatic organs; substances involved in homeostasis (b) The kidney (i) structure, functions and diseases of the kidney (ii) The effects of kidney diseases and remedy
7. **Mid – Term Break**
8. **Regulation of internal environment (Liver and Skin)**: (c) (i) Structure, functions and diseases of the liver, bile products (ii) The effects of liver diseases and remedy (d) Skin (i) structure of the skin (ii) care of the skin (iii) functions of the skin
9. **The Nervous System:** (a) Organization of the nervous system (i) Central Nervous System (CNS) (ii) Peripheral Nervous System (PNS) (b) The Brain-position, structure and functions (c) The Spinal Cord-position, structure and functions
10. **The Nervous System** (d) PNS (i) Somatic nervous system (ii) Autonomic nervous system (e) Structure and functions of a neuron (motor ,sensory and relay neuron) (f) Reflex and voluntary actions.
11. **Revision**
12. **Examination**

WEEK 1: REVISION OF LAST TERM'S WORK

WEEK 2

TOPIC: REPRODUCTIVE SYSTEMS IN VERTEBRATES I

CONTENT:

(a) Reproductive systems in bird and mammals

(i) Structures of the male and female reproductive systems

(ii) Parts of the reproductive systems and their functions

(iii)Structures of the male and female gamete (sperm and ovum)

(iv) Differences between male and female reproductive organs.

SUB-TOPIC 1: REPRODUCTIVE SYSTEMS IN VERTEBRATES.

The male reproductive system of birds (cock) consists of a pair of testis found near the kidneys. A sperm duct runs down from each testis and opens into the cloaca. Sperms cells accumulate at the end of the sperm duct.

As the male cloaca gets in contact in the female during mating, sperm cells are transferred into the female.

A typical female bird (pigeon) has only the left ovary which is located anterior to the kidney. Different sizes of follicles are found in the ovary. The left oviduct is large and wide-mouthed funnel with thick wall and a coiled duct leads into the uvodeum.

Hatchlings

A torrent of food—the result of as many as 1000 daily foraging trips by the parents—helps the chicks of many tree-dwelling birds grow from featherless, blind, helpless nestlings into self-sufficient animals within three weeks. A brood of blue tit chicks is shown here at 3 and 13 days of age, at which time they are fully capable of flight.

The male reproductive system in mammals consists of the following:

The male sex organs are the testis. These are in pairs and are contained in the scrotal sacs, outside the body in order to keep them under a temperature lower than 37^0C for optimum production of sperms. Sperms are produced in the semimiferous tubules of the testis and are stored in the tubes of the epididymis. The sperms then travel through the sperm duct (vas deferens) to the urethra. Liquid nutrient is added to the sperm from the seminal vesicles and

the prostate gland to form the semen. During mating (intercourse), the semen is discharged into the female vagina through the penis.

The female sex organs are called ovaries which are inside the abdomen. These produce eggs which are released into the opening of the oviduct and moved in to the opening of the oviduct and move down the funnel with the aid of the cilia in the oviducal funnel. The oviduct leads to the uterus or the womb. Humans have a single uterus while rats have a double uterus. A fertilized egg is retained in the uterus where it becomes embedded in the wall. The vagina leads from the uterus to the outside of the body. The cervix lies at the end of the uterus and this closes after fertilization to avoid further entrance of sperms and foreign bodies.

EVALUATION

1. What is significant about the testis and ovaries in the reproductive system of mammals?

2. Mention 3 parts of the female reproductive system in birds.

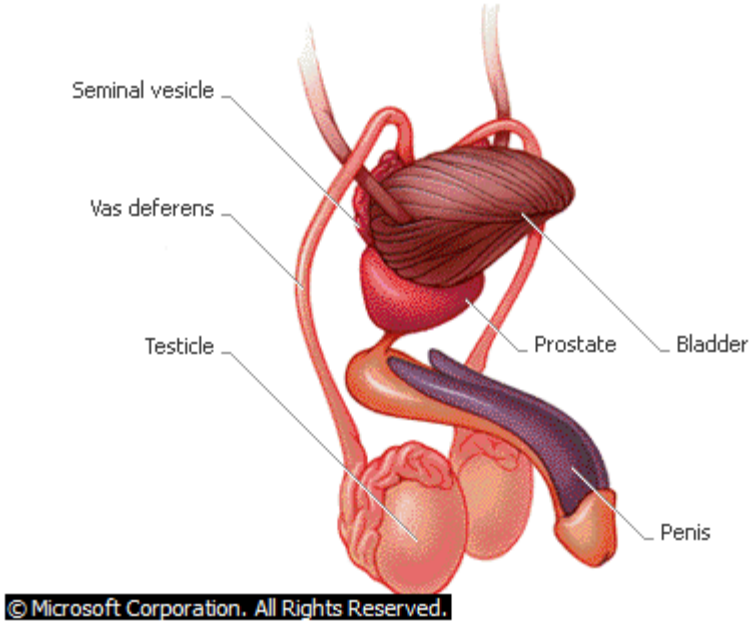
SUB-TOPIC 2: Parts of the reproductive systems and their functions. Reproductive system of birds and functions of the parts:

Male and Female Birds:

	PART	FUNCTION
1.	Testes	Production of sperm cells. It carries and accumulates sperms, point of transfer of sperms. Point of transfer of sperms.
2.	Ovary, Follicle, and Oviduct	Production of eggs. Contains the immature ovum, and coiled duct that leads into the urodeum.

Some parts of the reproductive systems of mammal and their functions.

Male reproductive system of mammals.



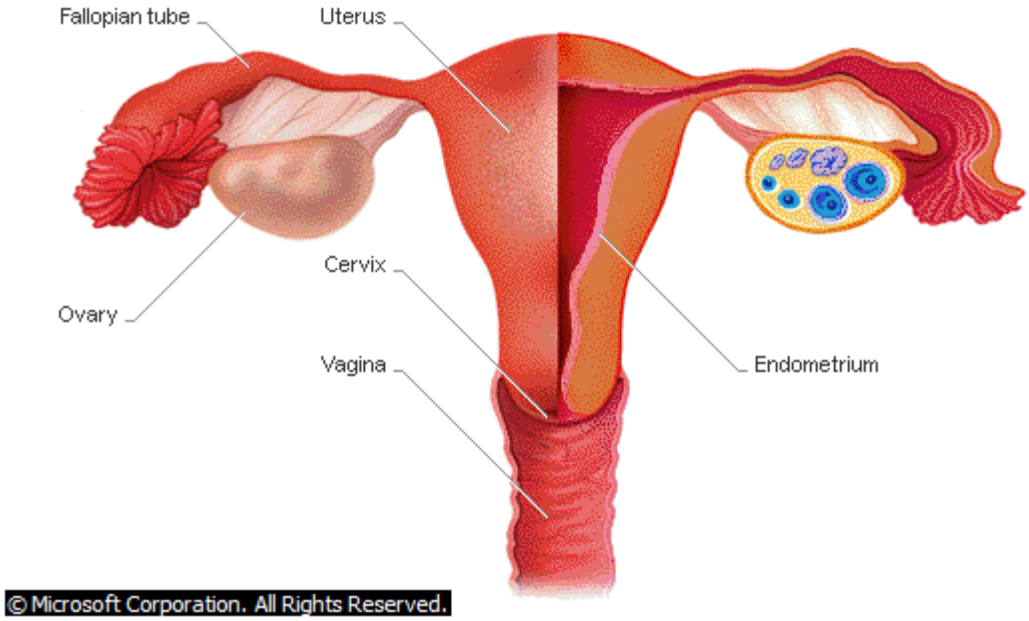
Male Reproductive System

The organs of the male reproductive system enable a man to have sexual intercourse and to fertilize female sex cells (eggs) with sperm. The gonads, called testicles, produce sperm. Sperm pass through a long duct called the vas deferens to the seminal vesicles, a pair of sacs that lies behind the bladder. These sacs produce seminal fluid, which mixes with sperm to produce semen. Semen leaves the seminal vesicles and travels through the prostate gland, which produces additional secretions that are added to semen. During male orgasm the penis ejaculates semen.

i. **The Testes:** this contains coiled tubules called seminiferous tubules in which actively dividing cells produce the male gametes-sperm cells. The testes also stores the sperm produced in addition to the production of sex hormones- **testosterone.** This hormone is responsible for the development of male secondary sexual characteristics.
ii. **Vas deferens:** this is the sperm duct which continues from the epididymis. It serves as the pathway through which the sperm run from the epididymis to the urethra.
iii. **Penis:** this is made up of spongy erectile tissue which is a sensitive urinogenital organ. The penis, when erected, discharges semen through the female vagina into the oviduct.
iv. **Prostate gland:** secretes substances that help to energise and transport the sperms
v. **Cowper's gland:** secretion from this gland help to normalise the alkaline concentration of the sperm.

PARTS OF THE FEMALE REPRODUCTIVE SYSTEM AND THEIR FUNCTIONS.

i. **Ovary:** the ovaries contain several thousands of potential eggs called primary Ooccytes. The ovaries produce the female gametes.
ii. **Oviduct:** released eggs are received by a funnel like structure known as the fallopian tube or the oviduct which serves as a pathway for the passage of ovum fertilisation occurs in the oviduct. Oviduct opens to the uterus.



Female Reproductive System

The bones of the human female pelvis form a bowl-shaped cavity that supports the weight of a developing fetus and encloses the organs of the female reproductive tract. Two ovaries, the female gonads, produce mature eggs. Leading away from the ovaries are the fallopian tubes, or oviducts, the site of fertilization. The uterus, a muscular organ with an expandable neck called the cervix, houses the developing fetus, which leaves the woman's body through the vagina, or birth canal.

iii. **Uterus:** this is a muscular structure connected to the outside or exterior through the vagina. Its glandular lining serves to nourish the embryo in the early stages of development. Its smooth muscles in the walls greatly increase in number during pregnancy. Contraction of the uterus eventually expels the foetus and its placenta during birth.

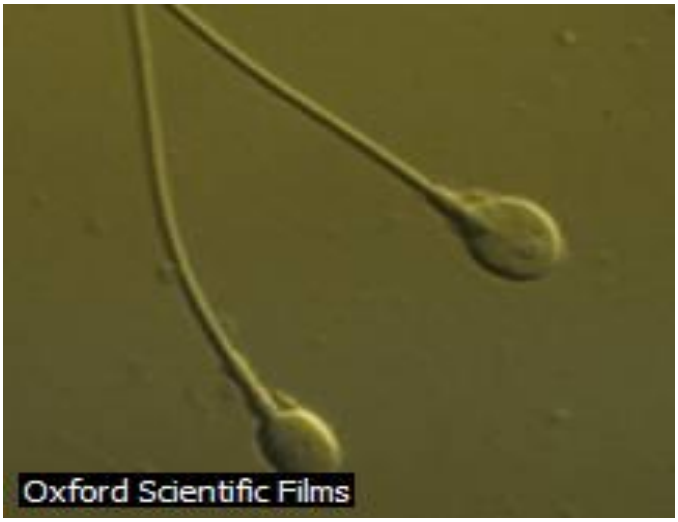
iv. **Cervix:** this lies at the ventral and of the uterus. It usually closes after fertilization to avoid further entrance of sperms and other foreign bodies.

v. **Vagina:** this serves as the receptor of sperm cells ejaculated by the male.

SUB-TOPIC 3: STRUCTURES OF THE MALE AND FEMALE GAMETES

The basic structures of the male and female gametes in mammals are as follows:

Male gamete: the human (mammalian) gamete is shaped like tadpole made up of a head with a nucleus and a tail (flagellum) the sperm is about 60 micrometers long, is microscopic and usually smaller than the female gamete.



Two Human Sperm Cells

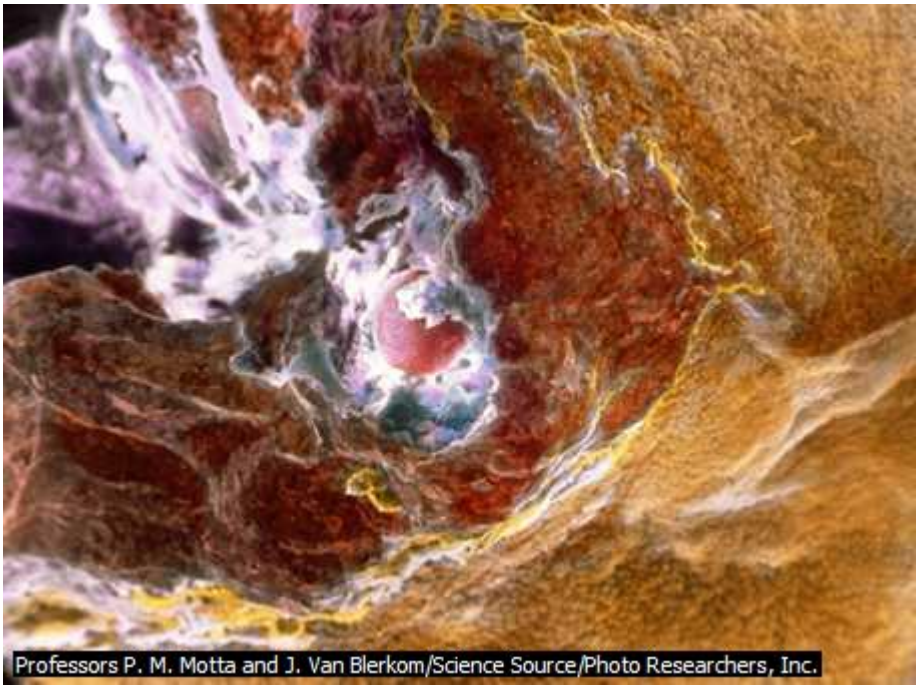
The small capsule-shaped head of the sperm cell contains the chromosome contribution from the male. The whiplike tail helps to propel the sperm cell toward the egg, where fertilization takes place.

EVALUATION

1. What is the function of the sperm duct in male birds?
2. Why is the mammalian male penis described as a urine genital organ?
3. By what means are sperms transformed from the male bird to the female.

FEMALE GAMETE:

The human (mammalian) female gamete is also microscopic but is larger than the sperm. The ovum as it is called is about 0.1mm in diameter. It consists of the cytoplasm, a central nucleus, granules and yolk droplets. The yolk serves as a source of nourishment for the embryo in its early developmental stages. The cytoplasm of the ovum is surrounded by a double membrane. The inner membrane is the plasma membrane while the outer one is viteline membrane. The ovum is bounded on the outside by a jelly coat of variable thickness made up of glycoprotein. The nuclei of both the male and female gametes contain chromosomes that carry the genes which are responsible for passing on parent's characteristics to the offspring.



Ovary Releasing an Ovum

The ovary is the female organ that produces the reproductive cells called eggs, or ova. This false-color electron micrograph shows the release of a mature ovum at ovulation. The ovum (red) is surrounded by cells and liquid from the ruptured ovarian follicle.

EVALUATION

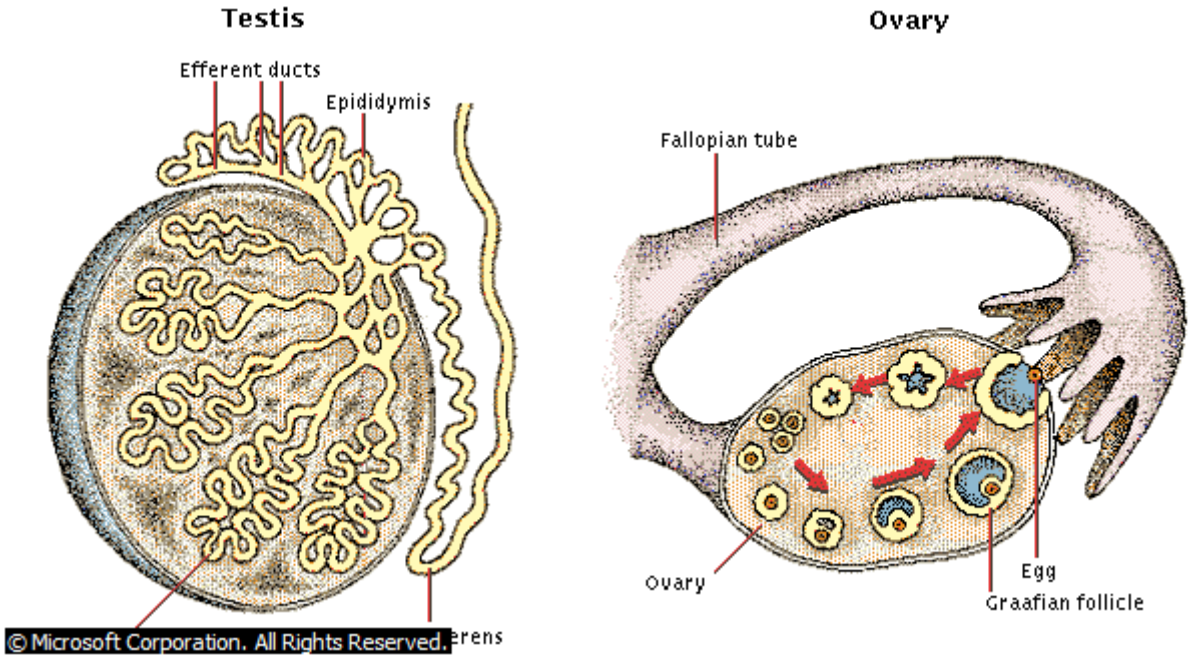
1. Draw and label the male gamete of a mammal.
2. What is the function of the Nucleus in the male and female gametes?
3. Describe the structure of the female gamete in mammals.

SUB-TOPIC 4: Differences between male and female reproductive organs

There are differences and similarities when the male and female reproductive organs are compared..

SN	MALE REPRODUCTIVE ORGAN	FEMALE REPRODUCTIVE ORGAN
1.	Testes are in scrotal sacs located outside the body.	Ovaries are located inside the body
2.	Epididymis present	Epididymis absent
3.	Sperm produced by testes	Egg produced by ovaries
4.	Sperm cells pass out through the urethra	Ova pass into the oviduct where they are fertilised
5.	Sperm duct present	Sperm duct absent
6.	Seminal vesicle present	Seminal vesicle absent
7.	Prostate gland present	Prostate gland absent
8.	Cowper's gland present	Cowper's gland absent
9.	Penis present	Penis absent
10.	Oviduct absent	Oviduct present
11.	Uterus absent	Uterus present

12.	Vagina absent	Vagina present
13.	Cervix absent	Cervix present
	Vulva absent	Vulva present



Structure of Human Gonads

Gonads—in the male, the testes (singular, testis), and in the female, the ovaries—are the organs that produce gametes and sex hormones. The male gamete is the spermatozoan, produced by cell division in the seminiferous tubules of the adult testes. Typically, several hundred million sperm reach maturity in the epididymis and are stored in the vas deferens each day. Whatever is not released in ejaculation is reabsorbed, part of a continuous cycle. In the female, the ovaries produce eggs, or ova. At birth, about 2 million oocytes, or immature eggs, are present in the ovaries. Once the female reaches puberty, one egg matures approximately every 28 days inside a saclike Graafian follicle. Ovulation occurs when the mature egg bursts from the follicle and the ovary, beginning its journey down the fallopian tube toward the uterus.

For similarities: Both reproductive organs have;

1. Gonads or sex organs (testes and ovaries).
2. Gametes are produced by gonads.
3. Have external opening.
4. Have gonads acting as ductless (endocrine) glands.

EVALUATION

1. Mention three (3) differences between the male and the female reproductive organs.
2. Mention three (3) similarities found in the comparison of male and female reproductive organs.
3. In what way does male reproductive organ function as an endocrine gland?

4. State the functions of the following parts of the reproductive systems of birds, mammals, fish (a) Claspers (b) Uterus (c) Cloaca (d) Oviduct (e) Seminal vessicle (e) Ovum.
5. Briefly discuss the structural differences in the male and female gametes of mammals.
6. State four similarities and five (5) differences between the reproductive organs of male and female mammals.

OBJECTIVE TEST

1. The part Cloaca is present in the reproductive system of (a) protozoa (b) Mammal (c) Mollusca (d) Insects (e) Birds.
2. Gametes are produced in which of these structures (a) Ovary (b) Cowper's gland (c) Seminal vessicle (d) Vas differens (e) Epididymis.
3. The function of the prostate gland in the male reproductive system of mammals is (a) Storage of sperm (b) Pathway for sperm (c) Secretion of chemicals to energise cells (d) produce sperm cells (e) Neutralize semen.
4. The male gametes are produced and stored in the testes which are found in the scrotal sacs outside the body due to the consideration of: (a) Light (b) Humility (c) Pressure (d) Temperature (e) Sound.

WEEKEND ACTIVITY

1. Draw and label the ovum and sperm.

WEEK 3

TOPIC: REPRODUCTIVE SYSTEM IN VERTEBRATES II

CONTENT:

i. Structural differences in Eggs of vertebrates.
ii. Comparison of reproduction in fish, reptiles and mammals.

SUB-TOPIC 1: Structural differences in Eggs of vertebrates.

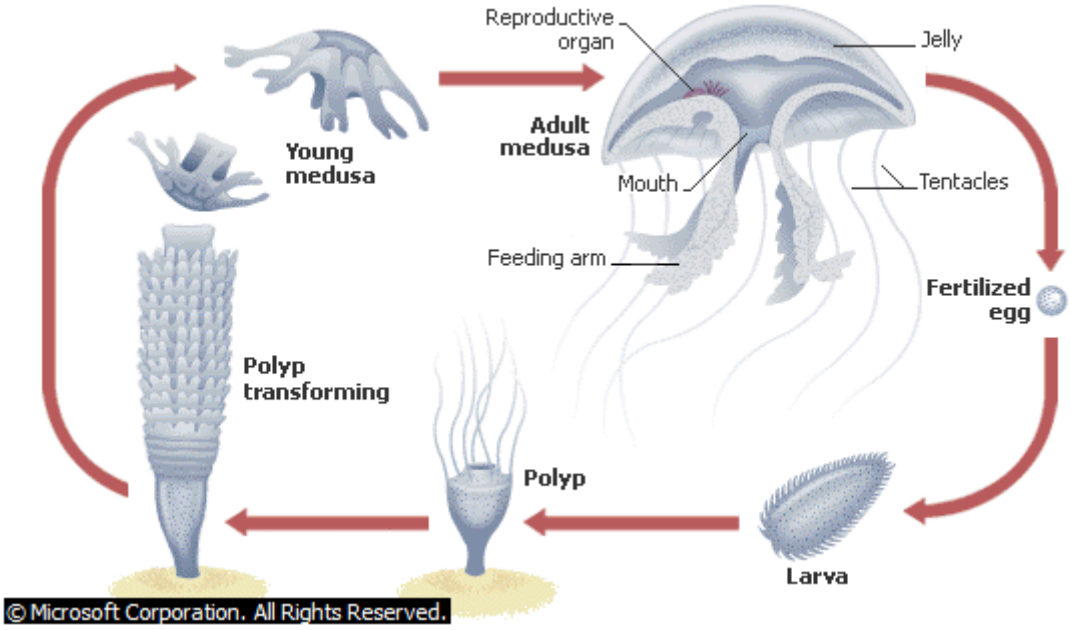
The fish eggs are very small and appear like mass of sand grains. The egg contains the young fish and is enclosed in and egg case or membrane. In amphibians- toad or frog, the eggs are small and spherical. An egg consists of semi liquid cytoplasm containing a nucleus surrounded by a tough black egg membrane. The toads egg is black on the under surface because the protoplasm of the egg is full of yolk granules abundant in the lower part of the eggs.

The egg has a thin coat which absorbs water and swells to form the jelly or albumen. This jelly protects the egg and separates them from one another in a bead-like manner.

In reptiles, e.g., Agama lizard. The egg is cream coloured. It has a soft but tough leathery shell. It absorbs water from the surrounding soil and increase in size or volume.

The egg of the bird is the largest single animal cell. Its porous shell allows for the exchange of gases with the egg and its environment. The egg possesses two membranes enclosing the albumen. The albumen contains the yolk in which the germinal disc or embryo occupies the inner most core.

The mammalian egg is microscopic and is about 0.1mm in diameter. It consists of the cytoplasm, a nucleus in the centre, granules and yolk droplets. The yolk provides a source of nourishment for developing embryo. The ovum (egg) is surrounded by two membranes. The inner one is the plasma membrane while the outer one is the vitelline membrane.



Life Cycle of a Jellyfish

In the reproductive life cycle of a typical jellyfish, males release sperm and females release eggs into the water. When an egg and sperm fuse to form a fertilized egg during sexual reproduction, a larva develops that attaches to a rock or other object and develops into a polyp. In a type of asexual reproduction, the polyp transforms into a colony of polyps that resembles a stack of saucers. Each saucer in the stack detaches itself from the colony as a new medusa, and the reproductive cycle repeats.

EVALUATION

1. Mention two structural differences between the eggs of a fish and a reptile.
2. In what ways are the eggs of a mammal different from that of reptile?

SUB-TOPIC 2: COMPARISON OF REPRODUCTION IN FISH, REPTILES AND MAMMALS.

All vertebrates start life as a result of the fusion of a male and female gamete, a process known as fertilization. In fish, fertilization is external of the animal body.

In reptiles, bird and mammal, fertilization is internal. Consequently, there is always some type of coition or mating before fertilization can occur. In all vertebrates, some courtship behaviour always precedes mating prior to fertilization.

Most fishes lay their eggs (with shells) in water (oviparity) where they are fertilized. Most reptiles also lay eggs (oviparity), which have shells that may be soft and leathery or hard. All reptiles lay their eggs on land. However, some fishes, reptiles, and most mammals are viviparous (they give birth to well –developed young ones alive).

Many fishes lay large number of eggs every breeding season. This is to compensate for high mortality rate from their eggs to the young ones.

Reptiles on the other hand lay fewer eggs, about 20-70 eggs at a time.

The number of eggs laid by birds varies from species to species. Most fishes and reptiles do not show parental care for their eggs or young ones. In the case of mammals, parental care is most highly developed. The young ones are protected and fed until they can fend for themselves.

Generally, vertebrates that show external fertilization (fishes). Produce more eggs and experience higher mortality rates among their eggs and young ones than reptiles and mammals which show internal fertilization.

COMPARISON OF REPRODUCTION IN SOME VERTEBRATES

TYPE OF VERTEBRATE	TIME OF BREEDING	MODE OF FERTILIZATION	NO OF EGG LAID	MODE OF GROWTH	PARENTAL CARE
Fishes	seasonal	External	Millions	Mostly oviparous	Most none
Reptiles	seasonal	Internal	Many	Mostly oviparous	None, except Nile Crocodile
Mammals	Seasonal except in human	Internal	None, except in monotremes	Mostly vivaparous	Occurs for a long time.

EVALUATION

1. Briefly describe the mode of fertilization in fishes and reptiles.
2. Give two reasons for vast difference in the number of eggs laid by fishes and reptiles.
3. What do you understand by viviparity.
4. Discuss the structural differences in the eggs of the fish, reptile and mammal.
5. Describe the mode of fertilization of the fish, reptile and mammal.
6. In which way does parental care by some vertebrates account for the number of eggs laid at a time? Use two typical examples.
7. Distinguish between oviparity and viviparity in vertebrates.
8. Briefly describe the reproduction process in (i) fishes (ii) reptiles.

OBJECTIVE TEST

1. Fertilization involves--- (a) the development of female gamete (b) The fusion of male and female gametes (c) The integration of single cell (d) The division of active cell (e) The movement of sperm cell.
2. In internal fertilization, mating or coition is preceded by—(a) Courtship (b) Fighting (c) Warning (d) Feeding (e) Flying.
3. Which of the following vertebrates is mostly viviparous? (a) Amphibians (b) Mammals (c) Fishes (d) Reptiles (e) Insects.

WEEKEND ASSIGNMENT

PRE-READING ASSIGNMENT: Read about reproductive systems in plants.

WEEKEND ACTIVITY

List five (5) problems associated with external fertilization and show how the organism concerned adapt to the problems.

WEEK 4

BIOLOGY

TOPIC: REPRODUCTIVE SYSTEMS IN PLANTS

CONTENT:

1. Structures and functions of the reproductive organs in plants.
2. Arrangement of reproductive organs in different plants.
3. Types of flowers (i) Hypogenous and (ii) Perigynous.
4. Kinds of placentation.

SUB-TOPIC 1: Structures and functions of the reproductive organs of plants.

The flower is the major reproductive organ of the flowering plant. Flowers exist in different sizes, shapes, colours and patterns of arrangements.

A flower is a cluster of modified leaves carried on a reduced stem called flower stalk or pedicel. The flower is made up of four floral parts. These are;

(i) Sepals (calyx)

(ii) Petals (corolla)

(iii) Stamen (androecium)

(iv) Carpel (gynoecium)

The structures and their functions are as listed below:

i. **Sepals (Calyx):** this consists of a circular outermost layer of leaf-like structures called sepals which are fixed to the receptacles. **Sepals protect the flower during the bud stage. They are mostly greenish are also photosynthetic**. Some sepals are brightly coloured and look like petals (petaloids). These serve to attract pollinators. **Sepals:** may be separated (polysepalous) as in Pride of Barbados. Others are fused or partly joined together to form a cup-like structure (gamosepalous) called Pappus (Tridax).

ii. **Petals (Corolla):** these are large brightly coloured modified leaf like structure called petals. They arise within the calyx. **They are most conspicuous and prominent part of the flower which attract pollinators to the flower**. **Petals** could be separated as in Hibiscus and Pride of Barbados (Polypetalous) or fused to form a tube are in Allamanda and Milk Bush (Gamopetalous). Petals are usually brightly coloured or scented thereby attracting pollinators. Petals also serve to protect the stamen and the carpals. In a few cases, petals appear greenish (Perianth).

iii. **Androecium:** this consists of the whorls or group of the male reproductive organs of the flower called stamens. These lie inside the corolla. Each stamen is made up of a lobed or swollen head called Anther and a long slender stalk called the filament which bears the Anther. Each anther is composed of four pollen grains (the male gametes) flowers may be free or united. The filament may also be united while the anthers are free. The fused filaments from a stamina tube as in hibiscus. In sunflower, the anthers are fused while the filaments are attached like petals (epipetalous).

iv. **Gynoecium:** this is the female reproductive organ of the flower. It is the innermost whorl of the floral parts of a flower. It consists of the carpels also known as the pistil. The carpel is made up of three parts, namely:
   i. Stigma: this receives the pollen grains during pollination.
   ii. Style: this is the tube that join the stigma to the ovary
   iii. Ovary: this contains the ovules which form fertile seeds after fertilization.

Other parts of a flower are;

1. **Pedicel:** this is the part attaches the entire flower to the stem or branch of the plant. It is also called the flower stalk. It is described as a reduced stem bearing the parts of the flower (modified leaves).
2. **Receptacle:** this is the enlarged end of the pedicle to which all the other floral parts are attached. It also encloses the ovary.

Hibiscus: The hibiscus is the common and scientific name for a genus of deciduous and evergreen trees and shrubs grown primarily for their large, showy, colorful flowers. The hibiscus is cultivated throughout warm, temperate regions of the northern hemisphere and grows best in sunny locations in very fertile, well-drained soils.

Flame Tree

The flame tree is named for its brilliant scarlet blossoms that cover long, spreading branches. It is a native of the island of Madagascar, where its dangling seed pods are often gathered and used as fuel. It is now cultivated as an ornamental in tropical and subtropical areas around the world.

Hibiscus Flower

The large, showy flowers of the hibiscus have five petals that range in color from red, orange, and pink to yellow and white. The many varieties of hibiscus grow in warm climates.

EVALUATION

1. What is a flower?
2. Name the parts of a typical dicotyledonous flower.
3. List three (3) parts of a flower stalking their functions.

A pistil is a separate carpel or a single structure of several fused carpels. Most pistils have the following;

i. An ovary
ii. One or more styles
iii. One or more stigmas

TYPES OF PISTIL

i. **Monocarpous pistil** (having a single carpel e.g flamboyant)
ii. **Apocarpous pistil** (having two or more separate carpels e.g, Rose)
iii. **Syncarpous pistil** (having two or more carpel to form a structure e.g. hibiscus)

SUB-TOPIC 2: ARRANGEMENT OF REPRODUCTIVE ORGANS IN DIFFERENT PLANTS.

The rattle box (crotalaria retusa) which is a short dicotyledonous shrub flowers are found clustered together (inflorescences) at the end of the branches. Each bisexual flower is butterfly-shaped. The flowers are complete (has all the floral parts) and zygomorphic (bilateral symmetry)

Acanthus

The acanthus, commonly called bear's breech, is cultivated for its ornamental leaves and bright flowers. The plant is native to southern Europe, preferring rich, well-drained soils and full sunlight.

In the Guinea grass (Panicum maximum) the flowers are wind pollinated unlike crotalaria which is insect pollinated. It is also inflorescence made up of long slender branches with a pair of flowers at intervals along each branch. The flowers are smell and inconspicuous. They are enclosed within a tract to form a spikelet about 4mm long.

Within the spikelet, the lower of the two flowers is made up of three yellow stamen. The upper flower has three stamens and an ovary with two feathery purple-red stigma. Each flower has two tiny structures called lodicules which represent a perianth. Some of the spikelets have protruding stamens whereas others have stigma. The flower is thus protandrous. The flowers with ripe stigma are therefore slightly older than those with ripe stamen. When ripened, the anther burst open releasing lots of tiny blown about by the wind.

Hibiscus Flower

The large, showy flowers of the hibiscus have five petals that range in color from red, orange, and pink to yellow and white. The many varieties of hibiscus grow in warm climates.

EVALUATION

1. Draw to show the arrangement of flower of a named insect pollinated plant.
2. State three (3) differences between the floral arrangements of and insect pollinated and a wind pollinated plants.

SUB-TOPIC 3: TYPE OF FLOWERS

Flowers can be classified based on the shape of the receptacle and the mode of arrangement of the floral parts on it.

1. **Hypogynous flower:** in this type of flower, the receptacle is in a conical shape. The other floral parts (whorls) are then arranged in concentric rings below the position of the ovary. Such an ovary is said to be **superior**. An example is Hibiscus.
2. **Perigynous flower:** in this type of flower, the receptacle is cup shaped with the ovary situated in the centre of the cup. The whorls then emerge from the edges of the cup. The ovary is then said to be **half inferior.** Example is Rose.

3. **Epigynous flower:** the ovary is completely embedded in a fleshy receptacle so that all the other floral parts are above it.

EVALUATION

1. Draw and describe a Hypogynous flower.
2. Mention 2 structural differences noticeable in Hypogynous and Perigynous flowers.

SUB-TOPIC: 4: KINDS OF PLANCENTATION

Inside the ovaries of flowering plants, the ovules are attached in various ways to the ridges of fleshy tissues, called plancentae, by short stalks called funicles. The arrangement of ovules within the ovary is called plancentation.

Plancentations are of various types i.e.

1. **Axile:** The ovule s here are attached to the centre of the ovary e.g. Tomato and cannas lily.
2. **Marginal:** The ovules are attached along one edge of a monocarpous ovary. E.g. pride of Barbados, flamboyant and crotaria
3. **Parietal:** The ovules are arranged along many lines on the ovary wall. E.g. pawpaw.
4. **Free-central:** The ovules are attached to projections from the base of the ovary. E.g water leaf.
5. **Basal:** The ovules are attached to the base of the ovary. E.g. sunflower.

After fertilization, the ovary develops into a fruit, whereas the ovules in most flowers develop into seeds.

EVALUATION

1. What is placentation?
2. Mention ad describe 3 types of plancentation.
3. Draw and label a longitudinal section of a named insect pollinated flower.
4. List 5 parts of a flower and state their functions.

OBJECTIVE TEST

1. Which of these is not a part of carpel?
   a. Stigma
   b. Ovary
   c. Pedicle
   d. Style
   e. Ovule
2. All are types of ovary except

a. Superior
b. Half superior
c. Inferior
d. Half inferior
e. None of the above

3. Which if the following parts of the flower holds the anther?
   a. Style
   b. Petals
   c. Filament'
   d. Receptacle
   e. Ovary
4. The type of plancentation found in the ovary of a Tomato flower is
   a. Marginal
   b. Axile
   c. Parietal
   d. Free-central
   e. Basal
5. Inflorescence usually refers to
   a. A solitary flower
   b. A cluster of flower
   c. An immature flower
   d. A mature flower

WEEKEND ASSIGNMENT

1. With the aid of diagrams describe 5 types of placentation in named plants.
2. Mention five differences between the flowers of a wind pollinated and an insect-pollinated plants.
3. State 4 differences between the Androecium and Gynoecium of a flower

WEEKEND ACTIVITY

Collect flowers of pride of Barbados, Hibiscus, Flamboyant and other flowers around the compound. Examine each flower and state the types of ovary.

WEEK 5

BIOLOGY
CLASS: SS 2
TOPIC: POLLINATION IN PLANTS
CONTENT:

1. Types of pollination.
2. Features of self and cross pollinated flowers
3. Features of wind and insect pollinated
4. Agents of pollination

SUB-TOPIC 1: TYPES OF POLLINATION

Pollination is the process by which pollen grains from an anther of a flower are transferred to the stigma of the flower or another flower of the same species. In most species of fowering plant, external agent brings about the pollination. Flowers have evolved special structured and mechanisms to ensure successful pollination. The proce enables fertilisation and sexual reproduction to occur.

There are two types of pollination:

i. **Self pollination**
ii. **Cross pollination.**

i. **Self pollination:** this is the process by which mature pollen grains are transferred from the anthers of a flower to the stigma of the same flower (autogamy) or other flowers on the same plant (cleistogamy). It is common in short-lived annual species. This process has a high successful rate. Self pollination brings the male and female gametes of the same plant together. The offspring show very little genetic variation.

ii. **Cross pollination:** this is the transfer of mature pollen grains from the anther of a flower to the stigma of a different flower of the same or closely related species. This process is risky and wasteful as most pollen grains fail to reach receptive stigma. Cross pollination brings the male and female gametes of two different parent plants together. There are great genetic variations among the offspring which tend to be healthy and well adapted.

EVALUATION:

1. What is pollination?
2. Describe the process of self pollination.
3. Mention two advantages of cross pollination.

SUB-TOPIC 2: FEATURES OF SELF AND CROSS POLLINATION

Self-pollination can occur only in bisexual flowers and in unisexual flowers of monoecious plants. The following are the adaptive features that favour self pollination:

1. **Cleistogamy:** this occurs among closed flowers. The ripe pollen grains are deposited on the stigma which ripens later.
2. **Homogamy:** the carpels and stamens in the bisexual flowers mature at the same time. This homogamous condition promotes self-pollination through one of these ways:
    i. Pollination agents readily carry pollen grains from mature anthers to the receptive stigma.
    ii. A slight wind may blow ripened pollen grains from a mature anther onto any receptive stigma.
    iii. Mature stigma pushing out of the corolla tube may brush against the anther and collect pollen grains on the longest filaments.
    iv. Filaments longer than the sigma may recoil and touch the mature stigmas.
    v. Styles longer than the filaments may bend to make the stigma touch the anther.

Evolution has favoured the development of plants flowers that promoted cross-pollination. Many flowers therefore exhibit various features that enhance cross-pollination and hinder self-pollination.

These features include the following:

i. **Xenogamy:** this is the transfer of pollen grains of a flower to the stigma of another flower situated on different plants of the same species.
ii. **Hydrisation:** this is the transfer of pollen grains of a flower of one species to the stigma of a flower of a flower of a different species.
iii. **Unisexuality:** this occurs when female and male flowers are borne on separate plants. (Dioecious plants) of pawpaw.
iv. **Dichogamy:** this is a condition in which the male and female reproductive organs of a flower mature of different times. Self pollination is usually impossible in this situation.
v. **Self-incompatibility:** the bisexual flowers of some species may bear mature stamens and carpels at the same time. However pollen grains falling on the stigma of the same flower of flower on the same plant fail to fertilise e.g. tea and passion flower.

EVALUATION

1. Mention 3 features that enhance self pollination in flowers.
2. List and briefly describe 3 features that make flowers adopt cross pollination

SUB-TOPIC 3: FEATURES OF WINFD AND INSECT POLLINATED FLOWERS

1. **Wind-pollinated flowers** are regarded as **Anemophilous** flowers. Examples are maize, rice, millet, grasses and sugarcane.

They have the following features:

i. The flowers are dull in colour. The perianth is usually tiny, pale green and inconspicuous.
ii. Flowers are usually small in size and inconspicuous but are often borne in large inflorescences e.g. coconut and cereals.
iii. They have neither nectar nor scent.
iv. They are not bilaterally symmetrical but are radially symmetrical.
v. The stamens have pendulous and long filaments with loosely attached or versatile on others, which can swing easily in the wind. Each explosive anther contains smooth pollen grains.
vi. The stigma is usually large branched and leathery. This feature provides a large surface area on which pollen grains may be caught.

Australian Honey Possum

The Australian honey possum is one of the only mammal species, other than bats, known to eat nectar and pollen as the mainstay of its diet.

2. **<u>Insect pollinated flowers</u>** are also known as **Entomophilous** flowers. They exhibit certain characteristics features as follows:

i. Petals parts like the tracts and sepals may also be coloured e.g. Bougainvillea.

ii. Flowers are usually large and conspicuous. They also consist of small florets which are grouped into a heed as in the composites of sunflower or large and conspicuous.

iii. Many flowers have sweet scent or scents. Flowers usually pollinated by nocturnal insects are strongly scented to attract.

iv. Insect pollinated flowers like hibiscus and flamboyant have a sweet and sugary juice known as Nectar. Nectar is a liquid food for many insect pollinators. Like Bees and butterfly.

v. Each has a peculiar shape or a complex arrangement of flora pants. This feature creates a mechanism specially suited for their associated insect pollinator. E.g. crotalaric and salvic

vi. The stamens are conspicuous and occur in definite numbers. The anthal are small, compact, and firmly attached to the filament. Pollen grains produced are few in number, heavy; rough edged and spiky or sticky. This feature reduces wastage and ensures attachment to a visiting insect pollinator.

EVALUATION

1. State 3 features of wind pollinated flowers.
2. List all the features that may attract insects to a particular flower.

Wind Pollination

Wind-pollinated plants such as corn typically produce inconspicuous flowers, rather than the brightly colored flowers designed to attract insects. In corn, the male and female parts of the flower are found on different parts of the plant. Shown here are the light green stamens (also called tassles), the pollen-bearing, structures located at the top of the plant. The female structures, which contain very long styles called silks, are growing laterally from the stalk below the stamens.

SUB-TOPIC 4: AGENTS OF POLLINATION

Pollination in most flowering plant depends on external pollinators. These include:

i. Wind
ii. Water
iii. Insects
iv. Other animals such as birds, squirrels, rats and snails.

Wind and insects are the commonest pollinators. Insects visit flowers for nectar and pollen on which they feed. Features like colour and scent serve to attract and guide insects to their food source. In the process of reaching their food source, insects bring about pollination. Common insect pollinators are bees, wasps, beetles, butterflies, moths and ants.

Insect pollinators, by their high mobility, can pollinate individual flowers of a species that are widely spaced apart.

Butterfly Pollinating a Flower

Many species of butterflies eat plant nectar. When these butterflies land on a series of flowers in search of food, they brush their bodies against both male and female floral organs, inadvertently transferring pollen from one flower to another.

Many flowering plants are wind pollinated. Wind pollination is however s highly wasteful process of the mIllions of pollen grains produced only a small proportion land on receptive shima. In monocropping culture, pollination by wind is highly successful.
Flower pollinated by birds are usually red coloured with no scent. They rather produce more nectar than other flowers. Humming birds are well known pollinators.

EVALUATION

1. Name 4 agents of pollination in flower.
2. Explain why insects are considered relatively more successful as pollinators than the wind.
3. With reference to a named example in each case, show how flowers are adapted for (a) wind pollinat0ion (b) insect pollination
4. A. Define pollination B. State 5 features that aid self pollination. C. State 5 features that aid cross-pollination.
5. In a tabular form bring out the major differences in the characteristics of wind and insect pollinated flower.
6. Briefly describe the mechanism of pollination in a named insect pollination
7. Describe pollination in a named wind-pollinated flower.

OBJECTIVE TEST

1. Pollination that involves two separate flowers located on the same plant is called (a) Hybridisation (b) Xerogamy (c) Autogamy (d) Geitonogamy (e) Polygamy
2. All the following features enhance cross fertilization except. (a) Homogamy (b) Protandry (c) Protogyny (d) Universality (e) Xerogamy
3. One of these is not a pollinator (a) Squirrel (b) Ants (c) Water (d) Sunlight (e) wind
4. Which of the following statements is not a feature of anemophilone flowers (a) there are no scent and nector (b) flowers are small and conspicuous (c) flowers are borne on large inflorescence (d) pollen grains are heavy, rough-edged and sticky (e) petals are not coloured.
5. This floral part plays the least role on pollination (a) anther (b) filaments (c) stigma (d) petels (e) Calyx.

WEEKEND ASSIGNMENT

Read Modern Biology for SSS y S.T. Ramalingam; Africana First Publisher ltd (page 475) and carry out the stated activity.

WEEK 6

TOPIC: REGULATION OF INTERNAL ENVIRONMENT (KIDNEY)

CONTENT:

1. Homeostatic Organs: substances involved in Homeostatis
2. The kidney (i) structure, functions and diseases of kidney (ii)the effects kidney diseases and remedy

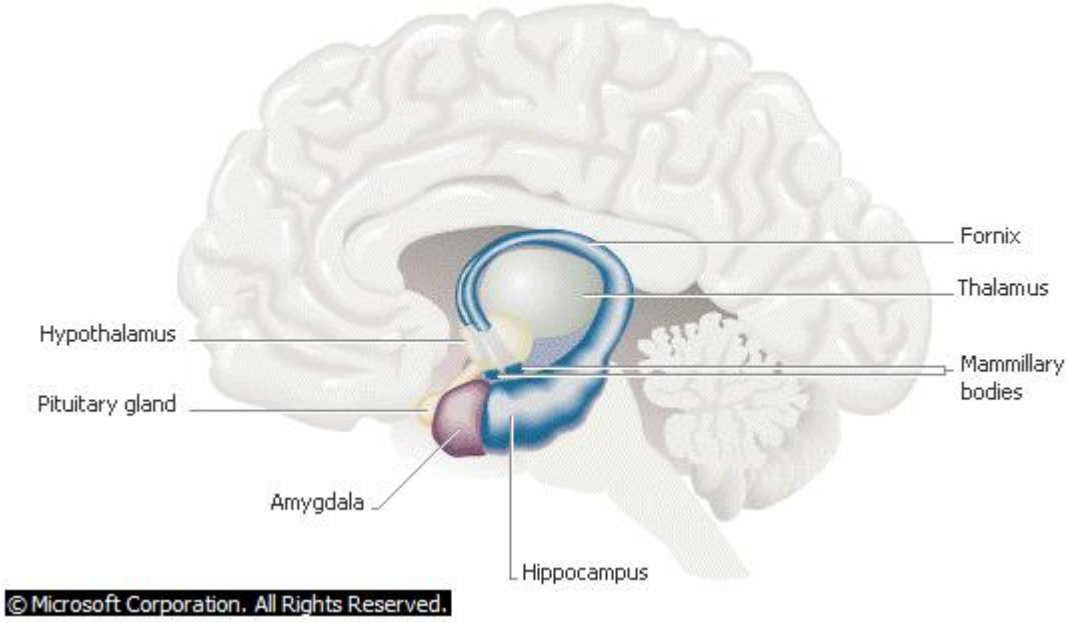
SUB-TOPIC 1: HOMEOSTATIC ORGANS: SUBSTANCE INVOLVED IN HOMEOSTASIS

Homeostasis is the maintenance of a steady internal environment in an organism. Internal conditions such as glucose level, salt concentration, osmotic pressure, body temperature, ionic concentration of substances like sodium ion (Na^+), potassium ion (K^+) and hydrogen ion (H^+) (and others like Ca^{2+}, Cl^-) are kept under control.

For example, when glucose level in the blood shoot up above the optimum, homeostasis ensures that some of it is withdrawn from the blood and converted to glycogen which is stored in the liver and muscle. Another example is when there is insufficient (Ca^{2+}) calcium ion in the diet of a pregnant woman, the homeostatic process can deplete from her bones as a last resort. That is why pregnant woman are advice to eat balance diet.

The process of homoestasis involves the detection of changes by sensory cells, signal is sent to the relevant body parts involved in the specific control mechanism. The central nervous systems interpret the signal and send message to the relevant effectors organs to restore normality in the internal environment. Thus, homeostasis involves monitoring changes in the

external and internal environment by means of receptors and adjusting the composition the body fluids accordingly.



Limbic System

The limbic system is a group of brain structures that play a role in emotion, memory, and motivation. For example, electrical stimulation of the amygdala in laboratory animals can provoke fear, anger, and aggression. The hypothalamus regulates hunger, thirst, sleep, body temperature, sexual drive, and other functions.

Organs involved in Homeostasis

The organs involved in homeostasis control are mainly organs involved in some body functions such as excretion, respiration and glands. Excretion and osmo-regulation are important in the process; especially in the maintenance of acid-base balance and temperature of the body. The brain has the most overall influence on homeostasis.

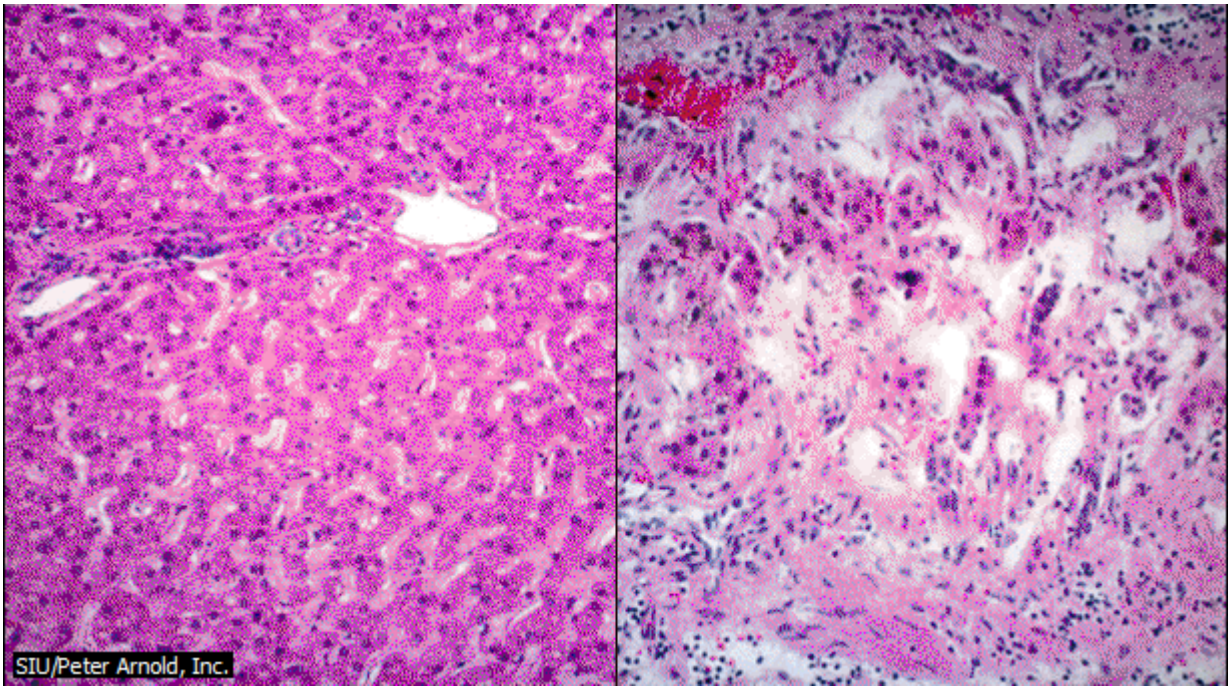
Among the major organs involved in homeostasis are:

i. Kidney
ii. Liver
iii. Lungs
iv. Skin and
v. Endocrine glands

EVALUATION

1. Define homeostasis
2. List five internal conditions of the body of an organism that need to be controlled.

3. Describe how the body regulates blood sugar.
4. List the organs that are involved in homeostasis.



Cirrhosis of the Liver

Severe cases of chronic hepatitis may lead to cirrhosis of the liver. In cirrhosis, dead and damaged liver cells are replaced by fibrous tissue, which can accumulate to form masses of scar tissue. On the left are normal liver cells, and on the right are liver cells from a person with cirrhosis.

SUB-TOPIC 2: THE KIDNEY

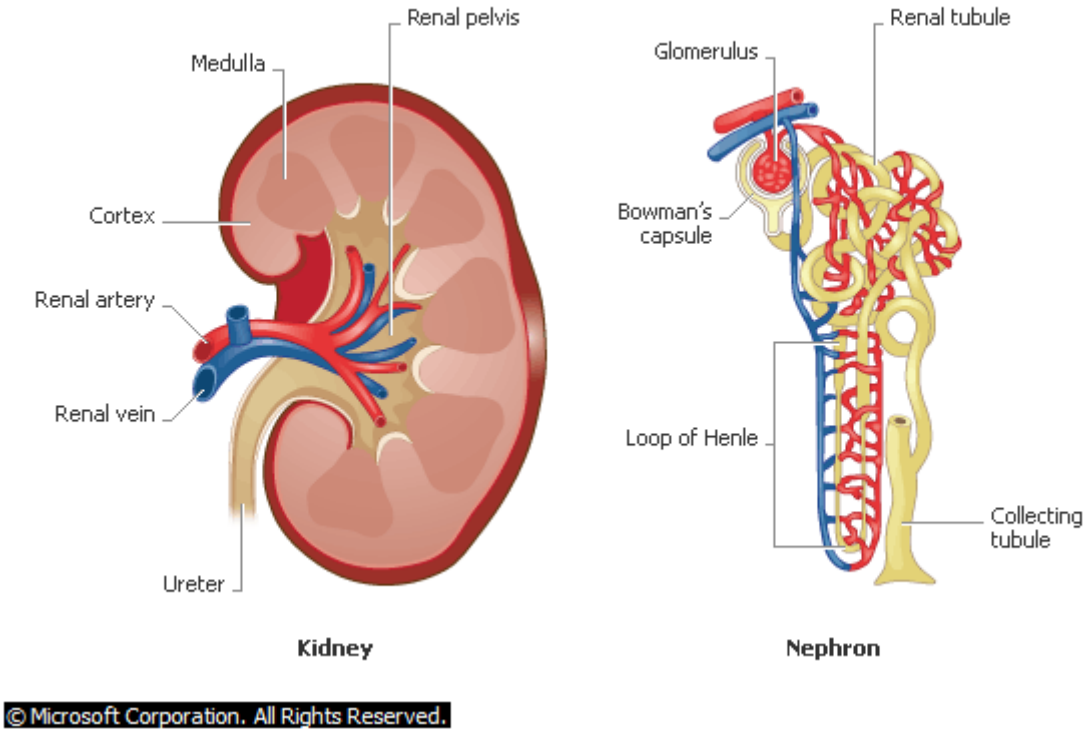
The kidney is the major excretory and osmo-regulatory organ of mammals. All vertebrate have a pair of kidney. The kidney has a rich supply of blood and regulates the blood composition. It ensures the composition of the tissue fluid is maintained at an optimum level for the cells bathe by it and enables the cell to function efficiently at all times.

Structure of the kidney

The human kidney plays dual role of removal of waste (mainly nitrogenous waste) from the body and also osmo-regulation maintaining the body water level and ensuring adequate aqueous medium for the body metabolic processes.

Each kidney is a bean shaped brown organ attached to the dorsal wall of the abdominal cavity. The concave part of the kidney called the hilum is connected to the renal vein and renal artery which carry blood into and out of kidney respectively. The third tube, ureter leads

downwards from each kidney to the bladder (the bladder is connected to the outside via urethra.



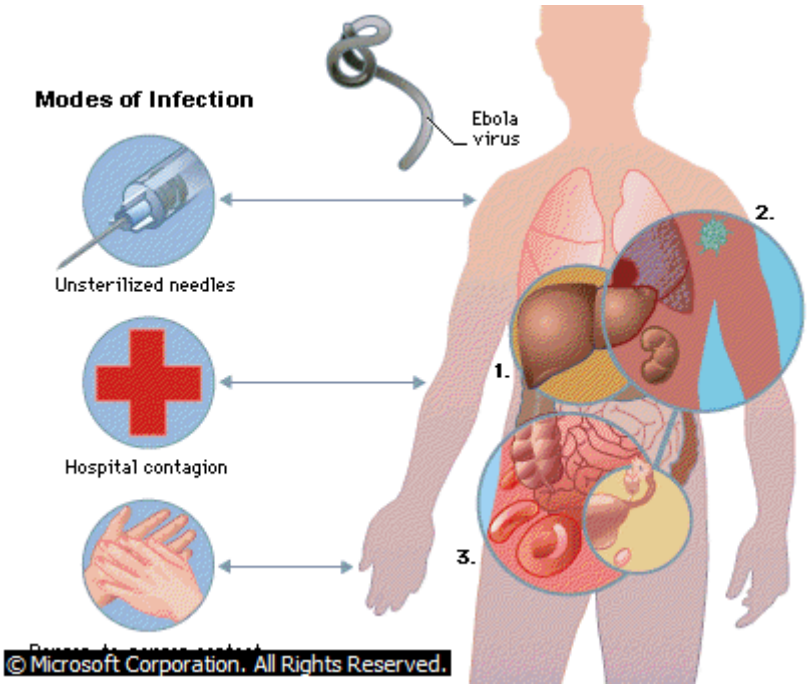
Kidney

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.

A longitudinal section of kidney shows three distinct regions: the outer contex, an inner medullar and the funnel shaped pelvis. The cortex and pyramid is the location of the urinary tubules which are the structures responsible for separating waste from the blood. There are millions of them and their function is enhanced by their connection with the rich network of capillaries in the kidney.

Each urinary tubule consists of a cup-like capsule known as the Boman's capsule leads away a coiled section of the tubule called the proximal convoluted tubule.

Beyond the cortex in the medulla the tube forms a U-shaped loop called the loop of Henle. The far arm of the loop leads to another coiled section of the loop called the distal convoluted tubule which is also richly supplied with capillaries connected to the renal veins. After this point, the tubule leads back into the cortex to join other tubules which eventually leads out through the pyramid into the pelvis.



Ebola Virus Infection

The Ebola virus is highly infectious and can spread through the use of unsterilized needles or through contact with an infected individual or the corpse of someone who has died from the disease. About one week after infection, the virus begins attacking blood and liver cells (1). As the disease swiftly progresses, the virus may destroy vital organs such as the liver and kidneys (2), leading to massive internal bleeding (3). Shock and respiratory arrest soon follow, then death.

Functions of the kidney

The main function of kidney is osmo-regulation, excretion and secretion of hormones. The removal of waste products from the body by the kidney is known as excretion. The kidney also function as endocrine gland by producing two namely erythropoietin and calcitrol. Erythroprorethin acts on the bone marrow to increase the production of red blood cells, while calcitro promotes the absorption of calcium from food in the intestine and acts directly on bones to shift calcium to the blood stream.

Osmoregulation is controlled by variation of quantities of water returned to the blood from the kidneys during selective reabsorption as follows:

a. If the osmotic pressure in blood begins to rise, more water is reabsorbed from the kidney tubules, so that less urine passed to the urinary tract.
b. If the osmotic pressure of the blood begins to fall, less water is reabsorbed and more urine is produced and passed to the urinary bladder. This regulation is controlled by the anti-diuretic hormone (ADH) which is produced by the pituitary gland. ADH stimulates water reabsorption y the kidney tubules, thus reducing theloss of water in the urine. It makes the cells living the distal convoluted tubules and collecting duct more permeable to water, thus facilitating the osmotid withdrawal of water into the surrounding blood vessels. This is an example of a homeostatic feedback process.

Fluctuations in osmotic pressure are quickly detected and the corrective mechanism is brought into action. The body becomes conscious of the salt or water level in the fluid or cell through the hypothalamus which is a part of the brain locate above the pituary gland. If the hypothalamus detects any change in the water content or concentration, it causes the pituary gland to secrete the hormones ADH which controls the adjustment of the salt to water ratio.

Excretory function of the kidney

Excretion is the removal of metabolic water product in the body of an organism. The process varies from one organism another and from one environment to another.

Lower animals such as amoeba get rid of waste product by diffusion through their body surface. Higher animals such as worms excrete through structures called nephridia; insects make use of malpighian tubules, while amphibians, reptiles, birds, and mammals have kidneys as their excretory organs. These kidneys differ in structure and their products as they are adapted to different environments where these vertebrates live.

Maintenance of acid-base balance

The body fluid becomes acidic when the concentration of acid exceeds that of the bases. The kidney regulates it by excreting more acid in the urine and at the same time and at the same time prevents excessive loss of base. On the other hand when the concentration of base becomes higher, more are excreted in the urine.

DISEASES OF THE KIDNEY

Diseases of the kidney include nephritis, kidney stone, dieresis, kidney failure, dropy and kidney cysts.

i. **Nephritis (Bright's disease).** This is a disease condition in which the kidney is inflamed as a result of bacterial infection. The blood vessels of the kidney, especially the glomenilus is affected, leading to incomplete ultrafiltration, as a result of which some useful substances are passed out in the urine. This disease may be acute or chronic. Symptoms of the disease include fever, headache, pain in the back vomiting, oedema (swelling of some parts of the body), loss of weight and hypertension.
ii. **Kidney stone (renal caulculi)**. Kidney stones may be produced when the water intake is low, salt intake is high or when the urine is either abnormally acidic or alkaline. Kidney stones are stony masses of minerals or organic matter which

crystallize in the kidney and narrow down the funnel of the tubules, thus obstructing the normal passage urine. This results in the infected person having difficult in passing urine and may also experience pain when passing urine. The urine may also contain albumin and blood. The kidney stones vary in size from very small sand-like particles to large masses which can block the renal pelvis. Kidney stones may be removed by surgery.

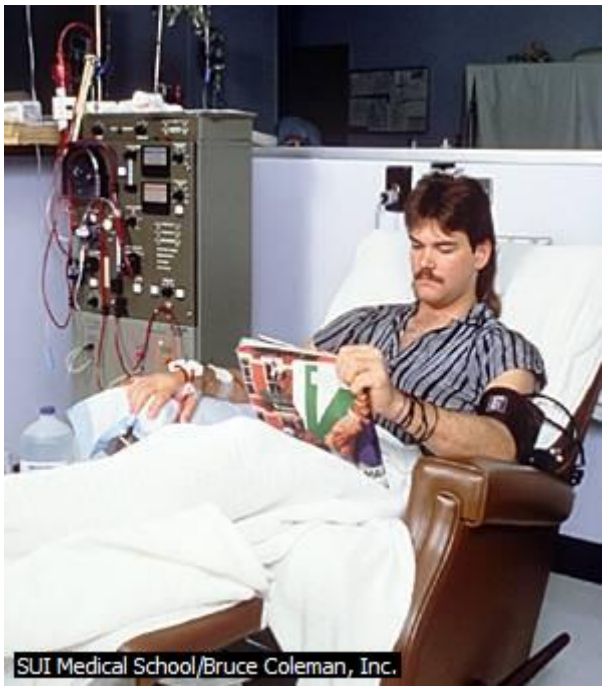
iii. **Diuresis:** it is a condition of the kidney that leads to the production of large volumes of urine not long after water has been taken (usually less than an hour of taken water). The condition is complicated in diabetic patient. The cells of the lubules fail to reabsorb water from the glomerular filtrate. As a result, large quantities of dilute urine in diabetic patients are the result of reduction in the production of ADH.

iv. **Dropsy (Oedema):** this condition is caused by an accumulation of large quanity of intercellular fluid in the tissues, thereby making the affected part to swell up. Most often, this results from the inability of the cells of the kidney tubules to absorb water within the blood.

v. **Kidney failure:** this is a condition whereby the kidney stop working and can no longer remove wasters and concentrated urine. It could be caused by injury to the kidney, high blood pressure, poisoning and dehydration. Sudden interruption of blood to the kidney also leads to kidney failure.

EVALUATION:

1. State three functions of kidney.
2. With an aid of well labelled diagram, describe the structure of the kidney.
3. State three functions of the kidney and discuss any are of them.



Kidney Dialysis

A hospital patient whose kidneys have ceased to function receives dialysis. In this process, the patient's blood is pumped through a dialysis machine, where it is filtered to remove waste products, then returned to the patient's body through a vein.

THE EFFECTS OF THE KIDNEY DISEASE AND REMEDIES

Most of the disease condition of the kidney gave rise to the following:

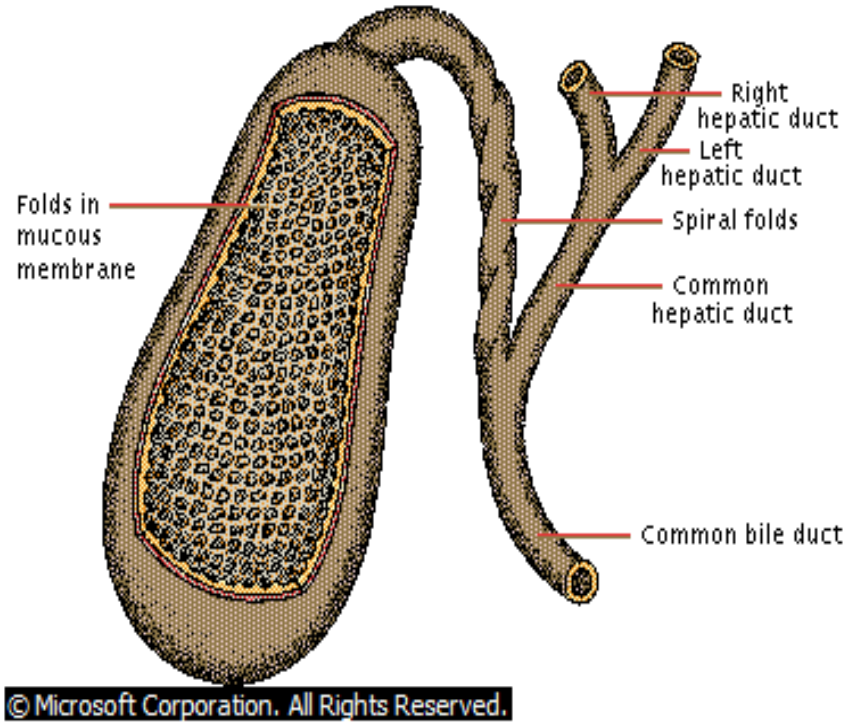
i. Alteration of the normal concentration of substances in the urine.
ii. Inefficiency of the kidney in removing waste products from the body.
iii. Retention of waste products in the body.
iv. Poisoning of the cells of the kidneys.
v. Death in some cases.

Remedies to kidney diseases

i. Immediate medical attention should be sought by people with diagnosed or suspected cases of kidney diseases.
ii. Drugs could be used to treat kidney diseases. Drug used to lower blood pressure can also slow down the progression of kidney disease.
iii. Patients with kidney failure can undergo either dialysis or kidney transplant. Dialysis is an artificial blood clearing process, while transplant involves total removal of the diseased kidney and replacing it with a healthy kidney from a donor. In dialysis the patient blood is passed through a machine which removes the wastes from the kidney.
iv. Patients with kidney disease should avoid high protein diets.
v. Surgery: kidney stones can be removed surgically in a process called nephrectomy.

EVALUATION:

1. State three functions of the kidney.
2. With an aid of well labelled diagram, describe the structure of the kidney.
3. Explain how the kidney regulates the amount of water in the blood.
4. Name four kidney diseases and their remedies.



Gallbladder

Located under and attached to the liver, the gallbladder serves as a reservoir for bile. As it is produced by the liver, bile passes to the gallbladder through a small tube called the cystic duct. The gallbladder's muscular walls absorb excess water and, when stimulated, contract to squirt concentrated bile through the biliary ducts and into the small intestine, where it aids in digestion.

ASSIGNMENT

1. **With the aid of well labelled diagram, describe the structure of the kidney and the nephron**

WEEK 7: MID-TERM BREAK

HOLIDAY PROJECT

1a Define Hormones
1b List five animal hormones
1c State the functions of the endocrine glands
2a Use a table to show a list of five endocrine glands, their locations and functions
b Use a diagram to show the locations of the endocrine gland in humans
3a List five hormones found in plants
b State two functions each of plant hormones listed above.
4a. Write short notes on the following:
(i) Endocrine glands of the gonads.
(ii) Diabetes mellitus.
(iii) IAA (Indole- Acetic Acid).

WEEK 8

TOPIC: REGULATION OF INTERNAL ENVIRONMENT (LIVER AND SKIN)

CONTENT:

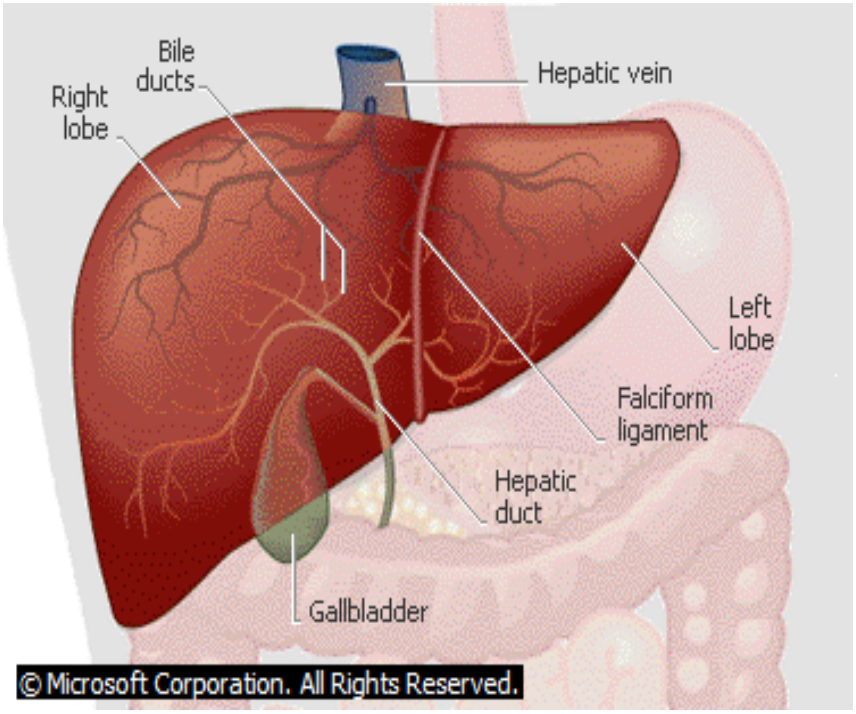
1. The liver
   (i) Structure, functions and diseases of the liver, bile products
   (ii) The effects of liver diseases and remedy.
2. The Skin

Structure of the liver

The liver is the largest gland in the body. It is located on the right side of the upper end of the abdomen, just below the diaphragm.

The liver is a reddish brown soft and well vascularised organ which consists of four lobes, two of which are very prominent. These are the right lobe which is the largest, the left lobe, the quadrate lobe and the candate lobe. The quadrate and candate lobes are small in size and lie behind the right lobe. Each lobe of the liver is made up of smaller units called lobules.

The liver is spongy in texture. Blood enters the liver through the portal vein. The gall bladder is found on the side of the right lobe.



Liver

The liver has many functions, among them the synthesis of proteins, immune and clotting factors, and fat-carrying substances. Its chief digestive function is the secretion of bile, a solution critical to fat emulsion and absorption. The liver also filters drugs and poisons from the bloodstream, neutralizing them and excreting

them in bile. When chronic liver disease leads to cirrhosis, all of these vital functions become impaired, causing complications throughout the body.

FUNCTIONS OF THE LIVER

The liver performs a number of functions and it is one of the most important organs concerned with metabolism, storage and detoxification.

Functions of the liver include the following:

1. **Control of glucose level:** the liver controls the amount of glucose in the blood stream. The optimum blood sugar level in man's about 90mg/cm^2/blood. Any amount in excess of this, the kidney first would attempt excreting it in urine and the liver follows by converting it to glycogen for storage. Any shortage from the optimum blood sugar level causes brain damage and the liver would again convert the store glycogen for release into the blood to prevent damage to brain cells. In the liver glucose is converted to glycogen is reconverted by glucagon (a hormone) to glucose when the body requires more glucose.
2. **Protein metabolism (Deamination):** deamination is the process by which the liver breaks down excess protein in the form of amino acids in the liver into ammonia to be excreted by the kidney. The liver is responsible for amino acids levels in homeostasis. When protein is in excess, the liver breaks down the excess nitrogen containing amino acids and then converts it to urea which is also excreted by the kidneys. Liver also converts keto acids to glucose, glycogen and fats.
3. **Manufacturing of plasma and protein, globulins, fibrinogen and bile.**
4. **Liver is a storage organ** for soluble vitamins such as A, D, E, K and water soluble vitamins such as B and C. Mineral ions of Zink, copper and potassium are stored in the liver.
5. **Formation of red blood cells** in foetus and lysis of red blood cells in adults. Haemoglobin released from worn-out red corpuscles destroyed in the bone marrow and the spleen is broken down by the formation of bile.
6. **It is involved in the de-toxication of toxin**, drugs and medicines, food preservations and additives as well as pollutants in air and water.
7. **Production of heat:** the liver produces heat which is distributed in the body through the circulatory system. The heat keeps the body warm.
8. **Production of prothrombin:** The enzyme ptothrombin, which takes part in blood clotting, is produced in the liver.
9. **Removal of lactic acid:** lactic acid, formed as a waste product by muscles during vigorous exercise is removed by the liver and converted into glycogen.
10. **Action on fats:** the liver acts on saturated fats and removes hydrogen, forming unsaturated fats. This is called desideration. The cell in tissues can use these unsaturated fats for their respiration.

Bile products

The liver metabolises and excretes many substances and toxins into the bile, thus eliminating them. One of the most important wastes thus eliminated is bilirubin. Bilirubin is a useless and toxic breakdown product of haemoglobin. The iron component is recycled. If in excess, bilirubib accumulates in extracellular fluid, a yellow discolouration of the skin, sclera and mucous membrane is observed. This condition is called jaundice.

Gall stone

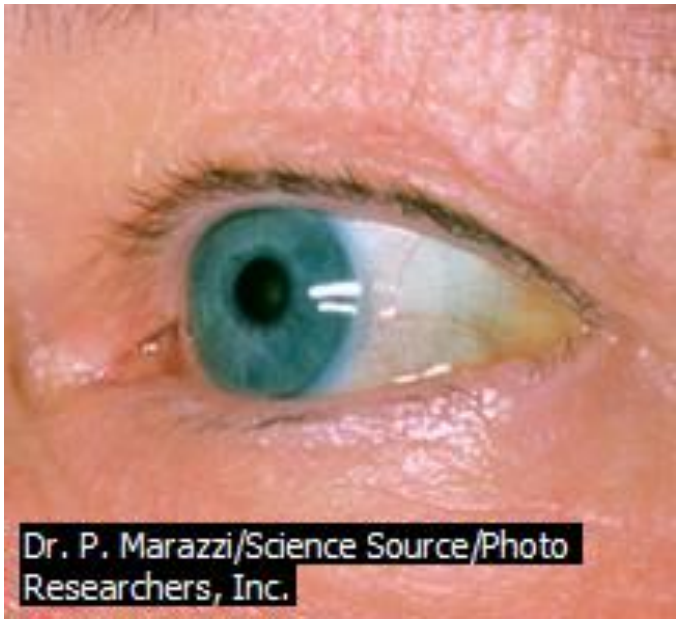
It is a crystalline growth formed within the gallbladder by accumulation of bile components. Presence of gall stones in the gall bladder may leads to inflammatory condition in which bile is retained in the gall bladder. It may cause obstructive jaundice. The condition could be treated using appropriate drug, ultrasonic shock waves or by surge**ry.**

THE EFFECTS OF LIVER DISEASES AND REMEDY

Some of the common liver diseases are

i. Jaundice,
ii. Cirrhosis
iii. Viral hepatitis,
iv. Gallstone,
v. Amoeba liver abscess

i. **Jaundice:** it is a disease characterised by yellowing of the eyes and skin. It results from the breakdown the red blood cells leading to increased production of bilirubin. Inherited red blood cell defects such as sickle cell may also cause it in newborn. Excessive destruction of the red blood cells in the case of infections like malaria could also lead to jaundice. Some poisons cause lysis of the red blood cells and release of bilirubin. When the bile duct is obstructed by gall stone or some other object, a back flow of bile and accumulation may lead to increase concentration of bilirubin in the blood. Additionally, this disease is also characterised by the passing of pale stool and yellow to dark brown urine. When the liver is diseased and its cells are damaged that they are no longer able to absorb bilirubin**.**



Jaundice

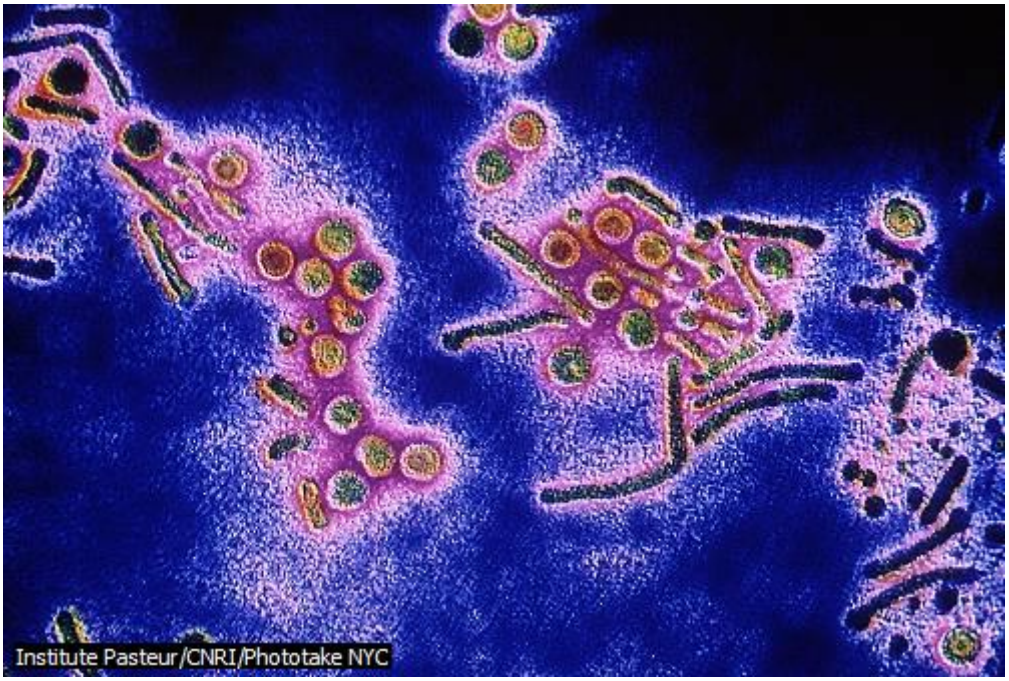
Jaundice is a yellow discoloration of the skin, the mucous membranes, and the whites of the eyes. The yellow color is caused by an excess of bile pigments in the blood. Jaundice can be caused by many different disorders, including hepatitis, cancer, and gallstones. It is sometimes a symptom of cirrhosis.

ii. **Cirrhosis:** it is a condition in which the liver tissue gradually turns from the soft highly vascularised texture to fibrous hard and irregular form. It is known to have a variety of causes, including hepatitis infection and excessive drinking. In many cases however, it is difficult to trace it to any particular cause.

iii. **Viral hepatitis:** the disease is characterised by inflammation and destruction of liver cells. There are two major types based on the type of virus.

Hepatitis A virus cause infection hepatitis and it is usually transmitted via the oral faeces route when an individual takes contaminated water, milk or food. Jaundice is one of the symptoms.

Hepatitis B causes what is called the serum hepatitis and this is usually transmitted via blood transfusion or exchange of body fluid or infected blood products. When hepatitis is unchecked, it may lead to complete damage of the entire liver tissue.



Hepatitis B Virus

The hepatitis B virus (HBV) is passed from person to person through contaminated body fluids. Although transmission can occur in many ways, the most important mode of transmission in the United States is sexual contact.

MANIFESTATION OF LIVER DISEASE

The common symptoms and signs of liver diseases include the following:

i. Weakness and tiredness
ii. Slight fever
iii. Jaundice
iv. Oedema (especially in the abdomen)
v. Enlarge and tender liver (in the case of hepatitis and liver abscesses)
vi. Biliary colic (in the case of gall stones lodged in the bile duct)

SUB TOPIC 6: THE SKIN

The skin is the outer covering of the body. It covers the entire body surface and it is thickly covered with hair in most mammals but in man, it is sparsely covered except the head where the hair is thick and long

Structure of the skin

The skin is made up of two main layers:

1. The external epidermis
2. The dermis

1. THE EPIDERMIS

The epidermis is made up of three layers, namely

i. The cornified layer

ii. The granular layer and

iii. The malpighian layer

i. **The Cornified layer** is the outermost layer of the skin. It is composed of dead cells. It is scaly and the dead constantly peel off it. The dead cells are impregnated with keratin, a fibrous protein. The cornified layer is well developed and very thick in the sole of the feet and palms of the hands. As the cells of the cornified layer are sloughed, they are constantly replaced by new cells from the granular layer

ii. **The Granular layer** is the middle layer of the epidermis containing living cells rich in keratin. The cells are constantly pushed up and flattened out to replace the cells of the cornified layer as dead cells.

iii. **The Malpighian layer** is made up of cells that are actively dividing. They are unboidal cells that are constantly being pushed up to replace cells in the granular layer. They are rich in melanin (the pigment which impact colour to the skin). The layer has many folding into the dermal layer where sebaceous glands and hair follicles are located. Because they are also actively growing, they are well supplied with nutrient and oxygen by the capillaries in the dermal layer.

Skin Cancer

The dark patch on this person's lower leg is a dangerous form of skin cancer known as malignant melanoma. Overexposure to ultraviolet radiation in sunlight is the cause of most skin cancers.

2. THE DERMIS

The dermis is thicker than the epidermis. It is made up of connective tissues. Most of the special structures of the skin including blood capillaries, hair follicles, sweat gland sensory nerve ending, sebaceous glands and fat cells are located here.
Blood capillaries supply the dermis and lower epidermis with nutrient and oxygen. They also remove wastes. They form a network around the root of the hair follicles and sweat glands.

Hair follicles contained the hairs of the skin. The hair follicle is an invargination into the dermal layer which is the lining with malpighian layer. The hair is a shaff made up of keratin with a bulbous base which is richly supplied with blood capillaries and nerve endings. The nerve endings are what makes the hair very sensitive to touch. Also attached to the base of the hair is the erector muscle.

The rector muscle contracts when the weather is clod causing the hair to become erect. This also happens when the animal is in fear. This is what gives rise to the so called goose pimples.

Sebaceous gland is a bulbous gland lined with malpighian cell layer on the side of the hair follicle. It secretes oil called sebum which helps to keep the hair and epidermal layer oily and water proof. It also wards off micro-organisms.

Sweat gland is a coiled tube embedded in the dermis that leads to an opening on the skin surface called sweat pore via the sweat duct. The capillaries associated with sweat gland release water and mineral salts; the mineral salts and water form what is called sweat which moves to the skin surface as droplets of water. This has both excretory and regulatory functions.

Sensory nerve endings: The skin is a veritable sense organ with many different types of sensory receptors and nerve endings. Some of these receptors include touch receptor (meissners corpuscle), pressure receptors (pacinian corpuscles) pain receptors (free nerve endings) and thermo receptors wider so that more blood flows to the surface and heat is lost by radiation and convention.

The sweat glands absorb fluid from the blood capillaries, which passes out sweat through the sweat pores

On evaporation of the sweat, a cooling effect is produced in the body and the body temperature is reduced.

Wart on Human Skin

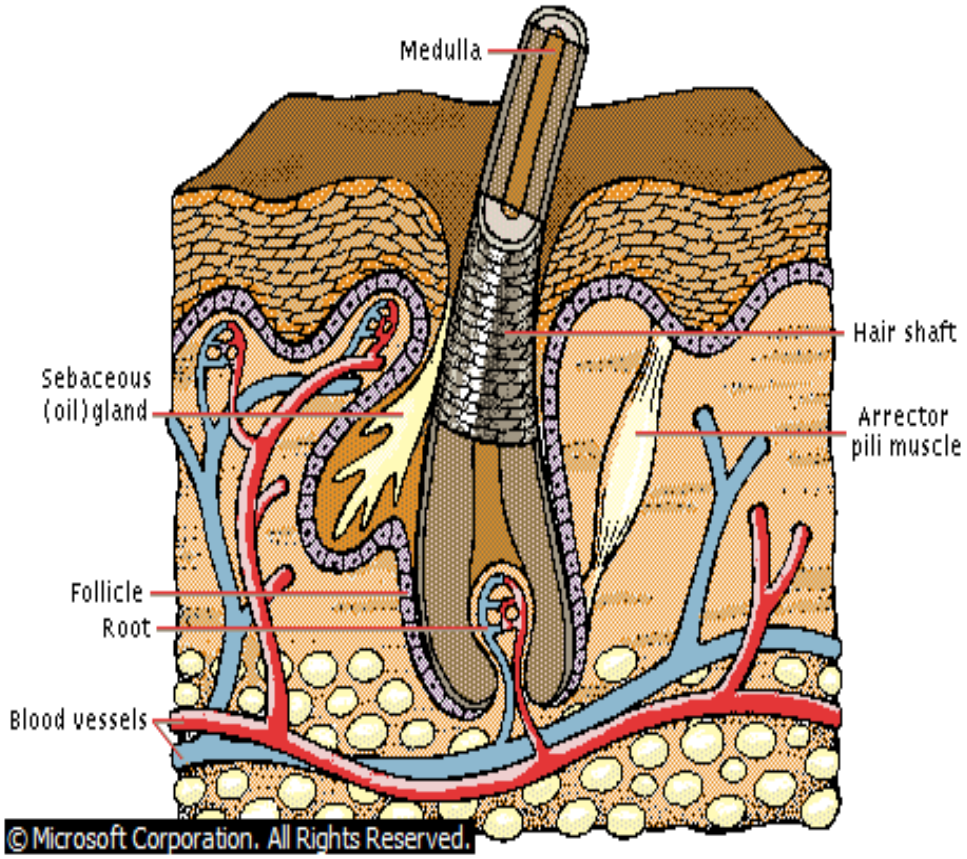
Warts, caused by the human papillomavirus, are generally harmless, benign tumors on the surface of the skin. Occasionally painful when they occur on the feet (plantar warts), warts can be treated with various medications or removed using freezing, burning, X rays, or surgery.

CARE OF THE SKIN

The skin is constantly in contact with the external environment and liable to be dirty and its function negatively affected. Although the outer layer is made up of dead cells, the pores and hair follicles and bruises when these occur are portals of entry of germs if not kept clean. Hence the need to take appropriate hygiene steps.

Some of these include:

i. Regular cleaning of the skin and keeping of moist, particularly avoiding oily body cream in hot weather
ii. The use of cosmetics which are likely to remove the melanin pigment should be avoided
iii. Regular intake of vitamins A and B2 (riboflavin) helps to maintain a healthy skin
iv. A regular exercise helps to keep the sweat pores and ducts clean and functional



Hair Growth

A hair grows upward from the root. Lengthening fibers of keratin-filled dead cells, grouped around the semihollow medulla, make up the cortex. A living structure called the bulb (visible as a white lump at the end of a plucked hair) surrounds and feeds the root, which lies in a pocket of the epidermis called the follicle. Hair grows fastest when it is short.

EVALUATION

1. With the aid of a suitable diagram describe the structure of mammalian skin
2. List five functions of the skin
3. Explain how the skin regulates body temperature
4. State three ways of taking care of the skin

(Defect changes in temperature)

The adipose tissue is a layer of fatty connective tissues below the epidermis. It serves as store for food supply and as an insulating layer.

FUNCTIONS OF THE SKIN

The skin performs a number of functions such as protection against entry of pathogens and excessive water loss, insulation, temperature regulation, sensation (sensitivity) and synthesis of vitamin

i. **Protection:** protection from cuts and scratches is provided by the horny (cornified) layer and also with the help of hair in some parts, such as the head. Also, the dead cells that form the cornified layer together with oily secretions from the sebaceous glands protect the body from excessive evaporation of water from dying and from penetration of germs
ii. **Sensitivity:** sensitivity is provided by the various types of nerve endings, each being sensitive to one particular type of stimulus. Each nerve ending, when stimulated initiates an impulse, which passes along a nerve to the brain, where it is interpreted as pain, heat or pressure. With the nerve endings, we can also distinguish grades of roughness and smoothness, which we call a sense of texture
iii. **Excretion:** the sweat gland of the skin secretes sweat which contains water, salts and urea
iv. **Production of vitamin:** The skin produces vitamin D on exposure to early morning sunlight
v. **Regulation of body temperature:** Animals whose body temperature varies according to changes in their external surroundings are said to be poikilothermic e.g fish, amphibians and reptiles). Birds and mammals whose body temperature remains constant regardless of the changes in the temperature of their external environments are said to be homeothermic. The mammalian skin helps to regulate the body temperature in specific ways. In a hot surrounding or weather a mammal keeps its body temperature constant in the following ways. The blood vessels close to the skin surface dialate

OBJECTIVE QUESTIONS

1. The condition known as cretinism is caused by the deficiency of (a) adrenalin (b) insulin (c) thyroxine (d) vitamin
2. Over-secretion of thyroxin is likely to lead to (a) dwarfism (b) reduced metabolism (c) thinness of body (d) Sluggishness
3. The hormone which tones up the muscles of a person in the time of danger is from (a) thyroid gland (b) adrenal gland (c) gonads (d) pancreas
   A dwarf plant can be stimulated to grow to normal height by the application of (a) thyroxin (b) gibberellins (c) ethylene (d) abscisic acid
4. An example of a ductless gland is (a) sweat gland (b) gall bladder (c) salivary gland (d) pituitary gland

EVALUATION

1. What are the functions of the skin?

2. Describe how the skin maintains a fairly constant internal environment in the body of the animal it covers.

WEEKEND ASSIGNMENT

Make a labelled diagram of the mammalian skin.

WEEK 9

TOPIC: THE NERVOUS SYSTEM I

CONTENT:

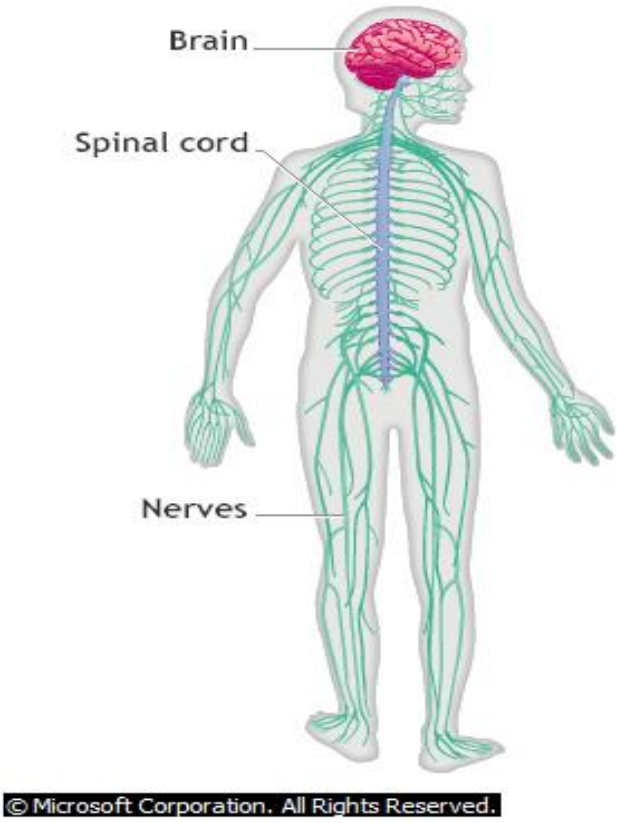
(1) Organization of the nervous system
    (i) Central Nervous System (CNS)
    (ii) Peripheral Nervous System (PNS)
(2) The Brain-position, structure and functions
(3) The Spinal Cord-position, structure and functions

SUB-TOPIC 1: ORGANIZATION OF THE NERVOUS SYSTEM

In a complex multicellular organism many activities go on almost simultaneously. These activities are coordinated by the endocrine and nervous system. The two systems are linked by the hypothalamus.

The basic structural unit of the nervous system is the nerve cell (neurons). The nervous system is made up of millions of neurons.

The main parts of the nervous system are the central nervous system and the peripheral nervous system.



THE CENTRAL NERVOUS SYSTEM (CNS)

This consists of the **brain** and the **spinal cord**. The CNS coordinates the activities of the nervous system. It receives impulses from the organism's internal and external environment, processes and integrates the information and sends out impulses to appropriate effector organs to take action.

The CNS has millions of interconnected nerves which are of two types;

i. the **cranial nerves** come out of the brain and enter mainly structures in the head (e.g. the eyes and ears).

ii. The **spinal nerves** come out of the spinal cord and go into the arms, legs and various structures in the trunk.

EVALUATION

1. State two differences between the endocrine system and the nervous system.
2. Mention the major parts of the nervous system

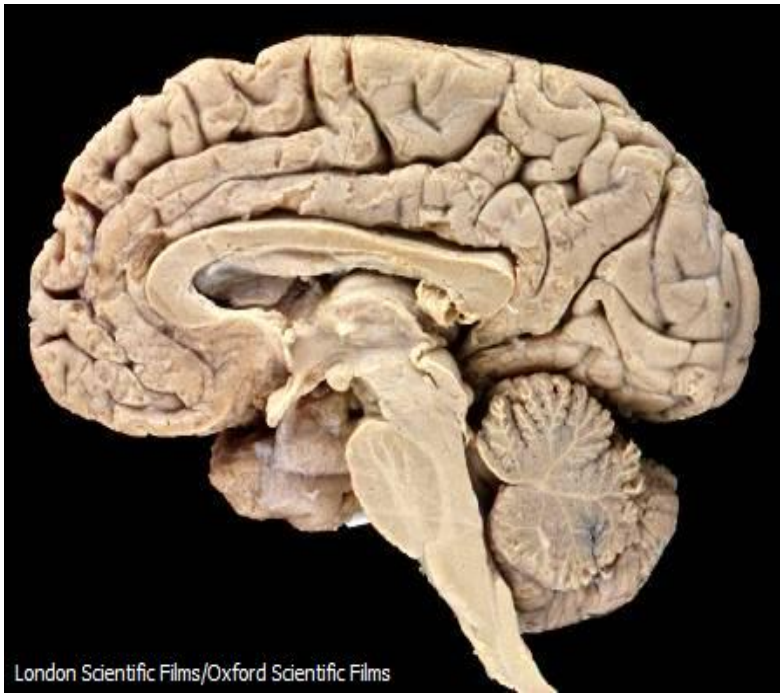
SUB-TOPIC2: THE BRAIN.

The human brain is made up of billions of neurones which form the grey matter (nerve fibres). The grey matter occupies the peripheral region, while the white matter is situated in the central portion of the brain.

Within the white matter lie hollow chambers called ventricles. The ventricles contain cerebrospinal fluid and are continuous with the spinal cord.

The cerebrospinal fluid is formed from the blood and returns to the blood stream after bathing the neurons, supplying them with oxygen and nutrients as well as removing wastes. The fluid

also acts as a shock absorber, so the brain is cushioned from damage when a person jumps around or bangs the head against an object.
The adult human brain weighs about 1.2 to 1.4 kilograms and forms about 2% of the body's mass. The brain is protected by the cranium or brain case.



Human Brain

The human brain has three major structural components: the large dome-shaped cerebrum (top), the smaller somewhat spherical cerebellum (lower right), and the brainstem (center). Prominent in the brainstem are the medulla oblongata (the egg-shaped enlargement at center) and the thalamus (between the medulla and the cerebrum). The cerebrum is responsible for intelligence and reasoning. The cerebellum helps to maintain balance and posture. The medulla is involved in maintaining involuntary functions such as respiration, and the thalamus acts as a relay center for electrical impulses traveling to and from the cerebral cortex.

The vertebrate brain is made up of three regions;

1. The Fore brain,
2. The Mid brain
3. The Hind brain.

1. THE FORE BRAIN,
This is associated with higher brain functions like intelligence and speech.

It is made up of three main parts, namely,

i. The Cerebrum,
ii. The Thalamus and
iii. The Hypothalamus.

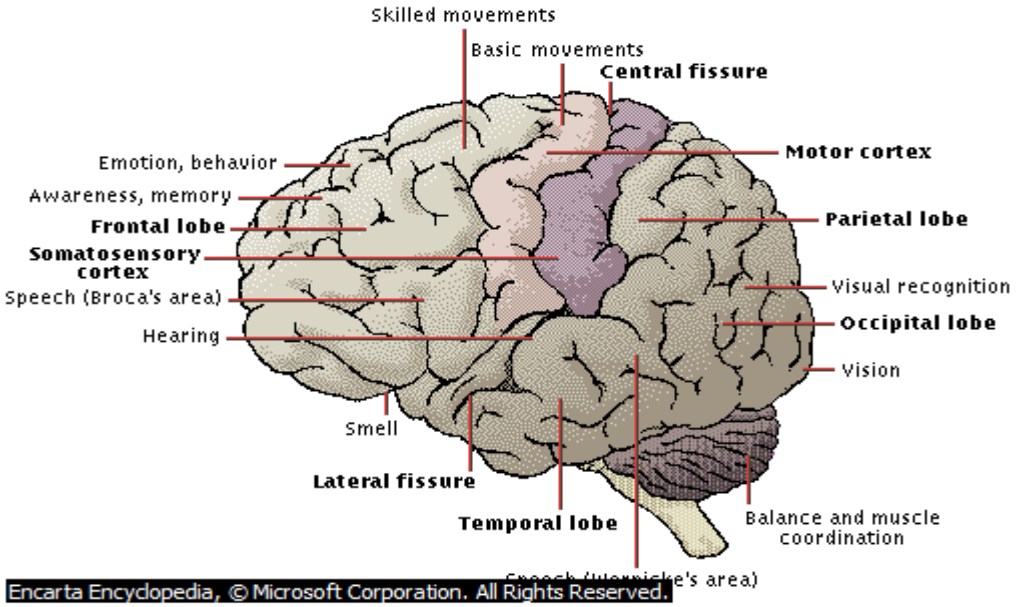
i. **Cerebrum:**

This is made up of two halves, the right and left cerebral hemispheres. The two halves are bound by fibres called the corpus callosum, which keeps each hemisphere informed about the other.

Each hemisphere has four distinct lobes namely;

a. Frontal lobe (in front)
b. Parietal lobe (at the top)
c. Temporal lobe (at the side)
d. Occipital lobe (at the back)

The most active part of the cerebrum is its outer layer, the cerebral cortex, which is composed of grey matter. It is highly convoluted to increase its surface area and consequently the number of neurones thus increasing the capabilities of the cerebrum.
The cerebral cortex is the seat of intelligence, speech, memory, learning, imagination and creativity. The left hemisphere controls the right side of the body while the right hemisphere controls the left part of the body.



ii. The Thalamus

There are two thalami, each one is an oval body attached to the back end of the cerebrum. They act as the relay centres for receiving and transmitting sensory information to relevant parts of the cerebral cortex. They also transmit outgoing motor impulses from the cerebral cortex.

iii. The Hypothalamus

This is an ovoid body projecting below the thalami. It is a controlling centre for the autonomic nervous system. It plays a homeostatic role by regulating temperature and endocrine secretions. Signals from it also trigger feelings of hunger and thirst. It also influences emotions like anger, pain and pleasure.

2. THE MIDBRAIN

This is the portion between the fore-brain and hind-brain. Specific portions control the reflexes of sight and hearing. Associated with these are the movements of the head when focusing on an object and the detection of sound.

3. THE HINDBRAIN

It is composed of three parts;

i. The Cerebellum,
ii. The Pons varolli and
iii. The Medulla oblongata.

i. The Cerebellum

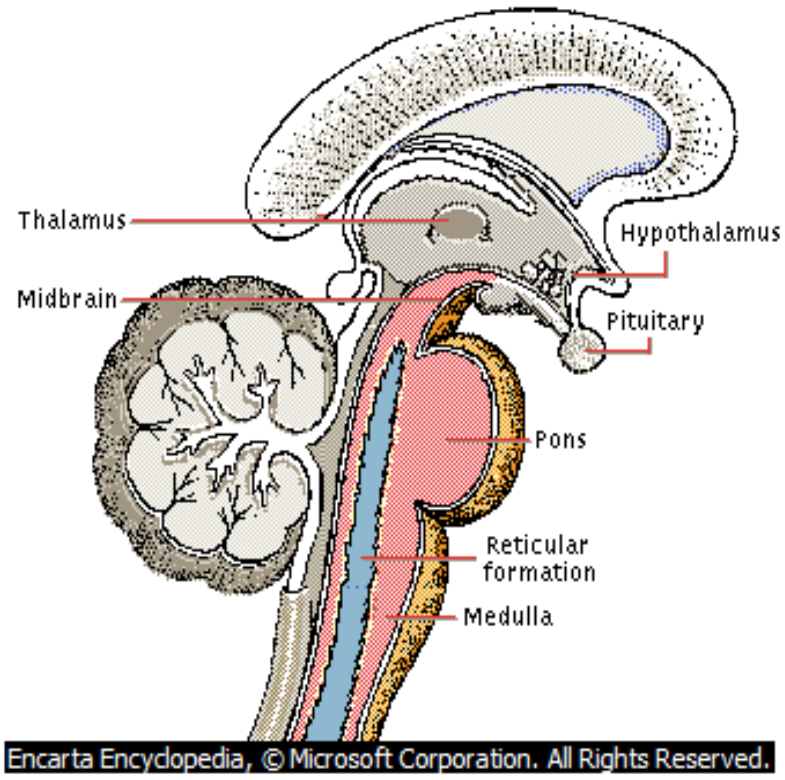
The Cerebellum is tri-lobed. There is one median lobe and two lateral cerebellar hemispheres. It controls and coordinates body posture and muscular movements, especially those that maintain the body's balance.

ii. The Pons varolli

The Pons varolli is a wide band of fibres that connect the lateral cerebellar hemispheres.

iii. The Medulla oblongata

The medulla oblongata is the posterior portion of the brain and continues into the spinal cord. It has an outer region of white matter and an inner region of grey matter. It controls involuntary movements like those involving respiration, digestion, heartbeat, constriction and dilation of blood vessels.



The Stem of the brain

EVALUATION

1. Discuss briefly the position and structure of the brain.
2. What are the functions of the brain?

SUB-TOPIC 3: THE SPINAL CORD

The spinal cord is composed of a soft white tissue running from the medulla oblongata to the tail region. It is protected by the bones of the vertebral column and passes through the neural canal. It is enveloped by three membranes called the menninges which further protect it. A narrow spinal canal filled with cerebrospinal fluid runs through the centre of the spinal cord. The spinal cord has an inner area of grey matter and an outer region of white matter. The grey matter is composed of the cell bodies of the neurones in the spinal cord while the white matter is made up of the nerve fibres which emanate from the cell bodies. Many of the nerve fibres leave the spinal cord at intervals as spinal nerves and run to all parts of the body. Some others run longitudinally along the spinal cord to the brain. The nerve fibres may be concerned with spinal reflexes or may carry sensory impulses to the brain or motor impulses from the brain to the muscles and other organs of the body.

Functions of the Spinal Cord

1. It coordinates simple reflex actions such as knee jerk and automatic reflexes such as sweating.
2. It connects all peripheral pathways to the brain.

EVALUATION

1. Describe the spinal cord.
2. What are the functions of the Spinal cord?

OBJECTIVE TEST

1. The cells that transmit messages to receptors are …… (a) Hair cells (b) motor neurones (c) effectors (d) sensory neurones
2. Coordination is achieved in the body of mammals through the action of
(a) Endocrine and nervous systems (b) circulatory and nervous system (c) muscular and nervous system (d) Skeletal and nervous system.
3. The central nervous system is made up of … (a) brain and liver (b) brain and kidney (c) brain and spinal cord (d) liver and kidney.
4. The part of the central nervous system responsible for withdrawing the hand from a hot object is the …. (a) Brain (b) motor neurone (c) spinal cord (d) sympathetic nervous system.
5. The part of the brain responsible for the control of voluntary actions and interpretation of sensations is (a) cerebellum (b) cerebrum (c) medulla oblongata (d) pons varoli

ESSAY TEST

1. What are the structural differences between the brain and spinal cord?
2. In a table differentiate the functions of the brain and spinal cord.

WEEKEND ASSIGNMENT

Examine the brain and spinal cord of sheep and make well labeled diagrams

WEEK 10

TOPIC: THE NERVOUS SYSTEM II

CONTENT: 1.The Peripheral nervous system
2. Structure and functions of a neurone
3. Reflex and voluntary actions

SUB-TOPIC 1. THE PERIPHERAL NERVOUS SYSTEM (PNS)

The peripheral nervous system links the CNS with the body's receptors and effectors in mammals. When receptors pick up impulses of change in the environment, messages are sent to the CNS which integrates the information and sends appropriate messages to the effectors accordingly.

The peripheral nerves are of two types;

i. the spinal nerves connected to the spinal cord and
ii. the cranial nerves, connected to the brain.

The spinal nerves serve the receptors and effectors in the other body parts.
The cranial nerves are associated chiefly with the receptors and effectors in the head, while

The PNS consists of

i. The Somatic nervous system (SNS) and
ii. The Autonomic nervous system (ANS).

i. **Somatic Nervous System**

The nerves of the SNS principally serve the parts of the body which take part in responses to external stimuli (e.g. sense organs, limb muscles and glands) and voluntary activities. Nerve fibres without synapses extend from the brain through the spinal cord to the skeletal muscles. The motor neurones stimulate the effectors. The SNS also controls the emptying of the bladder and the opening of the anal sphincters.

ii. **Autonomic Nervous System**

The ANS is concerned with control of the bodies involuntary activities e.g. heartbeat, movements of the gut and secretion of sweat.

The ANS consists of two parts;

a. The Sympathetic and
b. The Parasympathetic systems.

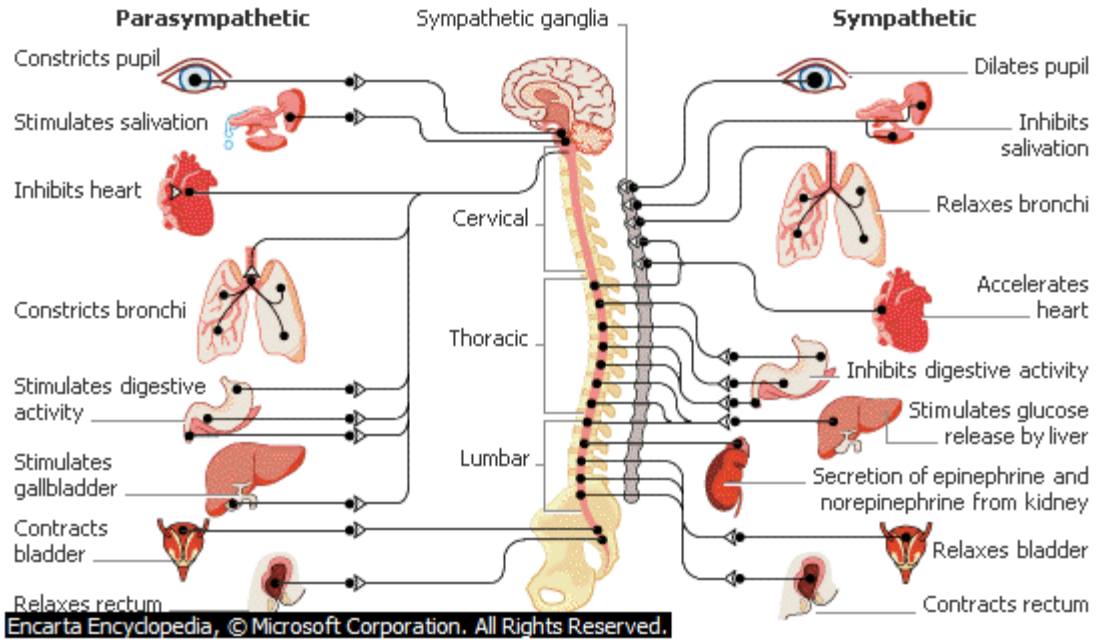
Both contain nerve fibres serving structures over which the body has little or no voluntary control. In both cases nerve fibres from the brain or spinal cord pass into the organs concerned. Along the course of each pathway there is a complex set of synapses forming a **ganglion**.

a. **In the sympathetic system,** the ganglia lie alongside the vertebrae close to the spinal cord.

b. **In the parasympathetic system**, the ganglia are embedded in the wall of the effector itself. The effects produced by the two systems generally oppose one another (antagonistic).

Thus, if the sympathetic system causes a certain muscle to contract, the parasympathetic system relaxes it.

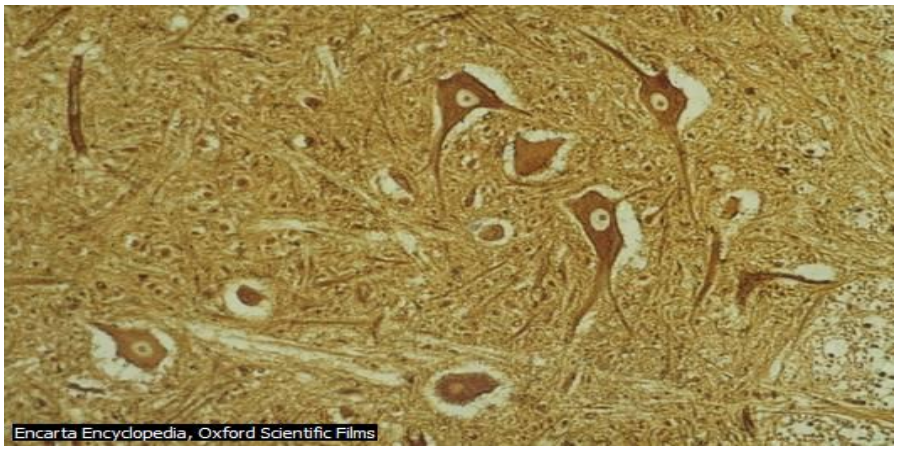
The following is a diagrammatic representation of the autonomic nervous system showing its connections with the central nervous system and its effects on some internal organs.



The Autonomic nervous system

The Neurone

The neurone is the basic structural unit of the nervous system**. It consists of a cell body and protoplasmic processes called nerve fibres** which are tied up in bundles called nerves. **It is specialized for transmitting electric impulses**. Mature neurones have lost their ability to regenerate.



Nerve cells

Structure of a Neurone

A Neurone has three basic parts;

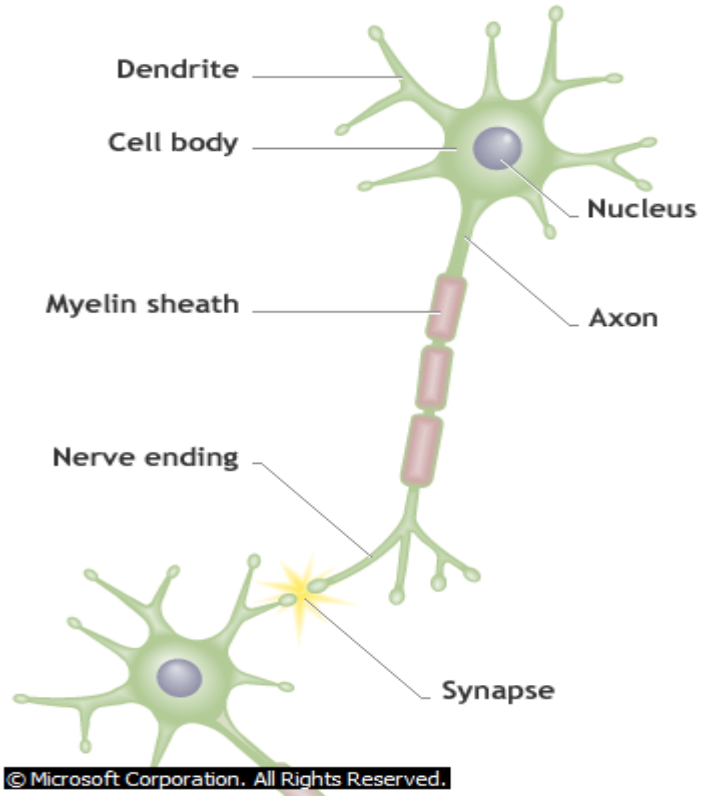
i. A cell body
ii. Dendron
iii. The axon

i. A cell body: this may be star-shaped, oval or angular. It has a large nucleus and dense granulated cytoplasm which gives it a greyish colour. The golgi apparatus manufactures vesicles containing chemicals needed for the transfer of electric impulses.
The cell body relays impulses to the axon

ii. Dendron with branches called dendrites: dendrons carry nerve impulses that their dendrites receive to the cell body.

iii The axon ending in synaptic knob(s): this carries electric impulses away from the cell body to their destination. The synaptic knobs release chemicals that bring about transfer of electrical impulses from an axon to the target cells.

Neuron



The nervous system is made of bundles of cells called neurons. Neurons are found throughout your body. They send electrical signals that direct all of your body's activities, including thinking, breathing, and moving. These signals travel along the length of one neuron and jump to another neuron over a gap called a synapse.

There are different types of neurons

i. **Based on their functions**
ii. **Based on number of axons they possess**

i. Based on their functions

a. Sensory (afferent) neurone: this receives impulses from receptors and passes them towards the CNS.
b. Motor (efferent) neurone: this receives impulses from the CNS and passes them to the effector.
c. Relay/ association neurone: this transfers impulses from the sensory neurones to the motor neurones.

ii. Based on number of axons they possess

Neurones may also be grouped according to the number of axons they possess, thus, there are

i. Unipolar (one axon)
ii. Bipolar and (two axons)
iii. Multipolar neurons (more than two)

NERVE IMPULSES

A nerve impulse is a wave of electrical activity travelling along a neurone.

Nerve impulses are transmitted along a neurone in two main ways;

i. Electrical and
ii. Ionic (chemical) means.

i. Electrical Transmission

When an axon is in the resting state, its inside is negatively charged and its outside is positively charged. Thus the membrane surrounding the axon is polarized. This is called its resting potential.
When an impulse passes through the axon, its inside becomes positively charged and its outside becomes negatively charged. This is the action potential and the nerve membrane becomes depolarized for a short time after which the original resting potential is restored.
Once an action potential is set up, it moves rapidly along the neurone until it reaches the end of the axon.

ii. Ionic (chemical) Transmission

When an axon is at rest, the membrane is polarized i.e. its outside is positively charged and the inside is negatively charged. A resting neuron actively pumps out sodium ions (Na^+) out through the cell membrane and retains chloride ions (Cl^-). As each sodium ion is pumped out a potassium ion (k^+) is pumped into the cell. The potassium ions leak out again but the sodium ions cannot move in because the sodium gates are closed. This results in the polarization of the neurone. An electric potential difference thus exists across the membrane of the neurone.

When an impulse passes along the axon, the membrane suddenly becomes depolarized and permeable to sodium ions. This reverses the resting potential i.e., the inside of the axon becomes positively charged and the outside negatively charged, thus an action potential is set up. Small local currents on both sides of the membrane (at the leading end of the region of

polarization) excite the next part of the axon, so that an action potential is propagated along the whole length of the axon.

Impulses are set up in nerve cells as a result of excitation of the receptors. Nerves are stimulated by mechanical, osmotic, chemical, thermal and electrical stimuli. If the strength of a stimulus is below certain threshold intensity no action potential is evoked. Further increase in intensity of the stimulus however does not give a larger potential. A stimulated neurone therefore acts in an all-or-none manner.

Transmission of the impulse across the synapse occurs by chemical means. When an impulse arrives at a synapse a chemical substance, acetylcholine, is released. This diffuses across the gap and causes excitation of the adjacent nerve cell.

The synapse prevents impulses from going in the wrong direction i.e. an impulse can only go in one direction across a synapse but it can go in either direction along an axon.

REFLEX AND VOLUNTARY ACTIONS

Actions are responses to stimuli. They involve the nervous and endocrine system. There are two main action patterns;

i. The Reflex action
ii. The Voluntary action.

i. <u>Reflex Action</u>

Responses to a stimulus that are not controlled by will i.e. involuntary responses are called reflex actions. We are often not aware of our reflex actions though sometimes we may become aware of them shortly after doing them. Reflex actions help to protect us against danger and also to maintain equilibrium in both our internal and external environment.

Other examples of reflex actions are;

i. blinking of the eyes.
ii. Withdrawing the hand from a hot object.
iii. The knee jerk e.t.c.

The Reflex Arc

The reflex arc is the simplest pathway taken by a nerve impulse in mediating a simple response. In the simplest form it involves only two neurones; a sensory neurone and a motor neurone. For example in the knee jerk a sensory neurone synapse directly with a motor neurone.

The structures which take part in a reflex arc are;

i. The sensory receptor that detects the stimulus.
ii. The afferent neurone along which the sensory impulse is transmitted.
iii. The relay neurone in the central nervous system which passes the impulse from the afferent neurone to the motor neurone.
iv. The motor neurone which receives the impulse from the relay neurone
v. The effector muscle or gland which responds to the motor impulse with an appropriate action.

Some reflex actions involve only the spinal cord and are known as spinal reflexes e.g. the knee jerk while others involve the brain and are called cranial reflexes e.g. contraction of the pupils when a light source approaches them.

Complex Reflex Actions
A reflex action could be complex when the actions involve neurones at different levels of the spinal cord or the brain. Complex reflexes are also fast and automatic and produce stereotyped activities like simple reflexes, but they involve ascending and descending nerve fibres within and between the spinal cord and the brain.

ii. Voluntary Actions

These are actions which we think about first before doing them. These actions involve the brain and are usually the acts of will. They are consciously carried out e.g. a sudden withdrawal of the foot from a sharp object is a reflex action but going back to examine the foot and extract the object is a conscious or voluntary action.

Voluntary actions therefore;

i. Involve higher centres of the brain.
ii. Involve numerous neurones.
iii. Bring about comparatively sloe responses.
iv. Bring about responses that vary with circumstances.

The brain may also initiate a voluntary action without any sensory stimulation.

ANIMAL BEHAVIOUR

An animal's response to the changes in its environment is referred to as its behavior.
There are two main patterns of behavior;

i. Instinctive behavior.
ii. learned behavior.

i. Instinctive Behaviour

Reflexes which originate from birth are described as instinctive or innate. Example are the sucking reflex of an infant and the pecking action of a newly-hatched chick.

ii. Learned Behaviour

Behaviours which are not innate/ instinctive develop through use. These are learned from experience. When a reflex action is modified by experience, it becomes a conditioned reflex.
The conditioned reflex was first demonstrated by a Russian scientist, Pavlov (1910) who noticed that a dog will salivate when food was presented to it. Pavlov changed the experience by ringing a bell just before food was presented to the dog. This was repeated several times, and then he decided to ring the bell without presenting food. He noticed that the dog salivated on hearing the bell. Thus in a conditioned reflex the stimulus and response do not have to be related, just like the bell was in no way related to the food.

Many simple reflex actions are consciously modified by manipulating conditions; the results are learned (conditioned) behaviours. With time these become almost automatic.
The learned behaviours of walking, speaking, typing, swimming, playing on an instrument and driving a car are almost automatic.

EVALUATION

1. Define the following terms (a) neuron (b) reflex action (c) behaviour (d) conditioned reflex (e) voluntary action
2. Discuss two of the terms you have defined

WEEKEND ASSIGNMENT

In a tabular form, differentiate between the reflex action and conditioned reflex.

Week 11: Revision

Week 12: Examination