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BIOLOGY NOTES

XII

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CONTENTS

Chapter 1 HOMEOSTASIS

Definition:

The self maintaining system of the internal stability of the body is known as homeostasis.

FEED BACK SYSTEM:

Homeostasis requires a check & balance mechanism operating in the body. This check & balance mechanism is known as feedback mechanism.

Types of feed back system:

There are two types of feed back system.

- Negative feed back
- Positive feed back

Negative feed back:

It refers to opposite effect produced in relation to any change in body fluids.

Positive feed back:

It refers to the series of similar effects produced which leads to the enhancement of change under consideration.

OSMOREGULATION:

It involves maintaining balance b/w water & solute contents of cell.

Hypotonic soluton:

If the concentration of the solution is lower than the concentration of the cell sap, then such a solution is called hypotonic solution.

Hypertonic solution:

If the concentration of the solution is higher than the concentration of cell sap then such a solution is called hypertonic solution.

Plasmolysis:

The shrinkage of protoplasm due to exosmosis is called plasmolysis.

Osmotic pressure:

The potential energy of water molecules is known as water potential or osmotic pressure.

Isotonic solution:

The concentration of this solution is equal to the cell sap concentration.

Turgor presure:

Due to endosmosis the protoplasm of a cell expands & a starts to apply a pressure on the cell wall. This pressure is known as turgor pressure & in this condition the cell is said to be turgid.

Wall Pressure:

The pressure which is applied by the cell wall on the protoplasm due to the turgor pressure is called wall pressure.

OSMOREGULATION IN PLANTS:

Plants are distributed in different habitats on the basis of the availability of water.

- Hydrophytes
- Halophytes
- Mesophytes
- Xerophytes

HYDROPHTES:

Definition:

The plants which are found in fresh water either partly or completely sub merged are termed as hydrophytes e.g. Hydrilla, water Lilly, lotus, etc.

Characteristics of hydrophytes:

- Their roots are poorly developed because they have no problem in the absorption of water.
- The stems & leaves generally lack cuticle on their surface.
- Stomata are very large & present only on the upper surfaces of leaf.

HALOPHYTES:

Definition:

The plants growing in saline places are called halophytes.

Characteristics of halophytes:

- Their roots grow with the surface of soil because they have to absorb water from the upper surface of soil.
- The cells of the roots develop high water potential which brings in water by osmosis.
- The excess salt can be stored in cells or excreted from salt glands on the leaves.
- E.g. glasswort such as *Atriplex* species, *Chenopodium* species.

MESOPHYTES:

Definition:

These are most of the plants which grow in moderate water availability.

Characteristics of Mesophytes:

They can easily compensate the water lost by transpiration through absorbing water from the soil.

- To present the excessive transpiration they have thick cuticle on their outer surface e.g. *Brassica campestris*, *Rosa indica*, *Mangifera indica*.

XEROPHYTES:

Definition:

The plants living in dry places such as deserts, steep hills etc. are known as xerophytes.

Characteristics of Xerophytes:

- The water potential of their roots is very low.
- Their leaves are mostly modified into spines.
- In most of the cases, the stem is green to perform photosynthesis.
- They have very thick cuticle e.g. *Opuntia* species, *Euphorbia cadicifolia* etc.

SEED / SPORES AS ADAPTATIONS IN LIFE CYCLE DURING DROUGHT CONDITIONS

Land plants produce seeds or spores during their life cycle. These structures have following important characteristics.

- Concentrated protoplasm
- Covered by a protective wall.

ADAPTATION FOR BALANCE BETWEEN TRANSPIRATION & WATER UPTAKE

- Deep article roots e.g. Acacia
- Superficial horizontal roots e.g. cacti
- Desert plants have less number of stomata, sunken stomata, having epidermis, folding of leaves.
- Folding of leaves
- Storage of water in parenchymatous cells e.g. succulent plants (*Suaeda fruiticosa*)

EXCRETION IN PLANTS:

Excretion in plants is not a serious problem because.

- The rate of catabolic process in much less than the animals of same weight.
- Waste products of catabolism are used by green plants in their anabolic process. However, the plants release some substances from their body.

- The plants release excess water in the form of vapour through stomata. This process is called transpiration.
- Some plants of land release water (in liquid form) by the hydathodes during night by the process of guttation.

TRANSPIRATION	GUTTATION
Water is released in the form of vapour	Water is released in the form of liquid
By stomata	By hydathodes
During daytime	During night time

- Green plants in light release oxygen due to photosynthesis. In dark plants release CO_2 because respiration is going on whereas photosynthesis is not.

ZOOLOGY

OSMOREGULATION IN TERRESTRIAL ANIMALS

Arthropods & vertebrates maintain osmoregulation by the following methods:

- Water proof external covering storing & excreting solid wastes
- Use of metabolic waste.
- Storing the waste

Water proof external coverings:

- Reptiles, birds & mammals have water proof keratinized epidermis
- The insects have water proof exoskeleton which is made up of chitin.

Storing & Excreting Solid Wastes:

Reptiles birds & insects excrete uric acid as nitrogenous waste while water is absorbed in Cloaca.

Use Of Metabolic Water:

Some mammals like camel, kangaroo, rat etc. make use of water produced during the breakdown of body fats.

Storing the wastes:

Mammals do retain some urea in their kidney which helps in the reabsorption of water.

OSMOREGULATION IN AQUATIC ANIMALS:

There are two methods of osmoregulation in aquatic animals.

- Osmoregulation by contractile vacuole.
- Osmoregulation by producing dilute urine.

osmoregulation by contractile vacuole:

Fresh water protoctists like amoeba, paramecium, etc have one or more contractile vacuole. The excess water is stored in contractile vacuole & when it is completely filled water is discharged out of the body through a pore into the surrounding water.

Osmoregulatoin by producing dilute urine:

Fresh water animals like fishes remove excess water by passing large quantities of very dilute urine.

Osmoregulation in aquatic(marine)animals:

- Marine bony fishes drink water constantly to conserve water in their bodies. The salts taken in along with water are excreted by special excretory cells in the gills.
- In cartilaginous fishes, like shark, slightly hypertonic osmotic pressure of body fluids is present as compared to the surrounding water excess salts are removed by special glands in their rectum.

EXCRETION IN ANIMALS:

In excretion nitrogenous metabolic wastes are released from the body. There are different types of nitrogenous metabolic wastes such as: Ammonia, urea, uric acid, Creatinin etc.

AMMONIA (NH_3):

Ammonia is a toxic gas. Excreting ammonia by an animal is advantageous due to the reason that its diffusion is rapid across the plasma membrane or body surface & also due to the fact that it does not require energy. However, its removal requires a lot of water for its dilution.

UREA ($COCNH_2)_2$:

Urea is relatively less soluble in water & about 100,000 times less toxic than ammonia. Urea is produced in the liver by a metabolic cycle that combines NH3 & CO2. In addition to mammals, most amphibians, sharks & some bony fishes also excrete.

URIC ACID ($C_5O_3\ N_4H_4$):

It is a relatively large molecule with extremely low solubility in water. Uric acid is excreted by terrestrial animals such as birds, many reptiles, insects, etc.

EXCRETION IN HYDRA:

In hydra nitrogenous waste is in the form of NH_3. Almost all the cells of hydra are in direct contact with water, so NH_3 is removed by simple diffusion from external surface as well as the internal surface into the external & internal water of gastrovascular cavity.

EXCRETION IN PLANARIA:

In Planaria the excretory organs are called flame cell or protonephridia. The excretory system of planaria is composed of tubules, therefore it is called tubular excretory system.

Mechanism Of Excretion:

The flame cells have the direct contact with the tissue fluids. Each flame cell is hollow inside & bears a tuft of cilia, which beat like a flame, water along with ammonia diffuse from the tissue fluid into the lumen of flame cell. The

beating of cilia propels this solution into the excretory canal where it is to be excreted out by excretory pores.

EXCRETION IN EARTHWORM:

Earthworms have combined excretory & osmoregulatory organs called metanephridia which are arranged segmentally.

Structure Of Metanephridia:

Each metanephridium is a highly coiled tubule immersed in coelomic fluid & surrounded by a network of capillaries. Its internal opening called nephrostome which lies in the colon while the external openings or nephridiopore opens outside in skin.

Working Of Metanephridia:

Due to the beating of cilia of nephrostome, coelomic fluid is pumped into the excretory tubule. Here selective reabsorption of useful substances also occurs which are taken back by the blood into the circulation. Finally the excretory fluid (urine) is transferred into the bladder which excretes it outside through nephridiopore.

EXCRETION IN COCKROACH:

In cockroach, the excretory organs are called malpighian tubules which arise from the junction of midgut & hindgut.

Working of malpighian tubules:

Cells of malpighian tubules absorb the excretory wastes along with some useful substances present in haemolymph. In the latter part of the tubule, the useful substances are reabsorbed and the uric acid is discharged into the rectum. In the rectum the reabsorption of salts & water takes place & uric acid is released in almost dry form from the body.

EXCRETION IN MAN

In human body homeostasis is maintained by the following organs.

Kidneys:

They maintain osmoregulation & eliminate nitrogenous wastes, excess salts & water.

Liver:

Liver excretes nitrogenous wastes, bile pigments etc

Skin:

It excretes salts & some other substances along with sweat during perspiration.

LIVER - AN IMPORTANT HOMEOSTATIC ORGAN:

1. Metabolism Of Carbohydrates & Lipids:

- It maintains concentration of glucose in the blood.
- It removes lipids from the blood either by oxidation or by modification & subsequently stored as fat.

2.Synthesis Of Important Substances:

It can also synthesize non essential aminoacids as well as plasma proteins like prothrombin, globulin, etc.

3.Deamination & Urea Formation:

The body cannot store excess aminoacid so any excess amino acid is broken down. Deamination takes place in which amino group is released from the amino acids. This amino is converted into urea is orinithine cycle.

This urea is released into the stream which carries it to the kidney for its elimination outside the body.

4.Production Of Bile:

Bile is a yellowish green alkaline fluid containing bile pigments (such as bilirubin & biliverdin) salts, cholesterol, phospholipids & mucus. Bile salts are involved in the emulsification of fats in small intestine while the bile pigments are excretory products.

5.Detoxification:

Liver can modify the structure of many drugs & poison to make them harmless.

6.Formation Of Cholestrol:

Cholesterol is chiefly synthesized in the liver & if it is in excess amount it is released in bile.

7.Thermoregulation:

Due to its efficient blood supply, large size & high metabolic rate, liver plays an important role in maintaining body temperature.

8.Storage Of Vitamins:

Liver stores a number of vitamins such as A, B, D.

URINARY SYSTEM OF MAN

The **urinary** system of man consists of the following parts:

- A pair of kidneys
- A pair of ureter
- Urinary bladder
- Urethra

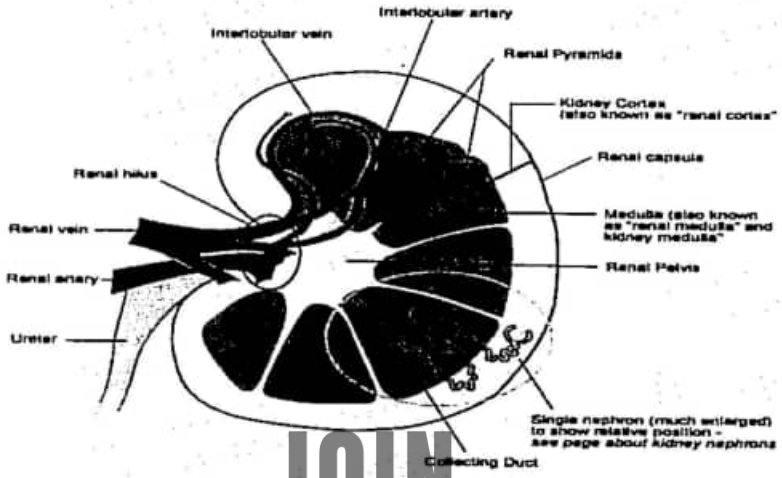
KIDNEYS:

Location:

A pair of kidney is located against the dorsal body wall in a retroperitoneal position in the superior lumber region. The kidneys extend from T12 – L3. The right kidney is positioned slightly lower than the left.

Shape & Colour:

Each kidney is dark red in colour & it is bean shaped. In the concave side there is a notch called hilus.



Size:

An adult kidney is about 10cm long, 6cm wide & 3cm thick.

Peritonium:

Each kidney is enclosed by a thin membranous covering called peritoneum.

Adipose Capsule:

In a living person a fatty mass, the adipose capsule surrounds each kidney.

Internal Structure:

The kidney is composed of three distinct regions.

Renal Cortex:

This is the outer region which is light in colour.

Renal Medulla:

Deep in the cortex is a darker reddish brown area, the renal medulla. The medulla has many triangular regions with a striped appearance, the medullary pyramids. The Pyramids are separated by extensions of cortical tissue which are called renal columns.

Renal pelvis:

On the inner side of medulla is a flat cavity called renal pelvis which continues to the ureter. The extensions of the pelvis are called calyces which form cup shaped areas which enclose the tips of the pyramids & drain it into the pelvis.

URETERS:

From the pelvis a narrow tube or ureter arises which brings urine into the urinary bladder.

URINARY BLADDER & URETHRA:

Both the urethras open into a sac like organ which is called urinary bladder. It stores urine for a short period. Then it passes through a narrow duct which is known as urethra. By the help of urethra the urine is discharged out of the body.

NEPHRONS

Nephrons are the structural & functional unit of kidney. Each kidney consists of about 1 million nephrons.

STRUCTURE OF NEPHRON:

A nephron is a tubular structure which is composed of following parts.

- Malpighian body
- Proximal convoluted tubule
- Loop of Henle
- Distal convoluted tubule
- Collecting duct.

1. Malpighian Body:

- It lies in the cortex of kidney.
- It is composed of cup – like Bowman's capsule. Inside this cup lies a dense network of capillaries known as glomerulus.

2. Proximal Convoluted Duct:

The Bowman's capsule gives out a coiled tubule known as proximal convoluted tubule. It lies in the cortex region.

3. Loop of Henle:

The proximal convoluted duct narrows & descends down into the medulla, makes a u-turn & comes back into the cortex. This narrow u-shaped part is called loop of Henle.

4. Distal Convoluted Duct:

The ascending limb of loop of Henle becomes larger in diameter in the cortex & forms a coil called distal convoluted duct.

5. Collecting duct:

The distal convoluted duct finally opens into a common collecting duct which receives urine from a number of nephrons & drains into the pelvis of the kidney.

6. BLOOD VESSELS OF NEPHRON:

Blood supply to the glomerulus of a nephron begins as an afferent arteriole arises from renal artery. From the glomerulus blood is carried by the efferent arteriole to the capillary network. One of the network called peritubular capillaries is associated with proximal & distal convoluted ducts while the other are called vasa recta runs straight parallel beside the limbs of loop of Henle.

REGULATORY FUNCTIONS OF KIDNEY:

Nephrons are the functional units of kidney & they perform regulatory function. This process is completed in the following stages.

- Ultra filtration
- Reabsorption
- Tubular secretion
- Counter Current Exchange

ULTRAFILTRATION:

- In the 1st stage non selective ultra filtration of blood occurs while passing through the glomerulus's of malpighia body.
- Two factors are responsible for this ultra filtration.

Factor # 1:

Both the capillary walls of glomerulus & the walls of Bowman's capsule are sieve like in nature which permit all the molecules except plasma proteins & blood cells to pass through them.

Factor # 2:

Blood pressure in glomerulus is high because the diameter of efferent arteriole is much less than that of afferent arteriole. Thus a hydrostatic pressure is generated which forces the smaller molecules of blood from glomerulus into the Bowman's capsules.

REABSORPTION:

- Active reabsorption of the glomerulus filtrate occurs in the proximal convoluted duct. So a large amount of filterate is reabsorbed & returned to circulation. Here glucose, amino acid water, salts are reabsorbed.

- Reabsorption of water also occurs when the filterate from the proximal convoluted duct passes into the descending limb is almost impermeable to other solutes.

- The ascending limb is impermeable to water. Here reasborption of sodium & chloride ions takes place through active transport.

- The distal convoluted duct is slightly hypotonic to the blood plasma. In this region concentration of various salts is adjusted under the influence of hormones.

- In the collecting duct of nephron water is reabsorbed in the presence of antidiuretic hormone.

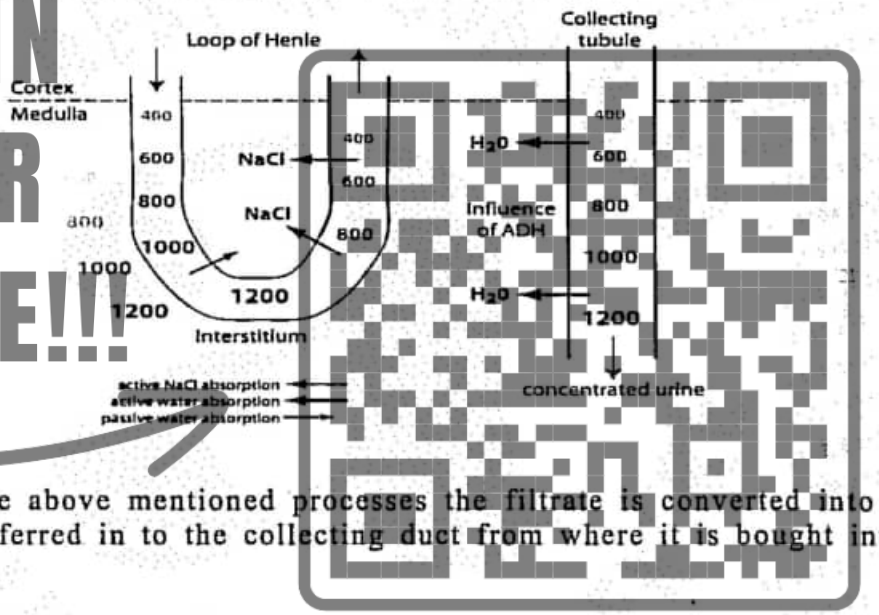
TUBULAR SECRETION:

At the level of both proximal as well as distal convoluted ducts, some poisonous substances as well as nitrogenous substances such as ammonia, urea, uric acid creatinine are secreted from the blood directly into the filtrate by active transport.

COUNTER - CURRENT EXCHANGE:

There are two counter current systems operating in the medulla which are involved in the exchange of solutes & water.

- One of the counter current is termed as counter current multiplier in the loop of Henle. It is involved in developing the concentration of ions across the medulla. During the passage of isotonic filtrate through the descending limb the
  reabsorption of water turns the filtrate gradually hypertonic to the tissue fluid. While in the ascending limb the sodium & chloride ions are actively removed from the filtrate thus reducing the hyper toxicity & tuning it into hypotonic. Due to the hypertonic environment in medulla, almost 90% of water of the filtrate is reabsorbed.
- The other counter current system is composed of Vasa recta, the blood vessels that run parallel to the loop of Henle. The blood supply to the vasa recta provides sufficient movement & oxygen to the cells of medulla & also takes away the water absorbed from the filtrate.



Urine:

After the above mentioned processes the filtrate is converted into urine which is transferred in to the collecting duct from where it is bought into the renal pelvis.

Composition of Urine:

Water = 95%
Solid wastes = 5%

COMPONENTS	COMOSITION (Concentration / 100cm^3)
Water	95.00
Proteins	00.00
Glucose	00.00
Urea	020.00
Creatinine	0.3 – 0.70
Ammonia	0.3 – 0.70
Uric acid	0.3
Sodium	0.3
Chlorides	0.60
[Ca, Mg, K, PO, So]	0.47

pH	5.00

EFFECTS OF HORMONES ON THE WORKING OF KIDNEY:

Following types of hormones effect the working of kidney.

- Antidiuretic hormone or vasopressin.
- Aldosterone
- Parathyroid hormone

ANTIDIURETIC HORMONE:

Site of Secretion:

Posterior lobe of pituitary gland.

Function of ADH:

It increases the reabsorption of water in the collecting duct.

ALDOSTERONE:

Site of Secretion:

Adrenal cortex.

Function of aldosterone:

It increases the reabsorption of sodium ions in the nephron

PARATHYROID HORMONE:

Site of Secretion:

Parathyroid Glands

Function of parathyroid hormone:

It regulates the concentration of calcium ions in blood. It increases the reabsorption of Ca^{+2} in nephrons.

KIDNEY PROBLEMS:

There are following types of kidney problems.

- Kidney stones
- Lithotripsy
- Renal failure
- Dialysis
- Kidney transplant

KIDNEY STONES (CALCULUS):

Kidney stones or calculi are mainly composed of calcium oxalate or phosphate.

Oxalate rich food:

Tomato, Spinach, Leafy vegetables.

Infective Stones:

About 20% of calculi are termed as infective stone. These calculi consist of combination of Ca, Mg NH_4 $(PO_4)_2$.

LITHOTRIPSY (TREATMENT OF CALCULI)

Lithotripsy is a recent method for removing kidney & uretral stones.

Procedure of Lithotripsy:

In this process shock waves or ultrasonic waves are used to break up calculi for removal.

RENAL FAILURE:

It is a condition in which there is a reduction in the ability of the kidneys to filter waste products from the blood & excrete them in urine.

Complications due to renal failure:

Due to renal failure nitrogenous wastes start accumulating in the blood which leads to the symptoms such as nausea, loss of appetite, vomiting, weakness, breathlessness, high blood pressure etc. In severe cases it leads to coma & death.

DIALYSIS:

Introduction:

It is a techniques used to remove waste products from the blood & excess fluids from the body as a treatment for renal failure.

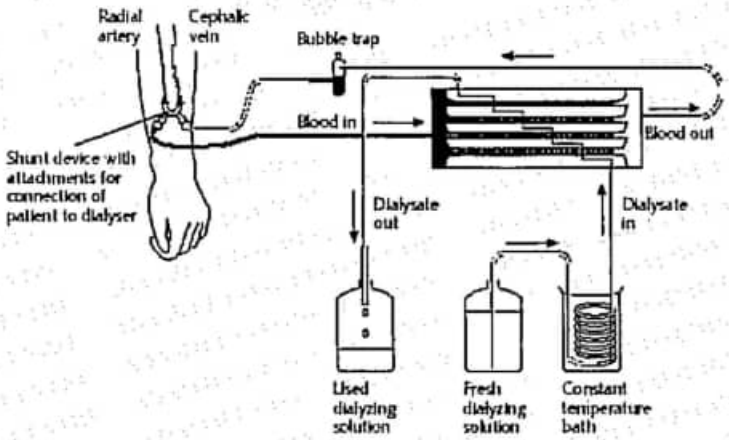
Methods of Dialysis:

There are two methods of dialysis.

- Haemodialysis
- Peritoneal dialysis

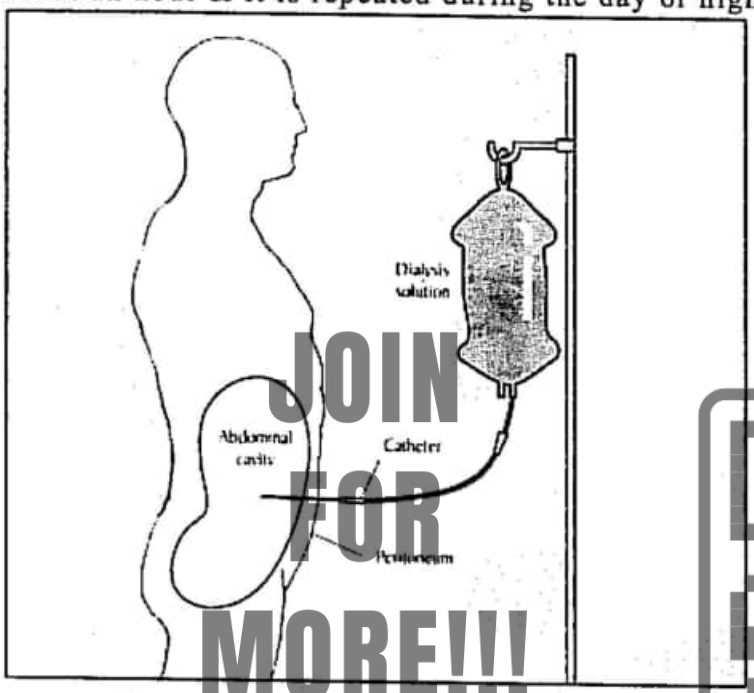
Haemodialysis:

In this dialysis kidney machine or an artificial kidney containing a fluid (the dialysate) is used. During this dialysis the blood from the body is pumped repeatedly through a tube of partially permeable membrane (dialysis membrane) bathed in dialysate. While passing through the dialysis the nitrogenous wastes & excess salts are diffused out from the blood into the dialysate through the dialysis membrane. Thereafter the blood is returned to the circulation. It goes on for 6-10 hrs.



Peritoneal Dialysis:

This dialysis requires an abdominal incision. Through the incision a catheter is inserted into the peritoneal cavity. Dialysate from a bag attached to the catheter passes into the cavity where it is left for several hours. During this period waste materials from the vessels living to transferred into the dialysate. The fluid is then allowed to drain out through the catheter. The process takes about an hour & it is repeated during the day or night.



KIDNEY TRANSPLANT:

In young patients, having kidney failure transplantation of a healthy kidney is along term solution. It is a surgical procedure & successful in 80% of the cases.

THERMOREGULATION:

It is the maintenance of body temperature within a range in at enables the body to function efficiently. The normal temperature range for active life is 10°C to 35°C for most of the organisms.

ADAPTATIONS OF PLANTS TO LOW / HIGH TEMPERATURE (BOTANY):

LOW TEMPERATURE:

The low temperature at the level of freezing point causes in crystals formation in cells. This is avoided by the plants by developing freezing tolerance in which the composition of solutes of cell is altered in a way that ice crystals are formed in the cell wall rather than the cytosol.

HIGH TEMPERATURE:

High temperature is more harmful than low temperature since enzymes are denatured. The principal way to cool down the plant in this situation is transpiration. At 40°C or above most of the plant cells synthesize that shock

proteins that protect enzymes & other proteins from denaturing due to high temperature. Shiny cuticle, small leaf surface area, wilting also provides protection from heat.

THERMOREGULATION IN ANIMALS:

SOURCES OF BODY HEAT GAIN & HEAT LOSS:

HEAT GAIN:

There are two methods of heat gain in animal body.

- Externally heat is obtained by solar radiations.
- Internally heat is obtained as a by product of metabolism & muscular contraction.

POIKILOTHERMS OR COLD BLOODED ANIMALS OR ECTOTHERMS:

Poikilotherms are those animals whose body temperature changes according to the environmental temperature.

EXAMPLE:

Invertebrates, fishes, amphibian & most reptiles.

HOMEOTHERMS OR WARM BLOODED ANIMALS OR ENDOTHERMS

Homeotherms are those animals which have a constant body temperature which is independent of the environment.

EXAMPLES:

Mammals, Birds

MEANS OF THERMOREGULATION IN ANIMALS:

There are two types of thermoregulation.

- Behavioural regulation
- Physiological regulation

BEHAVIOURAL REGULATION:

Many animals can increase or decrease heat loss by changing their location. This is a type by behavioural regulation.

PHYSIOLOGICAL REGULATION:

It is extribited by slight change in the blood circulation pattern change in the rate of metabolism, cooling by evaporative heat loss & activation of certain muscles.

THERMOREGULATION IN MAMMALS (MAN):

MECHANISM OF THERMOREGULATION IN COLD TEMPERATURE:

- Physiological Mechanism
- Behavioural Mechanism

Physiological Mechanism:

A. Non - Shivering Thermogenesis:

1. Erection Of Hair:

In furry animals the hair in vertical position can trap a thick layer of stationery air next to the skin. Due to this, heat loss from the skin is reduced.

2. Reduction in blood flow towards skin:

In cold temperature the owing of the arteriole or vaso constriction occurs so lesser blood is supplied to the body surface to conserve the body heat.

3. Sub-cutaneous fat accumulation:

In mammals fat is stored in adipose tissue below the skin. The fat is a bad conductor of heat so it functions as a chemical insulator.

B. Shivering Thermogenesis:

In cold temperature shivering begins in the body, which generates heat in muscles.

Behavioural Mechanism:

Behavioural mechanisms include moving to a warmer place, huddling close together with each other, in humans putting additional clothes.

MECHANISM OF THERMOREGULATION IN HOT TEMPERATURE:

- Physiological mechanism
- Behavioural mechanism

Physiological Mechanism

- Secretion of sweat from the sweat glands in the skin.
- To promote heat loss vaso-dilation of arterioles of skin occurs.
- Reduction of sub cutaneous fat
- Loss of heat by breathing.

Behavioural Mechanism:

Behavioural mechanism means moving to cooler location, use of thin clothes, etc.

ROLE OF BRAIN IN TEMPERATURE REGULATION OR THERMOREGULATION:

Hypothalamus is the part of brain which has thermoregulatory centre. It is commonly called the thermostat of the body. The hypothalamus is set at a particular temperature called the set point. Any change in the body temperature below or above the set point is detected by the hypothalamus & instructions are sent to appropriate organs to bring the body temperature back to normal.

FEVER (PYREXIA):

Definition:

Pyrexia is defined as:

"The body temperature above the normal set-point i.e. 37°C or 98.6°F".

CAUSES OF PYREXIA:

- Bacterial infections
- Viral infections
- Non infections

Chapter 2

SUPPORT AND MOVEMENT

SUPPORT AND MOVEMENT IN PLANTS

SUPPORT IN PLANTS:

There are three types of cells in a plant body:

i) Parenchyma
ii) Collenchyma
iii) Sclerenchyma

(i) PARENCHYMA:

These cells are found in epidermis, cortex and pith.
These are alive cells with intercellular spaces.

STRUCTURE OF A PARENCHYMATOUS CELL:

They usually have thin primary wall but no secondary wall.
Inside the cell there is a large central- vacuole which is surrounded by peripheral layer of cytoplasm.

SUPPORT BY A PARENCHYMATOUS CELL:

They take in water by endosmosis and become extended. These extended parenchyma are turgid, exert an internal pressure called turgor pressure. Due to the turgor pressure the plant organs remain firm and rigid.

(ii) COLLENCHYMA:

These cells are found in the hypodermis of a dicot stem.
These are also alive cells without intercellular spaces.

STRUCTURE OF A COLLENCHYMATOUS CELL:

Their cell wall has irregular thickness due to the thickness of wall all the inter-cellular spaces are filled.

SUPPORT BY A COLLENCHYMATOUS CELL:

Collenchyma functions as an important supporting tissue in young plants.

(iii) SCLERENCHYMA:

Sclerenchyma are mostly dead cells which lack intercellular spaces.
Tracheids and vessels of xylem are composed of sclerenchymatous cells.

STRUCTURE OF A SCLERENCHYMATOUS CELL:

They have uniformly thick, highly lignified secondary walls.
In most of the cases they lack protoplasm.

SUPPORT BY A SCLERENCHYMATOUS CELL:

Sclerenchyma are the main supporting cells in a woody plant.

TYPES OF SCLERENCHYMATOUS CELL:

1- FIBERS:

Fibers are very elongated cells with tapering ends. They are tough and strong but flexible.

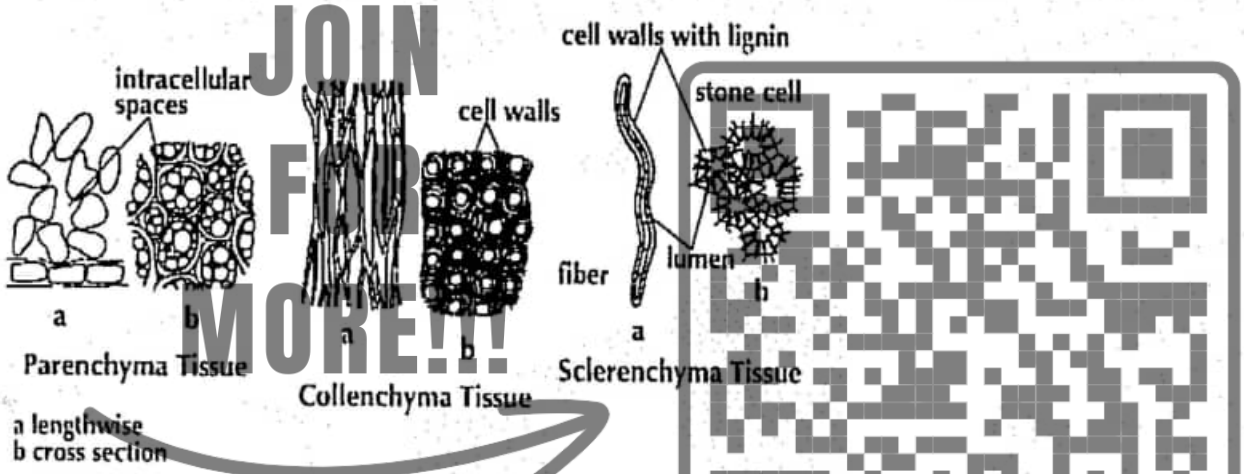
Example: Cotton fibers.

2- SCLEREIDS:

These are variable often irregular in shape.

Example: Simple unbranched sclereids are generally called stone cells which are common in nuts and hard parts of seeds.

THE THREE BASIC TYPES OF PLANT TISSUE



SECONDARY GROWTH

GROWTH:

The irreversible increase in the length and the weight of an organism is called growth.

GROWTH IN A PLANT BODY:

There are two types of growth in a plant body:

(i) Primary growth
(ii) Secondary growth

(i) PRIMARY GROWTH:

The increase in the length of a plant due the activity of apical meristem is called primary growth.

(ii) SECONDARY GROWTH:

The increase in the width of stem due to the activity of vascular cambium and cork cambium is known as secondary growth.

MECHANISM OF SECONDARY GROWTH:

FOMATION OF CAMBIUM RING:

In the dicot stem vascular cambium is present between xylem and phloem. At the time of secondary growth strips of meristematic cells are appeared in the medullary rays. These strips spread laterally and combine with the vascular cambium. These strips of meristematic cells are known as inter fasicular cambium and the vascular cambium is also known as fasicular cambium. When both of these cambiums are combined a ring of meristematic cells are formed which is known as cambium ring.

FORMATION OF SECONDARY TISSUES:

The cambium ring starts to form secondary tissues by rapid cells divisions. This ring forms secondary xylem towards the inner side while secondary phloem towards the outer side. The activity of this ring is more rapid towards the inner side therefore a large amount of secondary xylem is formed inside the stem.

1- SECONDARY XYLEM AND SECONDARY PHLOEM:

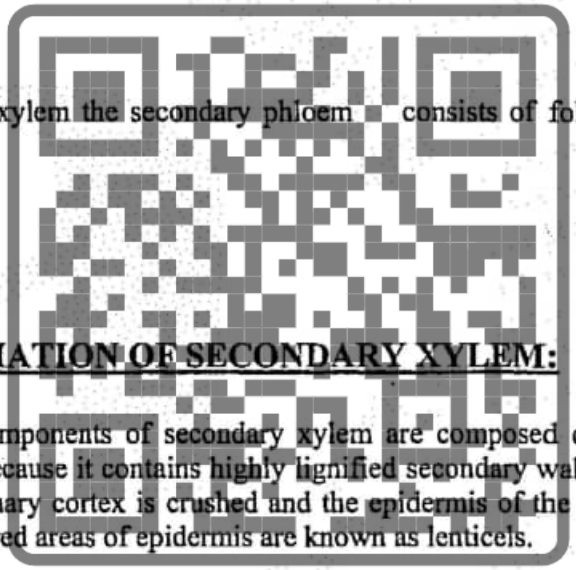
2-

The secondary xylem is also known as **wood,** which is composed of following components:

1- Tracheids
2- Vessels
3- Wood parenchyma
4- Wood fibers

In contrast to the secondary xylem the secondary phloem consists of following components:

1- Sieve tubes
2- Companion cells
3- Bast parenchyma
4- Bast fibers



EFFECTS OF THE FORMATION OF SECONDARY XYLEM:

As we know that most of the components of secondary xylem are composed of dead sclerenchyma which is very hard tissue because it contains highly lignified secondary walls. Due to the formation of secondary xylem primary cortex is crushed and the epidermis of the stem is ruptured from various places. These ruptured areas of epidermis are known as lenticels.

FORMATION OF CORK CAMBIUM:

After the formation of secondary xylem and secondary phloem a ring of meristematic cells also appears in the outer region of primary cortex. This ring is known as Cork cambium (phallogen).

This ring of meristematic cells also forms secondary tissues towards inside as well as outside. It forms secondary cortex (Phelloderm) towards the inner side and cork towards the outer side. The secondary cortex overcomes the function of primary cortex and the cork replaces the function of epidermis.

XYLEM AFTER SECONDARY GROWTH:

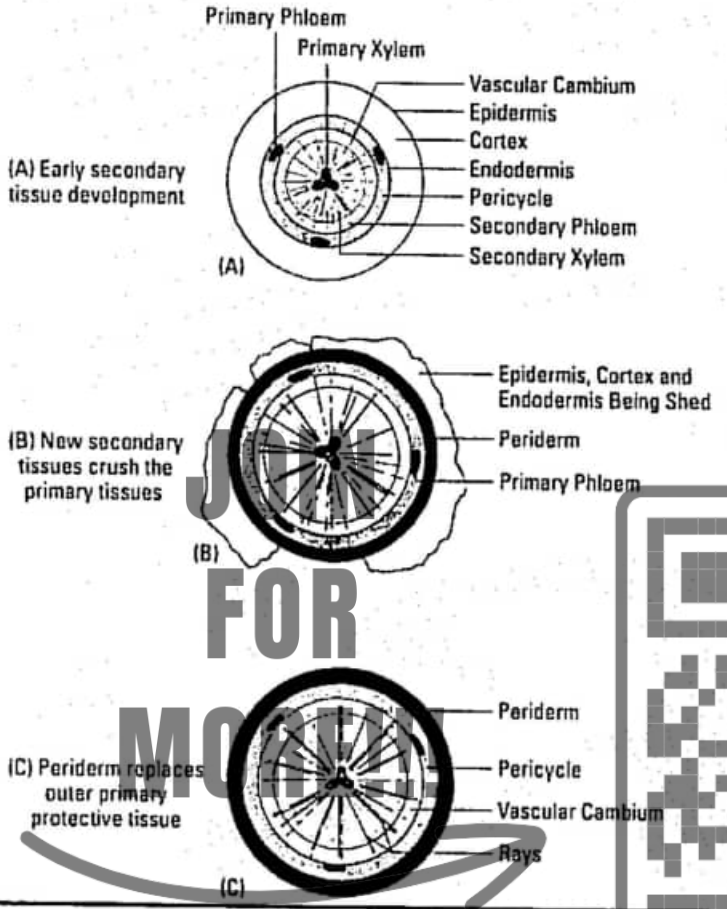
After the secondary growth two types of xylem or wood can be seen in a dicot stem.

i) **HEART WOOD:** This xylem is unable to transport water and dissolved substances.

ii) **SAP WOOD:** This is the functional xylem inside the dicot stem.

ANNUAL RINGS:

The plants of temperate regions accumulate secondary xylem in the form of concentric layers which are known as annual rings. Each annual ring consists of two zones. An inner zone of spring-wood and an outer zone of summer-wood. The age of a plant can be calculated by the counting of these rings.



MOVEMENT IN PLANTS

Definition:

Any action taken by living organs to reduce its irritability produced by stimuli is known as movement.

TYPES OF MOVEMENT IN PLANTS:

1- Autonomic or spontaneous movement.
2- Paratonic or induced movement.

1- AUTONOMIC MOVEMENT:

Such plant movement which appears due to internal stimulus is known as autonomic movement.

There are three types of autonomic movement:

(i) Locomotary movement
(ii) Growth and curvature movement
(iii) Turgor movement

(i) LOCOMOTARY MOVEMENT:

DEFINITON:

Movement of whole plant body or an organ or material within a plant cell from one place to another is called locomotary movement.

EXAMPLES:

1- The streaming movement of cytoplasm (cyclosis)
2- Chromosomal movement during cell division.
3- Ciliary movement or movement due to flagella.

(ii) GROWTH AND CURVATURE MOVEMENT:

The beneficial changes due to the differences in the ratio of growth of different parts are called growth and curvature movement. There are two types of this movement.

(a) Nutation
(b) Nastic movement

(a) NUTATION:

The growth in the apex of young stem takes place in zigzag manner due to an alternate change in growth rate an opposite side of the apex.

EXAMPLE: movement of climber around any rope.

(b) NASTIC MOVEMENT:

This movement occurs due to the differences in the rate of growth on two opposite sides of a plant organ.

EXAMPLE: opening of the petals.

(iii) TURGOR MOVEMENT:

This movement appears due to change in the turgidity of cells.

EXAMPLE: movement of leaves of Touch-me-not.

2- PARATONIC MOVEMENT:

Those plant movements which appear due to the external stimuli are known as paratonic movement.

There are two important types of these movements:

(i) Tropic movement
(ii) Nastic movement

(i) TROPIC MOVEMENT OR TROPISM:

Tropic movements are growth responses in which plant organs move in particular directions.

There are following types of tropism.

(a) PHOTOTROPISM:

The tropic movement due to the stimulus of light is called phototropism.

EXAMPLES: The upward movement of shoots towards the light is called positive phototropism and downward movement of roots away from light is called negative phototropism.

(b) GEOTROPISM:

The tropic movement due to the stimulus of gravity is known as geotropism.

EXAMPLE: The downward movement of root towards the gravity is called geotropism and the upward movement of shoot away from gravity is called negative geotropism the growth of secondary and tertiary roots is called transversal geotropism.

(c) CHEMOTROPISM:

The tropic movement due to the stimulus of certain chemicals is known as chemotropism.

EXAMPLE: The growth of pollen tube towards the ovary.

(d) HYDROTROPISM:

The tropic movement due to the stimulus of water is called hydrotropism.

EXAMPLE: Roots are positively hydrotropic.

(e) THIGMOTROPISM:

The tropic movement due to the stimulus of touch is called thigmotropism.

EXAMPLE: The coiling of a tendril around a rope.

(ii) NASTIC MOVEMENT:

Those plant movements which appear due to the diffused stimuli in which there is no particular direction of movement are called nastic movement. There are two important types of nastic movement.

(a) PHOTONASTIC:

The nastic movement caused by light is known as photonastic.

EXAMPLE: The flowers of ***Oxalis*** and ***Protulaca*** open in day and close at night while flowers of ***Nicotiana*** close in day and open at night.

(b) HAPTONASTIC:

Haptonastic movements are caused due to the stimuli of touch.

EXAMPLE: These movements are found in insectivorous plants.

SUPPORT AND MOVEMENT IN ANIMALS

SUPPORT:

In an animal body the support is provided by the skeleton, which is tough and rigid frame work which provides protection, shape and support to the body organ. It is composed of inorganic or organic substances or both.

MAJOR FUNCTIONS OF SKELETAL SYSTEM:

(1) SUPPORT AND SHAPE:

Bones support soft tissues and serve as attachment sites for most muscles and provide shape to the body.

(2) PROTECTION:

Bones protect the inner sensitive organs of the body such as skull protects brain, spinal cord is protected by vertebral column, lungs and heart are protected by rib-cage.

(3) MOVEMENT:

The elements (bones) of skeleton system act as lever during the movement.

(4) MINERAL HOMEOSTASIS:

Bones keep calcium, phosphorous, sodium and potassium. Through negative feed back mechanisms, bones can release or take up minerals to maintain homeostasis.

(5) BLOOD CELL PRODUCTION:

Red blood corpuscles, white blood corpuscles and platelets are produced in bone marrow, which is a connective tissue found with in certain bones.

TYPES OF SKELETON

(1) *HYDROSTATIC SKELETON:*

In animals that lack a hard skeleton a fluid filled gastro vascular cavity or coelom can act as hydrostatic skeleton. It is found in cnidarians, annelids and other soft-bodied invertebrates.

Example:

Sea anemone, earthworm etc.

(2) *EXOSKELETON:*

The skeleton, which is found outside the body of an animal, is called exoskeleton. It is inert and non-living.

Examples: -

PROTOZOANS: -	Radiolarian (silica)
	Foraminifera (Limy shell)
MOLLUSCS: -	Limy shell
CRUSTACEANS: -	Chitinous

EXOSKELETON OF ARTROPODS:

- The arthropods have highly complex exoskeleton. This skeleton has variety of adaptations.
- The invagination of exoskeleton forms firms ridges and bars for muscle for attachment.
- This skeleton is thin, soft and flexible at joints.
- This skeleton has sensory receptors called sensilla.
- It permits gaseous exchange.

ECDYSIS or MOULTING:

The shedding of the old skeleton at the different stages of growth and a new one is formed. This process is known as ecdysis.

(3) *ENDOSKELETON:*

1) The skeleton, which is found inside the body of an animal, is called endoskeleton.
2) This skeleton is composed of bones, cartilage or both. Both bones and cartilage are rigid connective tissue, which are consisting of living cells embedded in the matrix of protein called collagen.

BONE:

1) It is the most rigid form of connective tissue.
2) The collagen fibres of bones are hardened by the deposition of Calcium phosphate.
3) The long bones consist of an outer shell of compact bone, with spongy bone in the interior.
4) The outer compact shell provides an attachment site for muscle. The spongy bone is light, rich in blood vessels and highly porous.
5) The cavity of spongy bone contains bone marrow where blood cells are formed.
6) There are three types of cells associated with bones.
   i) Bone forming cell (osteoblast)
   ii) Mature bone cell (osteocytes)
   iii) Dissolving cells of bones (osteoclast)

CARTILAGE:

1) It is much softer than bones because the collagen fibres do not contain calcium phosphate.
2) It is found at the articulating surface of bones and also found in flexible portions of nose and external ear (Pinna).
3) The living cells of cartilage are called chondrocytes.
4) There is no blood vessels penetrate into the cartilage.
5) There are two types of cartilage.

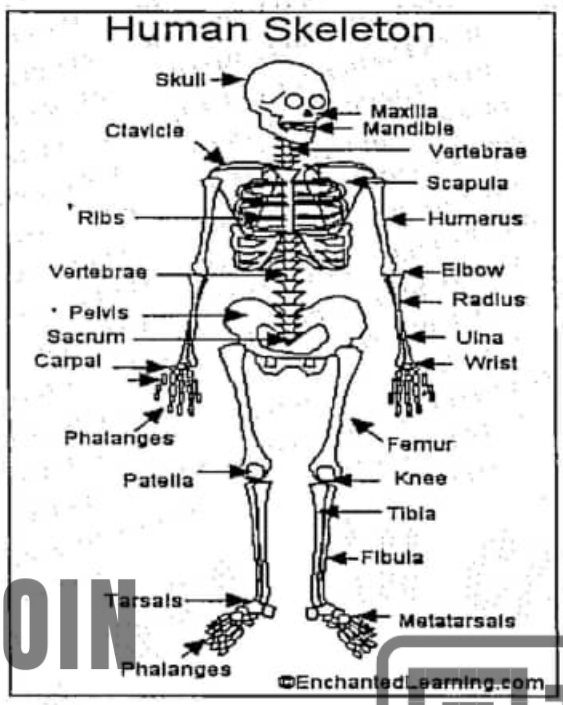
(i) HYALINE CARTILAGE:

It is the most abundant type in human body. It is found at the moveable joints.

(iii) FIBRO CARTILAGE:

It has matrix-containing bundles of collagen fibres. It forms an external pinnae of ears and in the epiglottis.

HUMAN SKELETON



Human skeleton is composed of 206 bones and it is divided into two parts.

1) Axial skeleton
2) Appendicular skeleton

(1) AXIAL SKELETON:

It is composed of:

1) Skull
2) Vertebral column
3) Ribs and sternum

(i) SKULL:

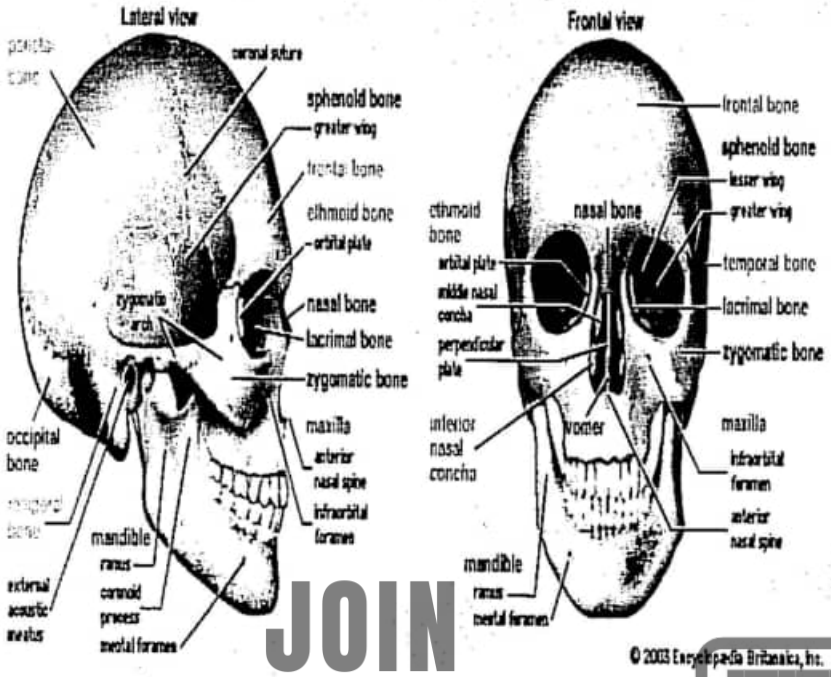
It is made up of Cranium and Facial bone.

Cranium Bones:- These bones form the brain box. There are following eight cranium bones

- Frontal.
- Parietal (paired bone).
- Temporal (paired bone).
- Occipital.
- Sphenoid.
- Ethmoid.

Facial Bones:- There are ten facial bones which form the front part of face.

- Maxilla.
- Palatine.
- Zygomatic.
- Lacrimal.
- Nasal.
- Vomer (unpaired bone).
- Inferior Conchae.
- Mandible (unpaired bone).



(ii) VERTEBRAL COLUMN:

- It is extended from skull to the pelvis to form backbone, which protects the spinal cord.
- It is composed of 33 bones (vertebrae), but after fusion there are 26 bones.

(iii) RIB CAGE:

It is composed of 12 pairs of ribs that articulate thoracic vertebrae. Ten of them connect anteriorly with sternum. The lower two pairs of ribs are called "**floating ribs**", because they do not attach with the sternum.

(2) APPENDUCULAR SKELETON:

It is composed of pectorial girdle, pelvic girdle and limb bones.

(i) Pectoral girdle:

A pair of pectoral girdles, at shoulder, holds the arms to the axial skeleton. Each pectoral girdle consists of a **Scapula** and a **Clavicle**.

(ii) Pelvic girdle:

The pelvic girdles serve to attach the leg with the vertebral column at hip region. Each pelvic girdle called Innominate bone, which is composed of **Ilium**, **Ischium** and **Pubis**.

(iii) Fore limbs:

It consists of 1 humerus, 2 radius and ulna, 8 carpals, 5 metacarpals and 14 phalanges.

(iv) Hind limbs:

The hind limb consist of 1 femur, 1 Patella, 2 tibia and fibula, 7 tarsals, 5 metatarsals and 14 phalanges

JOINTS

The regions of skeleton where two or more bones meet together are called joints.

CLASSIFICATION OF JOINTS

(1) ON THE BASIS OF MOVEMENT:

i) **IMMOVEABLE JOINTS: -**
They do not allow any movement e.g. joints in skull.

ii) **PARTIALLY MOVEABLE JOINTS: -**
They allow a little movement e.g. joints b/w ribs & vertebrae.

iii) **FREELY MOVEABLE JOINTS: -**
They allow movement.

a) **Hinge joint: -** It allows movement in one plane e.g. elbows and knee joint.

b) **Ball and socket joint: -** It allows movement in many planes e.g shoulder and hip joint.

c) **Pivot joint: -** It allows a twisting movement e.g. it is present in elbow.

d) **Sliding joint: -** In this type of joint bones slide over another e.g. joints in ankle and wrist.

e) **Gliding joint: -** By this joint bones move easily over one another e.g. joint b/w the vertebrae.

(2) ON THE BASIS OF STRUCTURE:

i) **Fibrous joints: -**
These joints are held together by short fibres embedded in connective tissue such joints are present in the skull which fix teeth into jaws.

ii) **Cartilaginous joints:**
The bones held together by fibrous cartilage. e.g. joints in vertebrae.

iii) **Synovial joints:**
These joints contain a cavity filled with fluid and are adapted to reduce friction between the moving bones. This joint is surrounded by a layer of connective tissue called fibrous capsule. Inside the capsule a membrane is present which is called synovial membrane.
This membrane secretes a fluid called synovial fluid which acts as a lubricant and a buffer solution some parts of capsule may be modified to form distinct alignment, which held the bone together.

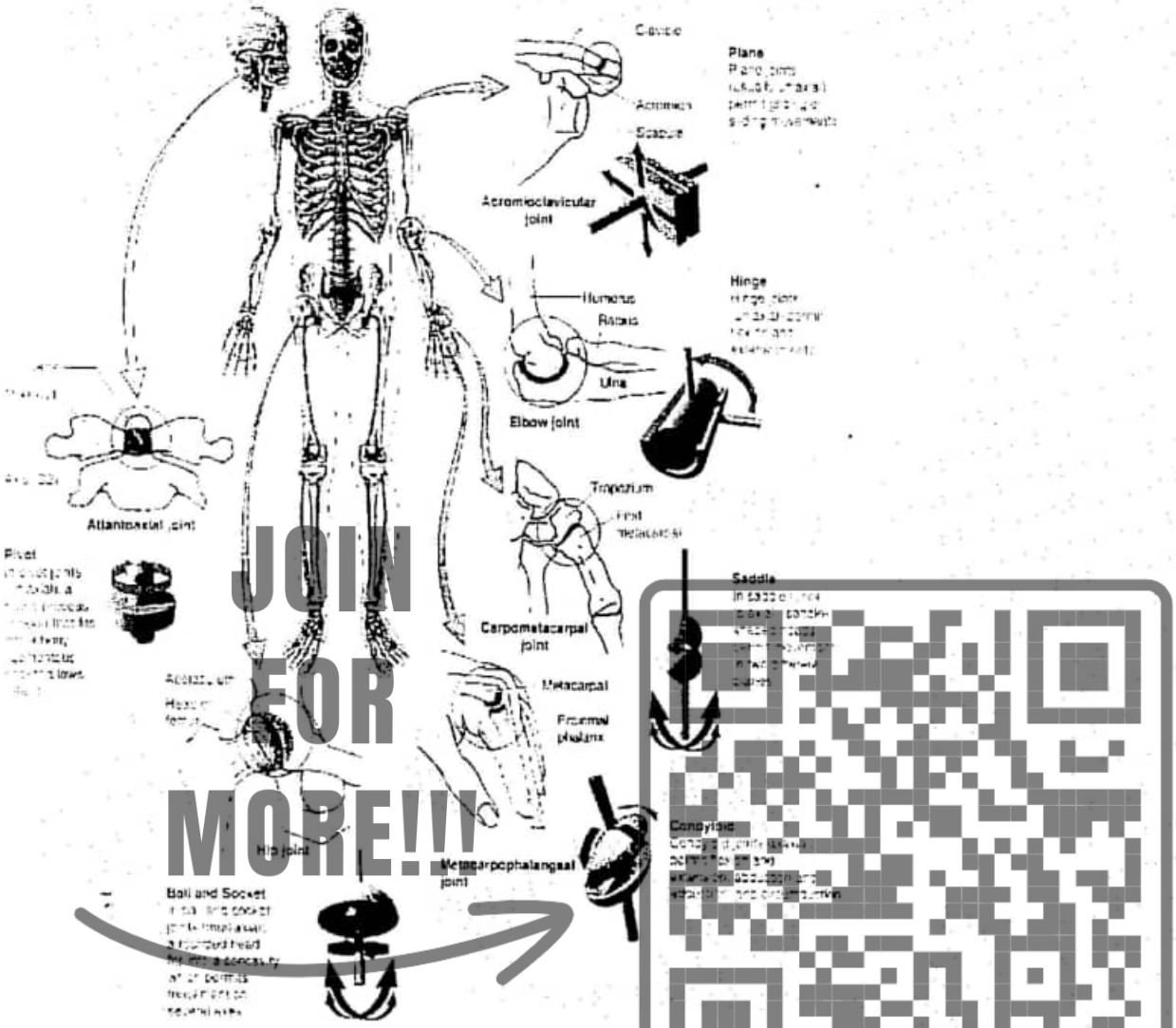


Figure I.14. Types of synovial joint. Synovial joints are classified according to the [illegible] articulating bones move [illegible]

DEFORMITIES OF SKELETON

(1) **GENETIC DISORDERS:**

i) Cleft palate (Hare lip)
ii) Microcephaly (Small head)
iii) Arthritis or Osteoarthritis

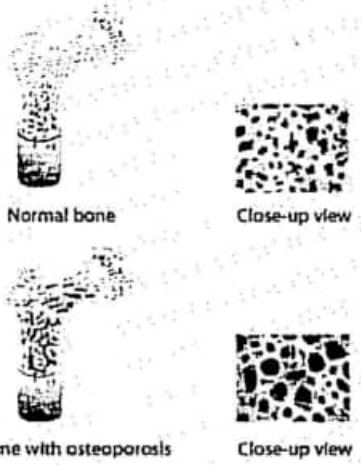
(2) **HORMONAL DISORDERS:**

Osteoporosis:

This disorder is found in elderly women because level of their estrogen secretion falls.

Complication:

Due to the deficiency of estrogen the bones become porous, thin and week, consequently easily breakable.



(3) NUTRITIONAL DEFICIENCY OR MALNUTRITION:

Rickets:

The curving of bones in children due to the deficiency of vitamin D or calcium.

(4) DISC SLIP:

Introduction:

1) The vertebrae of our body are provided with intervertebral disc which act as shock absorber.
2) If due to a physical trauma the cartilaginous ring of a disc ruptures and displaces, it is called a disc slip.

Complication:

This protrusion presses upon the spinal nerve between the vertebrae causing severe pain and inability to move.

Treatment:

Prolong rest on a hard bed and use of painkillers help repair the damage.

5) SPONDYLOSIS:

Introduction:

Spondylosis is a deformity of the joints of two vertebrae particularly of the neck.

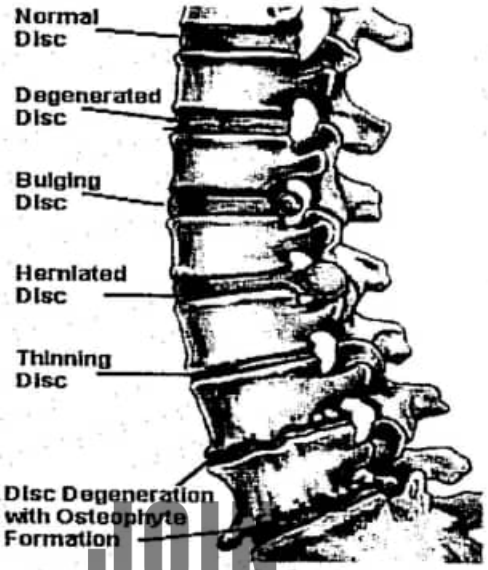
Complication:

This result in pressing upon the nerves emerging from the spinal cord and result in severe pain in neck, shoulders and upper limb etc.

Treatment:

The pain is relieved by wearing a hard collar around the neck.

Examples of Disc Problems



(6) **ARTHRITIS:**

Introduction:

It is a condition in which a joint becomes swollen, painful and immovable.

Causes:

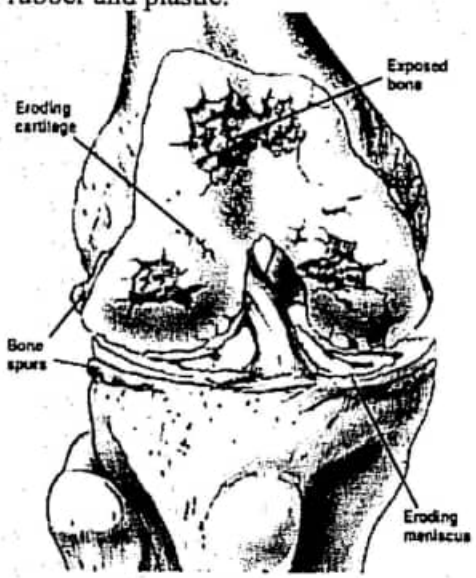
It may be hereditary may be due to a viral infection or due to an injury or some time only due to aging.

Complication:

The joint become very stiff and hard to move, and the person becomes crippled.

Treatment:

The only remedy is replacement of the affected joints by artificial joints made up of rubber and plastic.



7) **SCIATICA:**

Introduction:

It is the severe pain of the hind limb, which occurs when a nerve of the sciatica plexus is being pressed.

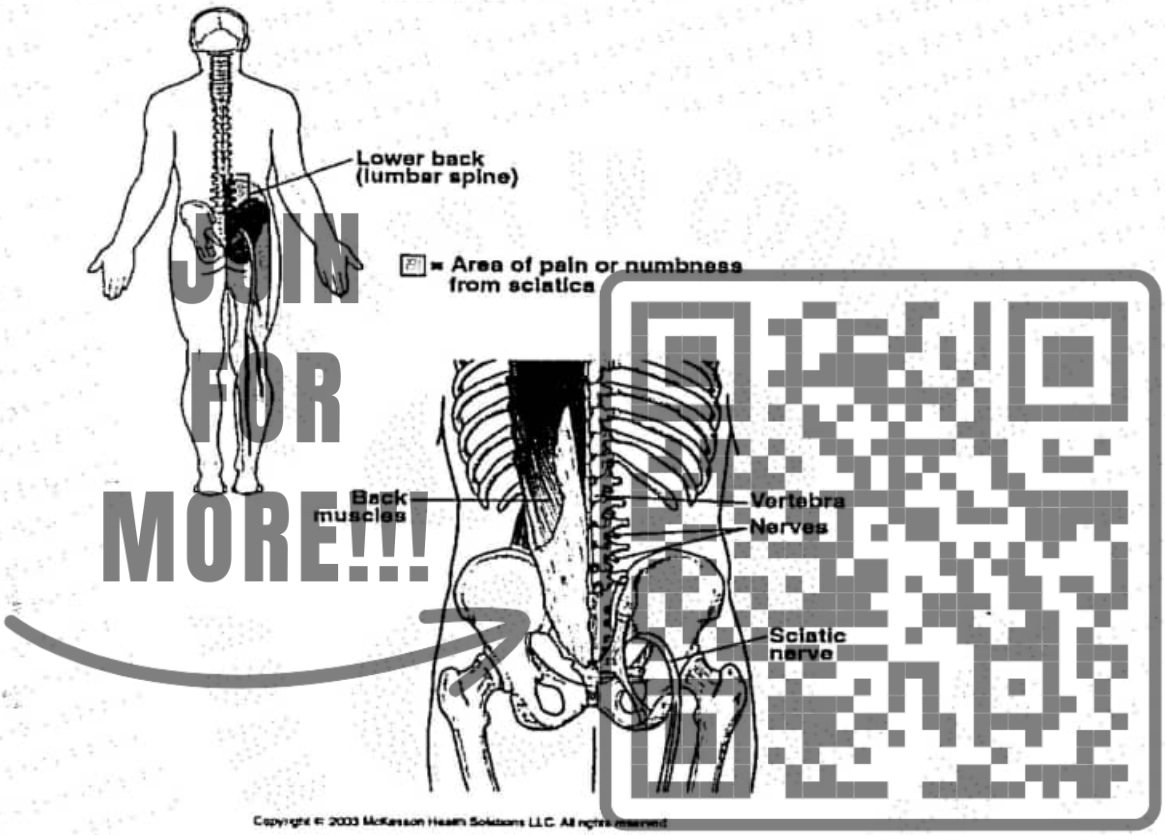
Causes:

It may be due to disc slip in the lower abdomen, a trauma or due to a damage to branch of sciatic nerve by the needle of a syringe.

Complication:

It makes the leg highly painful and virtually immovable. Recovery is very slow and often not complete.

Sciatica



REPAIR OF A BROKEN BONE

Fractured bone:

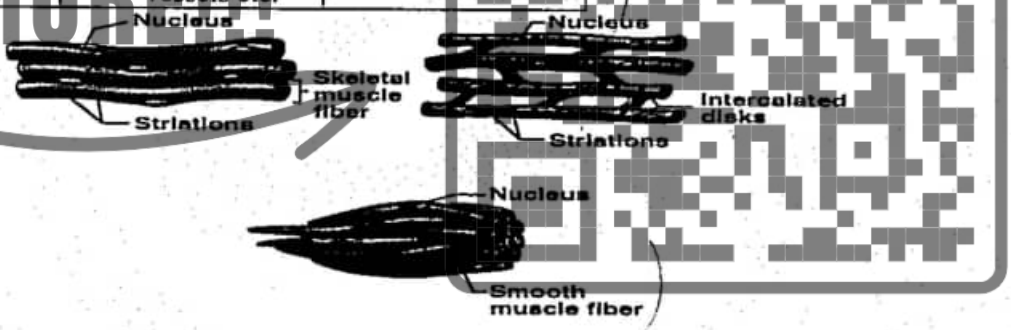
Bones are living tissue and whenever broken, start healing like any other damaged tissue of the body does. A broken bone is said to be a fractured bone.

Treatment of a fractured bone:

After a fracture the bone is made immovable for a few weeks by wrapping the affected area into a plaster (i.e. a cast of plaster of Paris).

MUSCULAR SYSTEM:

Skeletal Muscles	Smooth Muscles	Cardiac Muscles
1) Muscle fibres have light & dark band.	1) On smooth muscles bands are absent.	1) Cardiac muscles have light & dark band.
2) They are multinucleated.	2) They are uninucleated.	2) They are uninucleated or binucleated.
3) Their nucleus is present in peripheral region.	3) Their nucleus is present in the centre.	3) Their nucleus is present in the centre.
4) Muscle fibres are cylindrical & unbranched.	4) They are spindle shape and unbranched.	4) They are cylindrical and branched.
5) They are voluntary in action	5) They are involuntary in action.	5) They are involuntary in action.
6) These muscles are present on the skeleton.	6) These muscles are present in the alimentary canal and blood vessels etc.	6) These muscles are present in the Heart.



MUSCLES:

1) The muscles that are attached with the skeleton & associated with the movement of bones are called skeletal muscles.
2) These muscles are voluntary in action.
3) They have light and dark bands so called striated muscles.
4) They muscles are attached to bone by a bundle of collagen, Non-elastic fibres known as tendons.
5) On the basis of tendons there are two types of Skeletal muscles.

i) **Bicep:**

Those muscles, which are connected with the bone by the help of two tendons.

Example: - Flexor

ii) **Tricep:**

Those muscles, which are connected with the bone by the help of three tendons.

Example: - Extensor

6) Each muscle is an elongated mass of million of fibres called muscle fibres.
7) All the muscle fibres are surrounded by tough smooth connected tissue.
8) The end of the muscle that remains relatively fixed when muscle contracts is called origin, the end that moves is called insertion. Thick part between the two ends is called the belly.

SKELETAL MUSCLE FIBRE

1) Each muscle consists of a large number of muscle fibres or cells.
2) Each muscle fibre is long cylindrical cell with multiple oval nuclei, which are arranged in periphery.
3) Skeletal muscle fibre is large cells their diameter is 10- 100 μm.
4) **Sarcolemma:**
The cell membrane of a muscle fibre is called sarcolemma.

5) **Sarcoplasm:**
The cytoplasm of a muscle fibre is called sarcoplasm. Which contains large amount of stored glycogen and have unique oxygen-binding protein called myoglobin (a red pigment that stores oxygen).

6) **Myofibrils:**
In the sarcoplasm there are large numbers of protein filaments, which are arranged parallel to each other, these filaments are called myofibrils. The diameter of each myofibril is about 1-2 μm.

7) **Light and dark band:**
On a myofibril light and dark areas are present alternately. The light band are called I band, while the dark band are called A band.

8) **H – line:**
Each A-band has a lighter stripe called H-line.

9) **Z – line:**
The I-band has a dark line in the middle region called Z-line.

10) **Sarcomere:**
The region of a myofibril between two Z-lines is called sarcomere and it is the smallest contractile unit of muscles fibres.

MYOFILAMENTS:

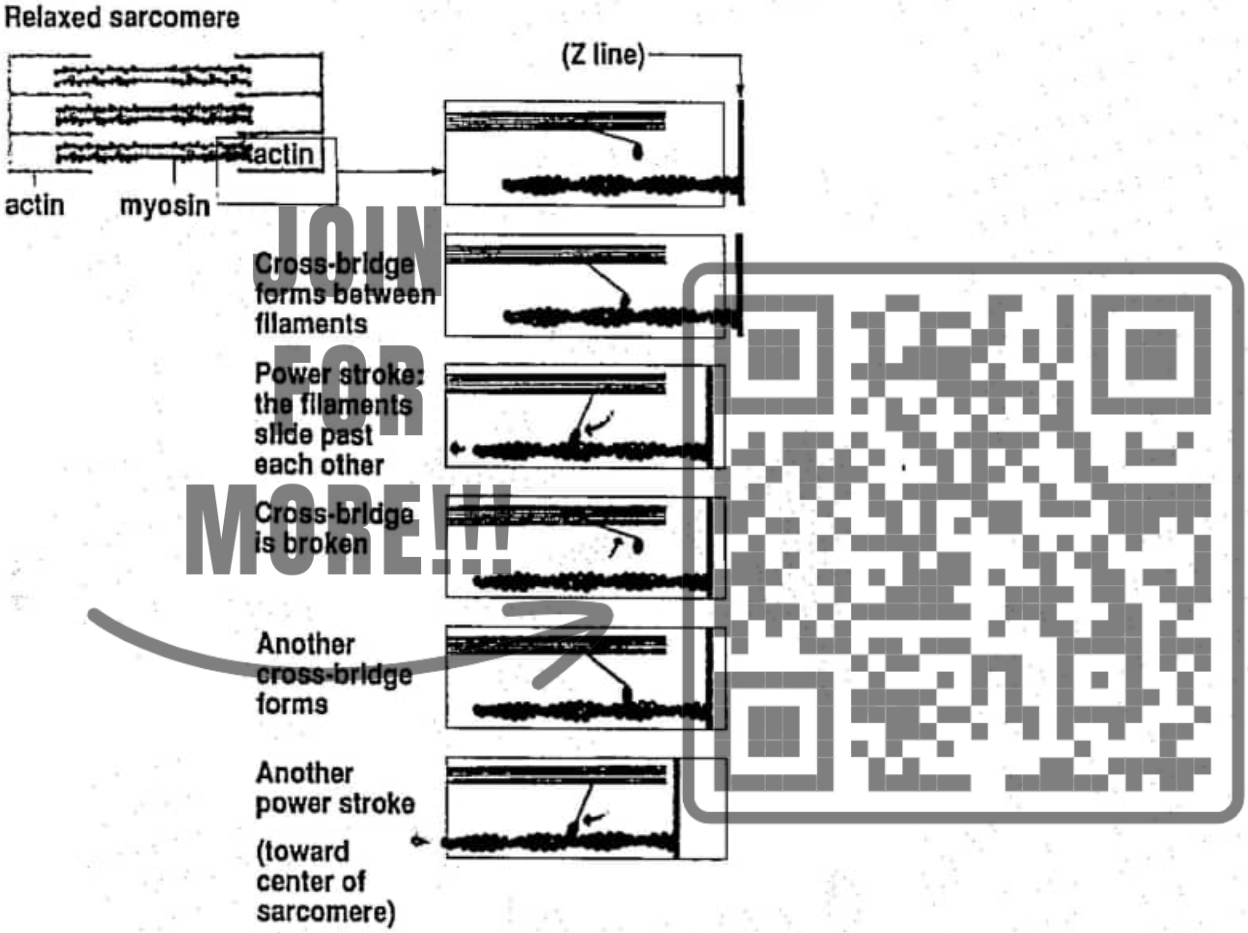
The myofibril contains two types of protein filaments called myofilaments.

ULTRA STRUCTURE OF MYOFILAMENT

1) Myofilament is made up of thick and thin filament. The central thick filament extend the entire length of the A-band the thin filaments extend across the I-band and partly into A-band.
2) The thick filament which is about 16nm in diameter is composed of myosin protein.
3) The thin filaments are 7-8 nm thick and composed of chiefly actin molecules.
4) **Cross Bridges:**
The region where myosin and actin filaments fixed together during muscle contractile are called cross bridges.

SLIDING FILAMENT MODEL:

1) When muscle fibre contracts the thin and thick filaments undergo shifting. The I-band reduces in length and Z-line get closer.
2) H. Huxley and A.F. Huxley suggested a hypothesis in 1954 to explain all events in muscle contraction this is called "Sliding filament model" of muscle contraction.
3) According to this concept the thin filaments slide over the thick filaments, in this way actin and myosin filaments overlap to greater degree.
4) Thus the Z-line is brought closer together, I – band shortens and H-line disappears.
5) In this process actin and myosin proteins are attached to form actinomyosin.



ENERGY REQUIRED FOR MUSCLE CONTROL

1) Energy requires for muscle contraction comes from the ATP supply of mitochondria.
2) ATP is maintained by the aerobic break down of glucose in muscle cells, which comes from stored glycogen in the cell.
3) When more energy is required due to high metabolism, it is provided by another energy storing substance called creatin phosphate.
4) Sometimes oxygen deficiency or very high metabolism, ATP are produced by anaerobic breakdown of glucose into lactic acid and lactic acid accumulation cause muscle fatigue.

Muscle Fatigue:

Muscle fatigue is a state of physiological inability to contract. Muscle fatigue results due to the accumulation of lactic acid in the muscle, which is formed by the anaerobic breakdown

of glucose. Accumulation of lactic acid causes muscle pH to drop, so the muscle is unable to contract for a while.

ABNORMAL MUSCLE CONTRACTIONS:

(1) Tetany:

Tetany is a sudden involuntary contraction of striated muscle, which is caused by low level of calcium in the blood.

Hence the muscle fibres are held under a constant contraction.

Tetany of the respiratory organs if not treated immediately may prove fatal.

(2) Cramps:

It is also a type of tetanic contraction, which is commonly called a muscle pull. It is usually occurs in a limbs muscles. It occurs due to dehydration, electrolyte imbalance or a low blood sugar level.

ANTAGONISTIC MUSCLES:

Definition:

Skeleton muscles work in pairs, with one muscle working against the other. Such a set of muscles is called antagonistic muscles.

Example:

1) **Protractor:** Moves the limb forward.
2) **Retractor:** Moves the limb backward.
3) **Abductor:** Moves the limb away from the body.
4) **Adductor:** Moves the limb towards the body
5) **Rotator Muscles:** Help the limb to rotate in all the directions even in a circle.
6) **Flexor:** Two parts of limb become closer.
7) **Extensor:** Two parts of limb move away.

LOCOMOTION IN PROTOZOA:

(i) LOCOMOTION IN EUGLENA:

Locomotory Organs:

Euglena moves with the help of flagellum.

Mechanism of Locomotion:

Flagellum is at its anterior end of the body and pulls the organism forward.

As the flagellum is whipped backward the organism moves forward.

Euglena is able to change its direction by the active contractile myonemes which run along the length of its body. When they contract the shape of the body is changed as well as its direction.

Euglenoid Movement:

First, body becomes short and wider at the anterior end then in the middle and later at the posterior end.

This movement is called Euglenoid movement.

(ii) LOCOMOTION IN PARAMECIUM:

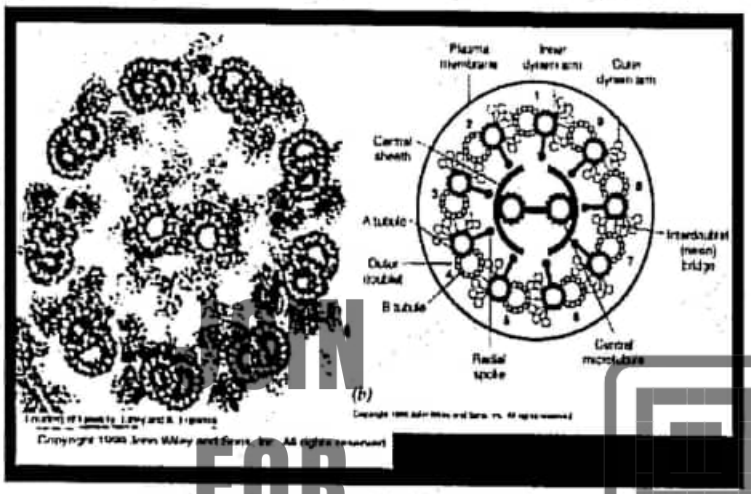
Locomotory Organs:

Paramecium moves with the help of cilia, this movement is also called ciliary movement.

Cilia:

1) Cilia are short, fine thread-like extension of the cell membrane. The length of cilia ranges from many microns to many hundred microns and the diameter varies in from 0.1 – 0.5 μ.

2) A cilium consists of nine peripheral double fibrils giving the appearance of 8-shaped figure and two central small fibrils. All these fibrils run longitudinally through the cilium these are covered with the extension of membrane.



Mechanism of Locomotion:

All the cilia do not move simultaneously, a branch of cilia move in a progressive wave – like manner at a time. The wave starts at the anterior end and progresses in the backward. Locomotion is brought about by alternate power strokes or effective strokes and recovery strokes. A powerful backward stroke of hundreds of cilia pushes the body forward.

(iii) LOCOMOTION IN AMOEBA:

Locomotory Organ:

The amoeba is a unicellular organism and has no special organs of locomotion, so locomotion is carried by Pseudopodia.

Mechanism of Locomotion:

During locomotion a blunt pseudopodium is formed in the direction of movement. Simultaneously the pseudopodia on the opposite side are withdrawn. This type of locomotion is called pseudopodia locomotion.

SOL – GEL THEORY:

Introduction:

This theory was formed by Hyman (1917) and later supported by Mast (1927). This theory explains the mechanism of the formation of a pseudopodium.

Explanation:

According to Mast the body of Amoeba is differentiated into three parts.

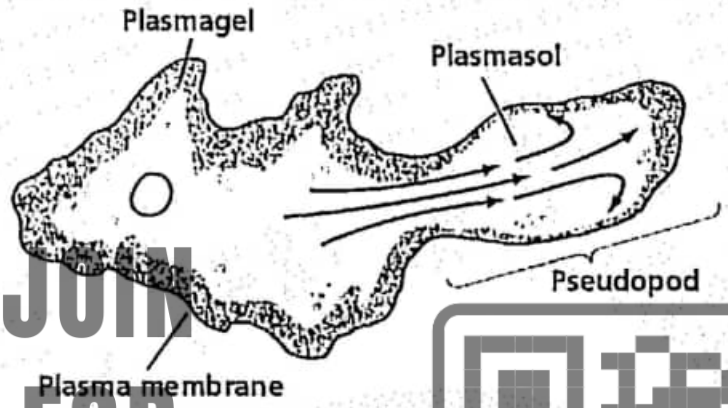
(i) A thin and elastic plasma lemma.

(ii) An outer non – granular ectoplasm.

(iii) Inner granular endoplasm. The endoplasm is further differentiated into an outer jelly like PLASMAGEL and inner more fluidly PLASMASOL.

(1) According to this theory the formation of pseudopodium is based upon spontaneous reversible sol – gel phenomenon.

(2) In this process first the plasma gel is changed into sol, so the inner protoplasm flows into this sol, which applies a pressure on plasmolemma to form a pseudopodium. After the formation of pseudopodium the sol is again converted into plasma gel.



LOCOMOTION IN ANIMALS

❖ LOCOMOTION IN EARTHWORM:

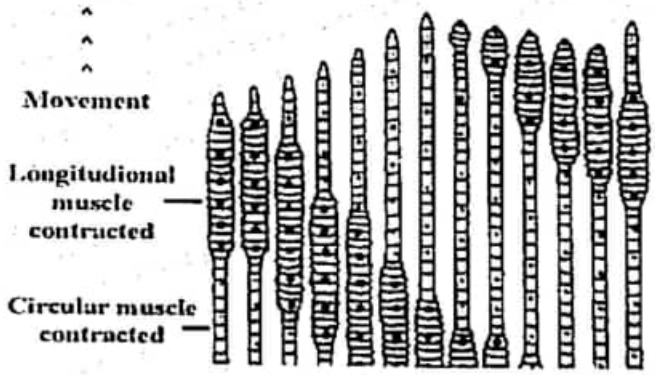
SKELETON: The earthworm has hydrostatic skeleton, in which the coelomic fluid exerts a pressure on the body wall.

MUSCLES: Two sets of muscles are found in earthworm which are known as circular muscles and longitudinal muscles.

LOCOMOTORY ORGANS: There are numerous bristles on the ventral surface on the body which acts as the locomotory organs. These organs are known as Setae.

MECHANISM OF LOCOMOTION:

- The anterior half of the animal becomes thin and elongated due to the contraction of circular muscles. Then its mouth is attached on the soil which acts as a sucker and firmly grasps the soil.
- Then the setae of this region protrude out by the contraction of protractor muscles, these setae firmly grip the soil.
- Now the posterior half of the body contracts due to the longitudinal muscles. Then the setae of this region are protruded out to take firm grip of the soil.
- When the posterior half is completed anchored, the mouth and the setae of the anterior half are withdrawn and the animal begins to elongate moving forward.



❖ LOCOMOTION IN JELLY FISH:

STRUCTURE: The jelly fish has an umbrella-shaped body which has a mouth at the anterior end which opens into a cavity, known as gastrovascular cavity.

MECHANISM: It swims by the contraction of its muscle cells forcing the water powerfully out of its mouth and umbrella to create a **jet propulsion** effect.

❖ LOCOMOTION IN SNAIL:

SKELETON: The snail has an hydrostatic skeleton.

LOCOMOTORY ORGAN: Like other molluscs the snail also has a muscular foot for locomotion.

MECHANISM OF LOCOMTOION:

Snail moves by the contractions of muscles inside the foot. These contractions are brought about under the influence of hydrostatic pressure of the body fluid. The waves of muscle contraction from the anterior towards the posterior end of the body push the animal forward.

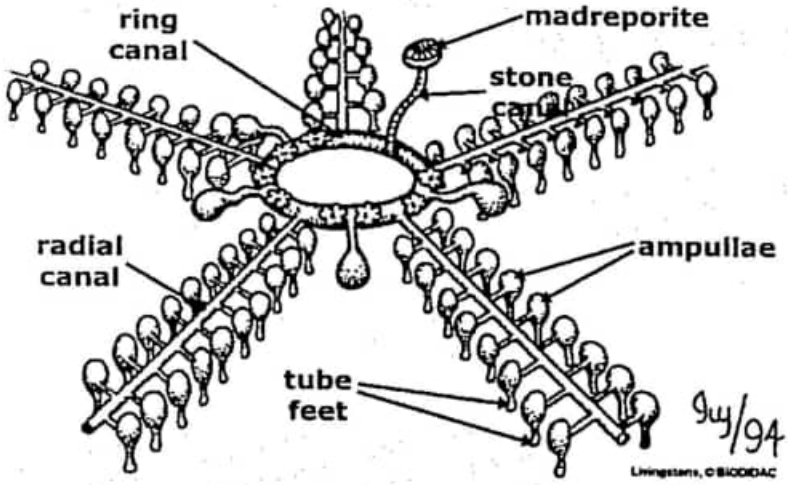
❖ LOCOMOTION IN STAR FISH:

SKELETON: The star fish has an exoskeleton in the form of spines on the skin.

LOCOMOTORY ORGANS: The locomotory organs of star fish are called muscular Tube Feet. The upper part of tube foot is a bulb shaped Ampulla, whereas its bottom part is a Sucker. All the tube feet are connected with the water vascular system.

MECHANISM OF LOCOMOTION:

- When ampulae contract water forces the tube feet to lengthen and suckers become attached to an object. When sucker muscles contract the water is pushed back into the ampulae, making the tube feet flaccid, losing the grip and the star fish is pulled forward.



❖ LOCOMOTION IN COCKROACH:

SKELETON: The cockroach has an exoskeleton which is made up of chitin.
MUSCLES: Inside the exoskeleton striated muscles are present and the locomotion is brought about by the interaction of muscular and exoskeletal system.

MECHANISM OF LOCOMOTION:

- The cockroach has antagonistic muscles which work in opposition to one another. Contraction of these flexor and extensor muscles move the appendages and the animal.

Chapter 3

COORDINATION AND CONTROL

CONTROL IN PLANTS

CONTROL THROUGH PLANT HORMONES:

The plants respond to a variety of stimuli like animals some of their parts having special tissues which produce special chemicals for control mechanism and also function as coordination chemicals. These chemical messages are called hormones. The plant hormones are also called phytohomones or growth regulators.

The first phytohomone was discovered by fret went in 1926 while studying the phenomenon of phototropism in oat coleoptile. He used the name of "Auxin (to increase)" for this hormone.

MECHANISM OF CONTROL AND COORDINATION IN PLANTS:

The plant hormones control and coordinate the plant responses in two ways.

- By shaving movement and regulating various metabolic functions.
- By controlling and initiating growth at various regions of plants.

BIOLOGICAL CLOCK & CIRCADIAN RHYTHMS:

- Living organisms when repeat their biological or behavioral activities at regular intervals, this behavior is called biological rhythms or biorhythms.
- The rhythmic movement of plant is not only controlled by light intensity and temperature changes but due to an independent time measuring system called **biological clock.**
- When biorhythms occur with a frequency of about 24 hrs then they are called **circadian rhythms** e.g. a bean plant will continue its sleep movement even if kept in constant light or darkness.

PHOTOPERIODISM:

The response of plants to relative length of the day and night is called photoperiodism.

RESPONSES TO ENVIRONMENTAL STRESSES:

Changes in environmental conditions are the big threats for living organisms especially for plants. These factors which change the normal condition of light, CO_2, nutrients, temperature, etc. cause severe stresses on plants. The common environmental stresses for plants are.

1. WATER SHORTAGE:

In dry condition, the guard cells of leaf become flaccid to close the stomata. In this way the transpiration is stopped. The dry condition also stimulates increased synthesis and release of abscisic acid. This hormone helps in keeping stomata close. These plants produce deeper root system.

2. OXYGEN DEFFICIENCY:

Those plants which grow in wet habitat or marshes, they develop aerial roots to absorb oxygen.

3. SALT STRESS:

The plants especially halophytes have salt glands in their leaves where desalination occurs. Those plants which grow in saline soil are called halophyte.

4. HEAT STRESS:

In plants there are two methods to tolerate the heat stress:

- Transpiration has a cooling effect on the plant body. By this method the effects of heat are reduced.
- About 40°C plant cell start synthesizing relatively large quantities of special proteins called heat shock proteins.

5. COLD STRESS:

- Plants respond to cold stress by altering the lipid composition of membrane.
- In freezing condition, changes in solute composition of cell also occurs by producing different polymers of fructose (fructans) which allow the cytosol to super cool without ice formation.

RESPONES TO HERBIVORY:

Plants overcome excessive herbivory by developing forms and production of distasteful or toxic compounds.

PLANT HORMONES (PHYTOHORMONE)

Phytohomones are synthesized by plants in minute concentration and exert their effect by alteringing gene expression or inhibiting enzymes or changing properties of membrane.

TYPES OF PHYTOHORMONES.

There are five types of phytohomones

- Auxins
- Gibberellins
- Cytokinins
- Abscisic acid
- Ethene

1. AUXINS:

Discovery:

The first auxin was discovered by fret went in 1926 in Oat coleoptile.

Chemical nature:

- Indol acetic acid (IAA)
- Indol butyric acid (IBA)
- Naphthalene acetic acid (NAA)

Site of Synthesis:

It is synthesized at the apices of stem and root, young leaves and young embryo.

Role of Auxin:

Cell division and cell elongation.

It stimulates cell division and cell enlargement and bring about increase in length of plant.

Initiation of Roots:

Auxin also initiates development of adventitious roots when applied at the cut base of stem.

Abscission:

In nature leaves and fruits when auxin production diminishes, a layer of thin walled cells is formed at the base of petiole and stalk of fruit. This layer is called abscission layer and causes fall of leaves and fruit with slight jerk.

Growth of Fruit:

Auxin produced in young embryo promotes he growth of fruit.

Parthenocarpy:

Use of auxin helps in producing parthenocarpic or seedless fruits.

Apical Dominance:

Besides growth promoting function, auxin also has inhibitory effect on growth. Growth of apical bud inhibits growth of lateral buds beneath the stem. This phenomenon is termed as apical dominance, removal of apical buds initiates growth of lateral buds with more leaves and axillary bud.

Weedicide:

Auxins are selective weed killer. 2-4 dichlorophenoxyacetic acid (2-4-D) is used to kill weeds in lawns & cereal crops.

2. GIBBERELLINS:

Discovery:

Gibberellins was discovered by T. Yabuta & T. Hayashi in a fungus called ***Gibberella fujikuroi***. This fungus causes foolish seeding (Bakannae) disease in rice. In this disease the infected rice seedlings elongated and ultimately fall over without producing gains.

Chemical Nature:

The chemical nature of Gibberellins is Gibberellic acid. 70 types of gibberellins have been discovered.

Role of Gibberellin:

Cell division and cell elongation:
Like auxin Gibberellin also promotes cell division and cell elongation.

Control of dwarfism:
Gibberellins can control genetic and physiological dwarfism in plants.

Seed Germination:
They promote the synthesis of α-amylase enzyme is dormant seeds due to the production of this enzyme, the seed starts to germinate.

Parthenocarpy:
These hormones help in the formation of seedless fruits which are called pathenocarpic fruits.

Increase of crop yield:
The crop yield of sugar cane can be increased by the application of gibberellin about 50 tons / acre

Formation of flower and growth of pollen tube:
They stimulate flowering and the growth of pollen tubes during fertilization.

3. CYTOKININS:

Discovery:
Cytokinins was discovered by Miller in coconut milk.

Chemical nature:
Chemically there are two types of cytokinins

- Kinetin: It is a synthetic cytokinin.
- Zeatin: It is found in maize grain.

Role of Cytokinins:

Cell Division:
They initiate rapid cell division only in the presence of auxin.

Delay in Senescence:
They also cause delayed senescence

Breaking of Seed Dormancy:
They break seed dormancy and promote fruit development in some species.

4. ABSCISIC ACID (ABA):

In contrast to growth promoting hormones abscisic acid is growth inhibitor produced by plants during adverse environmental conditions such as drought condition.

Role of abscisic acid:

- It increases dormancy in buds & seeds.
- It causes stomata to close.
- It turns leaf primordia into scales.

5. ETHENE:

It is a gas which also acts as a growth inhibitor.

Role of ethene:

- It triggers ripening of fruits.
- It contributes in leaf abscission & also breaks the dormancy of seeds & buds.
- It also initiates flowering in plants e.g. pineapple.

ZOOLOGY

COORDINATION & CONTROL IN ANIMALS

NERVOUS COORDINATION:

Nervous coordination is brought about by means of nervous system. In this method communication takes place by electrochemical messages called nerve impulses.

RECEPTORS:

Neurones receive information about any change in external or internal environment of the body through sensory cells on organs called receptors for e.g. skin.

EFFECTOR:

The organs, tissues or cells of the body which translate the message of central nervous system into an action are called effectors e.g. muscles.

Nervous system

CNS	PNS
Central nervous system	Peripheral nervous system
e.g. Brain + spinal cord	e.g. Nerves

Information → Receptors → Sensory neuron → CNS → Motor neuron → effectors → action

NEURON

A neuron is a special kind of animal cell, which can generates and conduct electric current.

STRUCTURE OF NEURON:

A neuron is composed of following parts:

- Soma or cell body
- Dendrites
- Axon

Soma or Cell Body:

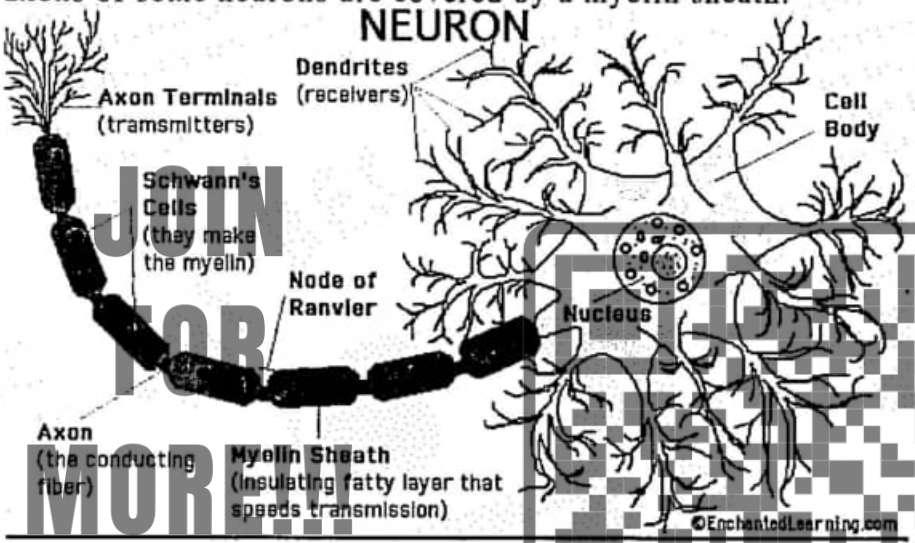
- The soma or cell body contains cytoplasm & nucleus.
- In addition to typical cell organelles it contains Nissl substances which consist of ribosomes

Dendrites:

- From the soma, arise a number of thread-like processes, the dendrites which receive stimuli and convey them to the soma.

Axon:

Axon is a long cytoplasmic process which usually arises opposite to dendrites. It ends in knob like structures which are called axon terminals. The axons of some neurons are covered by a myelin sheath.



TYPES OF NEURONS:

There are three types of neurons.

- Sensory neurons
- Motor neurons
- Inter neurons

Sensory Neurons:

It carries sensory information from receptor to the other neurons or directly to CNS.

Motor Neurons:

It takes commands of the control centre (CNS) to the effectors.

Inter Neurons:

It is found in central neurons system.

FUNCTION OF NEURON:

A neuron is the functional unit of nervous system. It is induced in communication by receiving stimuli, integrating various stimuli and sending appropriate instructions to some of the effector organs.

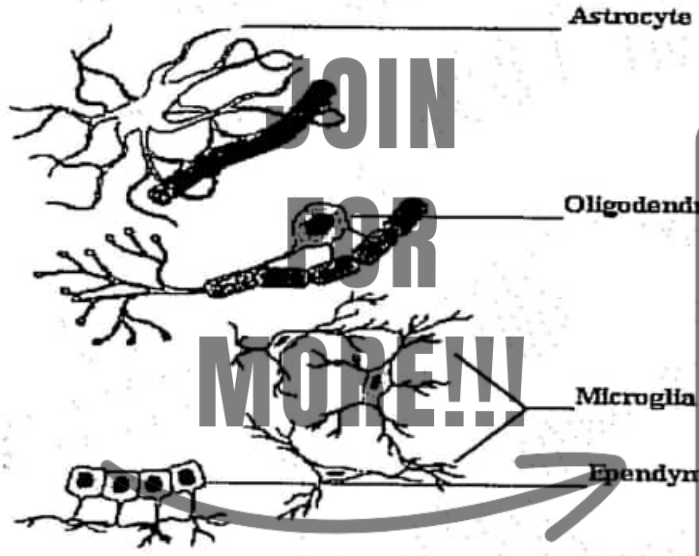
NEUROGLIA (GLIAL CELLS):

Neurons in CNS are associated with other types of cells called neuroglia.

Functions Of Neuroglia:

- Seperation of neurons from one another.
- They also perform the phagocytic function.
- They synthesize myelin.

Neuroglial Cells of the CNS



NERVE IMPULSE

The electrochemical signal developed by a neuron for communication is called nerve impulse.

DEVELOPMENT OF NERVE IMPULSE:

Most of the neurons develop an impulse in the following way.

- Resting membrane potential (RMP)
- Propagation of impulse
- Synapse.
- Action potential

Resting membrane potential (RMP)

It was first studied in squids that unstimulated inactive neurolemma (plasma membrane of neuron) maintains a charge of -65mv (variable b/w – 40mv - 90 mv). This electrical potential is called resting membrane potential.

Action potential:

It is a temporary & local reversal of the polarity of the neurolemma which arises when neruolemma is stimulated. During the action potential the polarity of neurolemma first changes to +40 mv (i.e. depolarization and then restores to -65 mv again (i.e. repolarization)

Propagation of impulse:

The action potential developed locally spreads along the entire neurolemma is called propagation of nerve impulse.

Synapse:

The region where the impulse moves from one neuron to another is called synapse. It consists of three components.

- Presynaptic membrane
- Synaptic cleft
- Post synaptic membrane

Pre-synaptic membrane:

It is found at the axon terminal.

Synaptic Cleft:

It is a narrow space b/w the pre & post synaptic membrane

Postsynaptic membrane:

It is found in the dendrites of the other neuron.

Neurotransmitter:

Those chemicals which transfer the nerve impulse from one neuron to the other Axon neuron are called neurotransmitters. e.g. acetylcholine, nonepinephrine, glycine, gaba, serotonin, dopamine, etc.

REFLEX ACTION

Reflex actions are automatic, involuntary responses which occur either due to internal or external stimuli e.g. hand withdrawal in a painful stimulus, knee jerk, blinking of eyes, etc.

MECHANISM OF REFLEX ACTION:

A reflex involves usually two neurons, a sensory and a motor neuron. The pathway of such transmission is called reflex arc. In this case, since only one synapse is involved so such reflex is called monosynaptic.

EVOLUTION OF NERVOUS SYSTEM:

- Diffused nervous system
- Centralized nervous system

DIFFUSED NERVOUS SYSTEM:

This is found in Cnidarians and echinoderms. In hydra & other Cnidarians because of the radial symmetry, there are no anterior and posterior ends. The

nervous system consists of a network which is woven through the tissues of the body. The flow of information through the network (nerve net) is in diffused form.

CENTRALIZED NERVOUS SYSTEM:

It is the characteristic of bilaterally symmetrical animals which have definite anterior and posterior ends. For example planaria is a simple animal which has the simplest form of centralized nervous system. It consists of an anterior part from which is connected with the sensory organs from the brain of planaria to cord like nerves running longitudinally through the body.

HUMAN NERVOUS SYSTEM

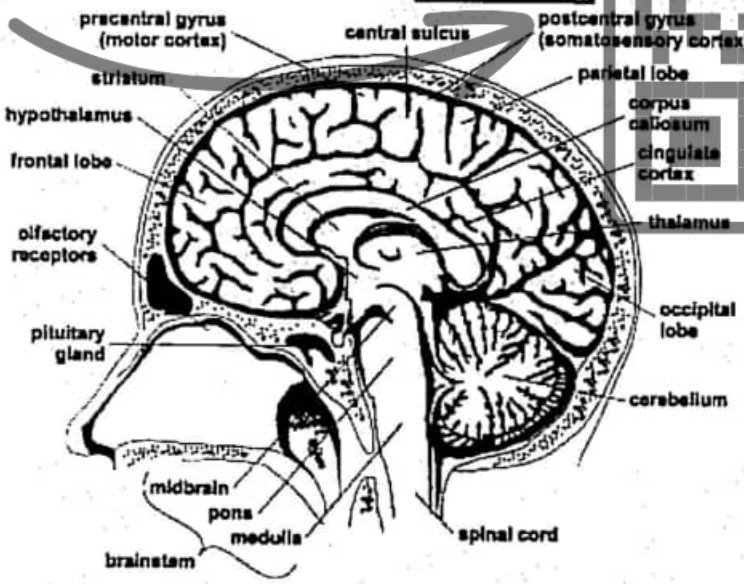
The human nervous system is of centralized type. It can be divided into following components.

- Central Nervous System (CNS)
- Peripheral Nervous System (PNS)

CENTRAL NERVOUS SYSTEM:

The CNS consists of a brain and a spinal cord. Both brain and spinal cord are protected by bony structures, the skull and the vertebral column respectively. Both brain and spinal cord are also enclosed inside a tough connective tissue cover called meninges. A plasma like fluid the cerebro spinal fluid (CSF) bathing the neurons of CNS is present inside the meninges.

BRAIN



There are three parts of brain:

- Fore brain
- Mid brain
- Hind brain

1. FORE BRAIN:

The fore brain can be divided into two regions.

- Telencephalon
- Diencephalon

I. TELENCEPHALON:

The telencephalon is the largest part of fore brain. It is differentiated into two cerebral hemisphere or cerebrum.

CEREBRAL HEMISPHERE:

Each hemisphere consists of two regions.

Gray matter or cerebral cortex:

It is the outer part of hemisphere it is the seat of all conscious activities and it is the place which is involved in **intelligence, reasoning, memory** etc. It is also divided functionally into an anterior frontal lobe, a lower central temporal lobe a parietal lobe and a dorsal occipital lobe.

White Matter:

It is the inner part of hemisphere.

COORDINATION B/W TWO CEREBRAL HEMISPHERE:

The activity of the two cerebral hemispheres is coordinated by corpus callosum.

II. DIENCEPHALON:

It consists of thalamus and limbic system.

(a) THALAMUS:

The thalamus is a clearing house for sensory impulses. It is also involved in the perception of pleasure and pain.

(b) LIMBIC SYSTEM:

There are following parts of limbic system.

Hypothalamus:

- It regulates homeostasis and pituitary gland.
- It also regulates **body temperature, blood pressure, hunger, thirst, aggression, pleasure & pain.**

Amygdala:

It produces sensation of **pleasure, punishment** and **sexual responses.**

Hippocampus:

It is involved in **long term memory.**

2. MID BRAIN:

The mid brain is relatively very small. It receives and integrates sensory information like **vision, odour** as well as sensory information from the spinal cord & relays them to fore brain.

3. HIND BRAIN:

There are following parts of hind brain.

I. Medulla oblongata
II. Cerebellum
III. Pons
IV. Reticular formation

(i) MEDULLA OBLONGATA:

It controls **breathing, heart beat, blood pressure, coughing, swallowing, sneezing, vomiting, digestion, hiccupping,** etc.

(ii) CEREBELLUM:

It is responsible for **muscular coordination, balance** etc.

(iii) PONS:

It regulates activities like **muscular coordination, facial expressions, breathing & sleeping.**

(iv) RETICULAR FORMATION:

It lies in medulla, pons & mid brain. It monitors the messages to which the nervous system should react and to which it should ignore.

BRAIN STEM:

The brain stem consists of mid brain, medulla obligation & pond.

SPINAL CORD

It is a thick, whitish nerve cord that lies below the skull, extends down through the neural canal of vertebrae up to the hips.

Structure of Spinal Cord:

In cross section, the spinal cord is differentiated into two areas, an outer called white matter an inner grey called grey matter. The outer region consists of neurons while the inner consists of nerve fibres of grey matter.

Functions of Spinal Cord:

Spinal cord serves as an express way for signals between autonomic nervous systems and brain. It is also the control centre for many reflexes.

PERIPHERAL NERVOUS SYSTEM

The peripheral nervous system (PNS) consists of following nerves.

- **Cranial nerves** connected with brain 12 pairs.
- **Spinal nerves** connected with spinal cord 31 pairs

The PNS transmits signals between CNS & the rest of the body.

TYPES OF NERVOUS SYSTEM ON THE BASIS OF NERVES

I. Somatic nervous system
II. Autonomic nervous system

1. SOMATIC NERVOUS SYSTEM:

The nerves which are related to the skeletal muscles constitute the somatic nervous system.

2. AUTONOMIC NERVOUS SYSTEM:

The nerves that deal with smooth muscles, heart & glands constitute the autonomic nervous system.

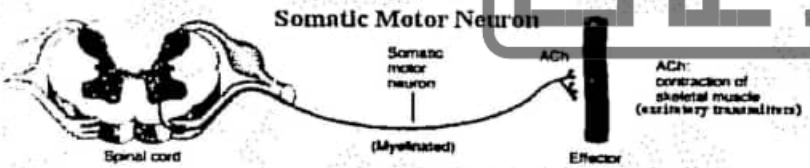
It is further divided into parasympathetic & sympathetic nervous system.

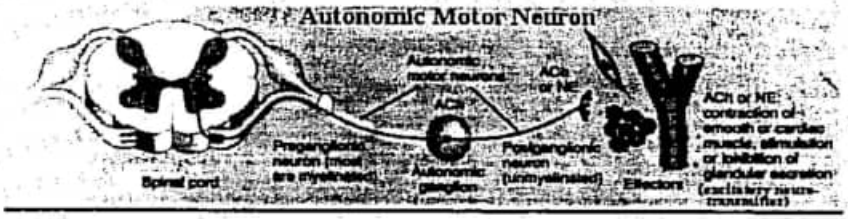
(i) Parasympathetic Nervous System:

It promotes all the internal responses e.g. contraction of pupil of eye, digestion of food, slow heart beat.

(ii) Sympathetic Nervous System:

It prepares the body for highly energetic activities such as light response. It increases the heart beat breathing rate, slows digestion, dilates pupil etc.





RECEPTORS

DEFINITION:

Receptors are either modified neurons or epithelial cells which occur either singly or in groups with other cell types e.g. In eyes. They receive stimuli either from external or internal environments and transfer them to CNS in the form of impulse.

TYPES OF RECEPTORS:

Receptors are classified into following types.

Thermo receptors:

They detect changes in temperature.

Mechanoreceptors:

They detect sound, motion, position in relation to gravity, touch, pressure.

Chemoreceptor:

They detect chemicals dissolved in fluid medium surrounding them.

Photoreceptors:

They detect visible & ultra violet light.

Pain receptors:

They detect tissues damage.

WORKING OF SENSORY RECEPTOR IN SKIN:

In mammals including man, the skin contains receptor for at least five different sensations of touch, pressure, cold, warmth & pain. These receptors are classified into two groups.

Free nerve endings:

They are the simplest type which lie in epidermis or dermis. They are of different type and involved in touch, pressure, pain, heat & cold.

Encapsulated receptors:

The nerve endings of these receptors are enclosed in capsule of connective tissue. The skin contains following types of encapsulated receptors.

Meissner's Corpuscle:

These receptors are mostly found in hairless areas such as finger tips, palms, soles, etc. These are sensitive to touch.

Pacinian's Corpuscles:

These receptors are located in dermis as well as in some internal organs & freely movable joints. They respond to rapid change in pressure associated with touch & vibration.

EFFECTS OF DRUGS ON COORDINATION:

A drug is a chemical substance which produces a specific physiological response in the body. Some drugs are useful medically & others act on brain producing artificial pleasure feeling.

NICOTINE:

It is a drug found in tobacco. It acts as a stimulant & is responsible for dependence on tobacco. It mimics the acetylcholine & directly stimulates a variety of sensory receptors.

Effects of nicotine:

In habitual smokers, the drug increases the heart beat & narrows the blood vessel (increases the blood pressure) and stimulates the nervous system. In this way it reduced fatigue, increasing alertness and improving the concentration.

NERVOUS DISORDERS

1. PARKINSON'S DISEASE

Introduction:

It is a brain disorder caused either by degeneration or damage to nerve tissue within the basal ganglia of brain.

Effects:

The disease effects both the sides of the body and causes stiffness, weakness & trembling of the muscles.

Treatment:

Leodopa, which the body converts into dopamine is usually the most effective drug.

2. ALZHEIMER'S DISEASE:

Introduction:

It is a progressive degeneration of neurons of brain.

Effects:

It causes dementia (loss of memory)

- The disease progresses in three broad stages.
- The patient notices his forgetfulness
- There is a severe loss of memory particularly of recent event psychosis such as hallucinations & paranoid delusions.

3. EPILEPSY:

Introduction:

Epilepsy is a tendency to recurrent seizures or temporary alterations in one or more functions.

Effects:

- The seizures may be spontaneous or due to some stimuli such as flashing light.
- The seizures may be generalized or partial. The generalized seizure is characterized by complete unconsciousness, stiff body with jerks. In partial seizure there is a momentary loss of consciousness.

Treatment:

Anticonvulsant drugs are used.

CHEMICAL COORDINATION

GLAND

A cell, a tissue or an organ which secretes a substance is called a gland. There are two types of glands in our body.

- Exocrine glands
- Endocrine glands

EXOCRINE GLAND:

These glands contain ducts by which they transfer their secretions to the target site e.g. liver, pancreas, etc.

ENDOCRINE GLAND:

The ductless glands of the body are called endocrine glands. These glands transfer their secretion though blood to the target cells e.g pituitary gland, adrenal gland, pancreas.

HORMONES:

- The secretions of endocrine glands are called hormones.
- A minute quantity of hormone may have a profound effect on an organisms activities like behaviour, development growth, reproduction, etc.

CHEMICAL NATURE OF HORMONE:

Hormones are organic molecules which can be divided chemically into following types.

1. Peptide hormones:

They occur as short chain of amino acids (e.g. glucagons, ADH, oxytocin, etc.) as well as long chains of amino acids (e.g. insulin prolactin, etc). The former are called peptide hormones while latter are called protein hormones.

2. Modified aminoacids hormones:

Few hormones consist of modified aminoacids e.g. thyroxine, epinephrine, nonepinephrine.

3. Steroid hormones:

These are lipid in nature examples are estrogen, progesterone, testosterone, aldostesone etc.

HORMONE ACTION:

Two main models have been proposed to explain the hormone action. However both models agree on the first step that the target cells have specific receptors in their plasma membrane.

Model # 1

According to this model, the receptor molecule is linked with an enzyme adenylate cyclase on the inner side of the plasma membrane. The hormone receptor finding turns slow adenylate cyclase into active form which converts ATP into cyclic AMP (adenosine mono phosphate) in the cytoplasm. The cyclic AMP serves as second messenger. It then activates specifc enzymes which bring about the appropriate response with in the cell. This model is related to peptide hormones.

Adenylate cyclase→receptor in plasma membrane → ATP→ AMP

Model # 2

This model is related to steroid hormones. These hormones are fat soluble. Therefore they can directly diffuse through the plasma membrane into the cell. In the cytoplasm, they find specific receptor which carry them into the nucleus where the hormone receptor complex directly activates the appropriate genes.

FEED BACK MECHANISM:

The hormone action is regulated by feed-back mechanism. The feed back is said to be negetive feedback if further secretion of hormone is inhibited. In the feedback, an increase in the concentration of secreted hormone facilitates the process of its further secretion.

ENDOCRINE SYSTEM

HYPOTHALAMUS:

- It is an important part of the fore brain.
- Its neuro secretary cells produce hormones called releasing & inhibiting hormones.
- Some of its cell secrete anti diuretic hormones (ADH) & oxytocin which are actually stored in their nerve endings located in posterior pituitary gland.

PITUITARY GLAND: (HYPOPHYSIS)

- It is a small pea sized structure which is attached with the hypothalamus of brain.
- It is also called the master gland of the body because it controls the functions of other endocrine glands.

PITUITARY G LAND LOBES	SECRETIONS (HORMONES)	TARGET SITE	ACTION OF HORMONE
Posterior Lobe	Antidiuretic hormone	Kidney	Increase absorption of water.
	Oxytocin	Uterus	Contraction of uterus at the time of delivery.

		Mammary Glands	Increases milk production & secretion.
Anterior Lobe	Adreno-Cortico tropic hormone (ACTH)	Adrenol Cortex	Controls the secretion of steroid hormones
	Thyroid stimulating hormone (TSH)	Thyroid Gland	Controls the release of thyroid hormone.
	Follicle stimulating hormone	Ovaries	Formation of Graffian-follicle
		Testis	Formation of sperms
	Lutenising hormone (LH)	Ovaries	Controls the secretion of progesterone
		Testis	Controls the secretion of testosterone.
	Prolactin	Mammary Gland	Development of mammary gland & milk production
	Somatotropic hormone (STH) or growth hormone (GH)	Most cells of the body	Controls protein synthesis, cell division, protein metabolism & growth.

CONDITIONS RELATED TO ABNORMAL PITUITARY OUTPUT

Gigantism:

It occurs due to hyper secretion of STH during childhood.

Acromegaly:

This abnormal condition appears due to the hyper secretion of STH after adulthood. In this condition the bones, cartilage and other soft tissues in hands, feet & jaws thicken abnormally.

Dwarfism:

This condition is produce due to the hypo secretion of STH during childhood.

THYROID GLAND

Introduction:

The human thyroid gland is located at the base of neck in front of trachea.

Hormones:

Thyroid glands secrete hormones.

- T_4 (Teraiodothyroxine)
- T_3 (Triodithyroxine)

Functions of hormones:

- Both T3 & T4 play an important role in controlling the metabolism of the body.
- Calcitonin maintains the calcium level in blood & bones

Disorders of thyroid gland:

Cretinism:

The hypothyroidism in early age is called cretinism which is characterized by stimulated growth mental retardation, etc.

Myxedema:

The hypothyroidism in old age is called myxedema which is characterized by over weight, sluggish dry skin, hair loss, intolerant of cold, confused & depressed individual.

Goiter:

The enlargement of thyroid gland due to the deficiency of iodine is called goiter.

Hyperthyroidism:

In case of higher levels of thyroid hormones, hyperthyroidism is produced which is characterized by protrusion of eye balls (exopthalmia), increased heart beat, heat intolerance, high blood pressure, profuse sweating & weight loss.

PARATHYROID GLANDS

There are four parathyroid glands inside the thyroid gland.

Hormone:

These glands secrete panathyroid hormone (PTH)

Function of PTH:

PTH increase reabsorption of calcium in the kidneys as well as it induces demineralization of osteoclast cells of bones to release calcium in the blood.

PANCREAS

There are patches of pancreatic cells known as Is lets of langerhans which are endocrine glands. The islets consist of two distinct types of cells that are α-cells & β-cells.

Alpha – Cells:

These cells secrete glucagons hormone.

Beta – Cells:

These cells secrete insulin.

Functions of Glucagon:

Glucagon is secreted in response to the decrease in blood glucose level whose set point is about 90 mg/100 ml of blood.

Functions of insulin:

Insulin is secreted in response to higher level of glucose in blood. It stimulates liver, muscle & adipose cells for uptake of glucose. It also promotes the synthesis of proteins & fats.

Deficiency of Insulin:

The deficiency of insulin causes diabetes mellitus.

ADRENAL GLAND

Adrenal gland is located on each kidney & it consists of two parts, an outer cortex & an inner medulla.

Adrenal Cortex:

It secretes following cortico – steroid hormones.

Cortisol:

Cortisol promotes the hydrolysis of muscle proteins to amino acids It also reduces the inflammatory responses & pain.

Disorders due to abnormal cortisol level:

(1) The hyper secretion of cortisol results in cushing syndromes which is characterized by obesity, muscle wasting, hyper tension, diabetes.

(2) The hypo secretion of this hormone courses addisons disease which is characterized by weakness weight loss, low blood sugar & reduced blood pressure.

Aldosterone:

It increases the reabsorption of Na+ and Cl- ions by the kidney, maintaining fluid volume & blood pressure.

Androgens:

- These hormones are similar to testosterone.
- They cause development of secondary male characteristic.

Adrenal Medulla:

Adrenal Medulla secretes adrenaline (epinephrine) & non-advenalline (non – epinephrine) under conditions of stress to bring about fight or flight, response in emergency conditions. Epinephrine increases heart beat, blood glucose, breathing rate & metabolic rate. The primary function of non-epinephrine is to sustain blood pressure.

THYMUS GLAND

- This gland is situated in the upper part of the chest & consist of two lobes that join in front of trachea.
- It secretes several hormones including thymosin that stimulates the development & differentiation of lymphocyte.

PINEAL GLAND:

- It is a tiny cone shaped body within the brain
- It secretes melatonin at night. It produces biorhythms

GONADS:

Testes:

- The male gonads or testes secrete androgens, the most important of which is testosterone.
- It stimulates bones & muscles growth & development of male secondary sexual characteristics.

Ovaries:

The ovaries secrete two hormones.

- Estrogen
- Progesterone

Estrogen:

It maintains female reproductive system & development of the secondary sexual characteristics in female.

Progesterone:

It maintains the uterus which supports the growth & development of an embryo.

ANIMAL BEHAVIOURS

The response of an animal in relation to its internal or external environment is called animal behaviour. The scientific study of the nature of behaviours is known as ethology.

TYPES OF BEHAVIOUR:

There are two basic types of behaviours

- Innate (instinctive) behaviour
- Learned behaviours

I. INNATE BEHAVIOUR:

Innate behaviours are automatic, pre-programmed, genetically determined, stereo type activities which do not include any learning.

Types of Innate Behaviour:

(i) Kinases:

In this kind, the rate of movement is related to the intensity of the stimulus rather than its direction.

Example:- Wood lice move about quickly in dry conditions but slow down & stop in humid areas.

(ii) Taxes:

This behaviours is related to the direction of stimulus.

Example: A moth flies towards the light in the phototaxis.

(iii) Reflexes:

These are stereo-typed, short-lived, rapid responses mediated by nervous system.

Example: Knee jerk, blinking of eye.

(iv) Fixed Action Pattern: (FAP)

This kind of innate behaviour is triggered or released by an external sensory stimulus known as sign stimulus or releaser.

Example: Male three spined stick-back fish which attacks other males that enter his territory. It was found that the releaser of the attack is the red belly.

II. LEARNED BEHAVIOUR:

It refers to a more or less permanent change in the behaviour which occurs as a result of experience.

Types of Learned Behaviours:

There are following types of learned behaviours.

- Habituation
- Imprinting
- Classic conditioning
- Operant conditioning
- Latent learning
- Insight learning

1. Habituation:

It is the simplest type of learned behaviours in which animal stops responding to a repeated stimulus which is neither beneficial nor harmful.

Example: Birds feeding along a road side.

2. Imprinting:

The term imprinting was coined by Konard Lorenz in 1930. It occurs during very early stage in the life of birds & mammals & the animal is primed to learn a specific information which is then incorporated into an innate behvaiour.

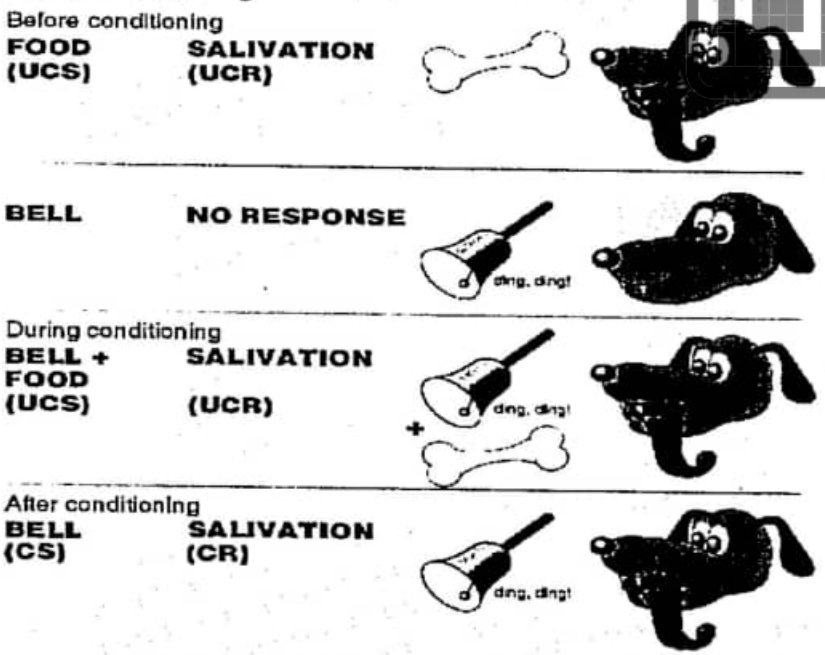
Example:- Ducklings follow the first large noisy moving object they see after hatching.

3. Classic Conditioning:

It is associated with reward or punishment. Ivan Pavlov, a Russian physiologist in 1902 performed classic experiment on digestion in dogs.

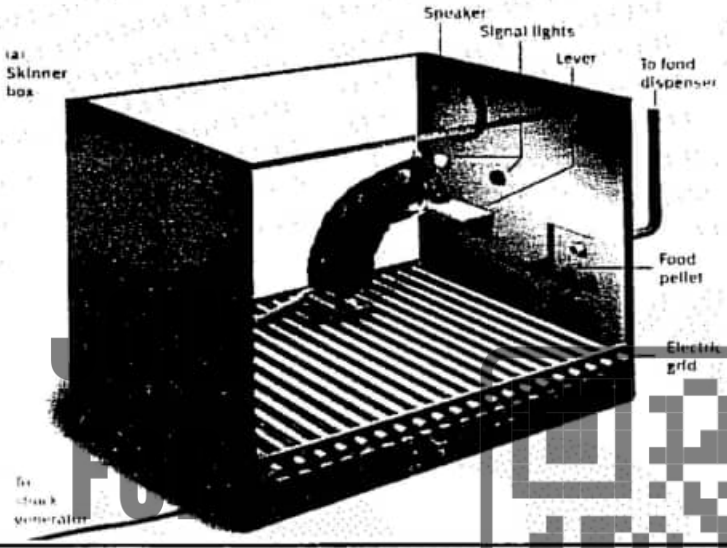
Experiment:

Pavlov first placed dried meat powder into a dogs mouth causing release of saliva. Thereafter, he rang a bell just before presenting meat powder. The process was repeated several times. Later, the dog started salivating at singing of the bell rather than seeing the meat.



4. Operant conditioning:

- In this kind of learning an animal learns to associate one of its behaviour to receive an award or punishment.
- An American psychologist, B.F. Skinner developed a box called Skinner box for his experiments with hungry pigeons or mice on conditioning.
- Inside the box there was lever which operated a food supply.



5. Latent Learning:

This type of learning is not associated with a particular stimulus & is not normally rewarded or punished e.g. If a rat is placed in a maze it was observed that using its natural ability. The rat very soon finds its way out of the maze.

6. Insight Learning:

Solving a problem without trial & error learning is called insight learning. It is the most developed form of learning behaviour. e.g. Insight learning was performed in (Chimpanzees) presented with a bunch of bananas too high to reach & few boxes. Some chimpanzees piled up boxes to make stand for themselves.

BIOLOGICAL RHYTHMS:

DEFINITION:

Some organisms do some activities at regular intervals irrespective to the season or day length. This kind of behaviour so called time biology or biological rhythms. It indicates the existence of a biological clock within the organism.

Types of Biological Rhythms:

There are two types of biological rhythms:

- Exogenous rhythms
- Endogenous rhythms

(i) Exogenous Rhythms:

These rhythms are controlled by external changes such as 24-hr cycle of light & dark.

(ii) Endogenous Rhythms:

These rhythms are controlled by biochemical & physiological changes.

EXAMPLES OF RHYTHMICAL BEHAVIOUR:

Breeding Season:

Many animals do not breed all the year round & there is a specific time of their breeding.

Biannual Migration:

Salmons & eels migrate between sea water & fresh water more than once in their life cycle. A number of birds also have migratory life cycles.

Daily Rhythm:

Animals are active for only a part of 24-hr cycle.

Examples:

- Some function at dawn (crepuscular)
- Some function in night (nocturnal)
- Some function in the day (diurnal)

Chapter 4

REPRODUCTION

The ability of living organisms to produce new organisms of their own kind is called reproduction.

REPRODUCTION IN PLANTS

There are two types of reproduction in plants:

1- Asexual reproduction
2- Sexual reproduction

ASEXUAL REPRODUCTION:

The reproduction in which sexes are not involved is called asexual reproduction.

There are following methods of asexual reproduction in plants.

✓ **BY SPORES OR SPORULATON:**

The spores are formed by a sporophyte plant by meiosis. Therefore these spores are haploid (n) in nature. The spores develop into new haploid organisms. The formation of spores is called sporulation. Sporulation occurs in bacteria, fungi, mosses, ferns, etc.

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✓ **VEGETATIVE PROPOGATION:**

Vegetative propagation involves the separation of a part of the parent plant, which then develops into a new plant.

✓ **APOMIXIS:**

The formation of seed without fertilization is called apomixis. In this process a diploid cell in ovule is directly converted into an embryo (i.e. no reduction division & gametic fusion).

✓ **VEGETATIVE PROPAGATION IN AGRICULTURE:**

✓ **CUTTING:**

Cutting is a very common method of vegetative propagation. Mostly house plants, woody ornamentals & trees are grown by this method.

In most of the cases, the cuttings of plants are used for vegetative propagation. But the leaves of some plants are also used for this purpose. Example: *Bryophyllum*

In some cases cuttings are taken from specialized storage stems. For example: a potato can be cut up into several pieces each with a vegetative bud or eye that regenerates into a whole plant.

✓ **TISSUE CULTURE (TEST-TUBE CLONING & RELATED TECHNIQUES) or CLONING:**

A group of genetically identical offsprings produced by asexual method is called clone & the technique to make a clone is called cloning.

EXPLANATION: It is possible to grow whole plants by culturing smallest plants (pieces of tissue cut from the parent plant) or even single parenchyma cells on an artificial medium containing nutrients & hormones. The cultured cells divide & form an undifferentiated callus form shoots & roots with fully differentiated cells. All of these experiments and performed in a test tube, therefore, these small plants developed by the callus are called test-tube plants which are transferred to soil where they continue their growth.

ADVANTAGES & DISADVANTAGES OF TISSUE CULTURE & CLONING

✓ **ADVANTAGES:**

Many plants can be grown in sterile areas ensuring a much greater survival rate than seed grown plants. In these techniques, the plants are grown in sterile conditions. Therefore, they are not attacked by the pathogens in the initial stage of life.

The manufacturing of used chemicals by plant cultures e.g. production of shikonin, a dye used in silk industry & in the treatment of burns has been produced commercially.

✓ **DISADVANTAGES:**

Plants propagated in this way may be unstable or non fertile.

These plants have unusual chromosome number e.g. when oil palms produced by tissue culture were produced by Malaysia (1970s) they turned out to be sterile.

SEXUAL REPRODUCTION:

The reproduction in which a new individual is developed by the fusion of dissimilar gametes (i.e. male & female gametes) is called sexual reproduction.

TYPES OF SEXUAL REPRODUCTION IN PLANTS:

✓ **ISOGAMY:**

The reproduction in which male & female gametes are similar in morphology & physiology is called isogamy. This is the simplest type of sexual reproduction.

✓ **ANISOGAMY:**

This is the sexual reproduction in which male & female gametes differ either in morphology or in physiology.

✓ **OOGAMY:**

The sexual reproduction in which male & female gametes differ both in morphology & physiology is called oogamy.

✓ **HETEROGAMY:**

In bryophytes a most successful kind of sexual reproduction is present which is called heterogamy. In this reproduction male gametes are small in size & they can locomote whereas the female gametes are non motile, large in size & they have stored food materials.

SEXUAL REPROCUTION IN FLOWERING PLANTS:

FLOWER:

Flower in the reproductive part of plant, which is actually the modified form of shoot.

Explanation: Flower develops from compressed shoots with four whorls of modified leaves separated by very short internodes. These floral leaves are called sepals, petals, stamens & carpels.

✓ **MICROSPOROPHYLLS:**

The stamens are also called microsporophylls. Each microsporophyll contains following three parts:

1. **Filament:** It is the basal stalk.
2. **Connective:** It is the middle part, which connects the filament with another.
3. **Anther:** It is the upper part in which mostly fore pollen sacs or microsporangia are found. Each microsporangium has numerous male gametophytes or pollen grains.

✓ **MEGASPOROPHYLLS:**
Megasporophylls are also called carpels. The carpel is flask shaped body having stigma (head), style (neck) & ovary (basal swollen part). Inside the ovary, ovules (mega sporangia) are found & each ovule has an embryo sac (megaspore) in which a female gamete is present.

POLLINAITON:

The transfer of pollen grains from anther to the stigma of carpel is called pollination. There are two types of pollination:

1. Self pollination
2. Cross pollination

✓ **SELF POLLINATION:**
The transfer of pollen grains from the anther of a flower to the stigma of the same flower is called self pollination.

✓ **CROSS POLLINATION:**
The transfer of pollen grains from the anther of a flower to the stigma of another flower is called cross pollination.

DEVELOPMENT OF MALE GAMETOPHTE:

- Inside the microsporangium (pollen sac) a large number of diploid cells called microspore mother cells are present.
- Each microspore mother cell forms four haploid microspores by meiosis.
- Each microspore divides into two cells by mitosis. One cell is called generative cell & the other is known as tube cell.
- The microspore is surrounded by a thick resistant -wall.
- In this condition the microspore is considered as immature male gametophyte.

DEVELOPMENT OF FEMALE GAMETOPHYTE:

- The female gametophyte or embryo sac develops inside the mega sporangium or nucellus of ovule.
- One cell is mega sporangium becomes distinct, which is called megaspore mother cell.
- The megaspore mother cell (2n) forms four haploid cells by meiosis, which are called linear tetrad.
- The linear tetrad contains four haploid megaspores. Out of them three are disintegrated & the remaining one megaspore develops into female gametophyte.
- The haploid nucleus of megaspore forms eight nuclei by three mitotic divisions.
- Out of these eight nuclei, two are fused to form a diploid secondary nucleus.
- In this stage, the embryo sac contains seven nuclei three nuclei towards chalaza are called antipodals & three nuclei towards the micropylar end are called egg apparatus.
- The egg apparatus contains two synergids & one egg nucleus or female gamete.

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DOUBLE FERTILIZATION:

- After the pollination, the pollen grain is transferred onto the stigma where it germinates.
- During the germination inner layer intine ruptures the exine at any germ pore & comes out in the form of a tube, which is called pollen tube.

- This pollen tube grows downward towards the ovule & finally it enters into ovule through microphyle.
- The nuclei of tube cell & generative cells are shifted into the pollen tube.
- When the generative nucleus enters into the pollen tube, it divides to form two male gametes.
- When the pollen tube penetrates into the embryo sac its tip bursts & both male gametes are discharged into the embryo sac.
- First male gamete is fused with egg nucleus to form diploid oospore. This fusion is called syngamy. The second male gamete is combined with secondary nucleus to form triploid (3n) endosperm nucleus.
- In this way fertilization takes place twice in an embryo sac, therefore this process is called double fertilization, which was discovered by Nawaschin in 1898.

CHANGES IN OVULE AFTER DOUBLE FERTILIZATION:

After double fertilization, the ovule is converted into a seed. In this process following changes take place:

i) The oospore is changed into an embryo cotyledons, plumule & radicle.
ii) The endosperm nucleus forms a nutritive tissue, which provides nourishment to the developing embryo, this tissue is called endosperm.
iii) The integuments form seed coats.
iv) Micropyle also persists in seeds.
The seed is dehydrated until its water contents become 5 to 15% of its weight.

INFLORESCENCE

The arrangement of flowers on floral axis is called inflorescence.

TYPES OF INFLORESCENCE:

1. Racemose
2. Cymose

RACEMOSE:

* The inflorescence in which the apical growth of branch remains continues is called racemose.
* The arrangement of flower is acropetal (young flowers inside)
* The opening of flowers is centripetal.
* The floral axis in racemose inflorescence is known as peduncle.

Types of Racemose

Peduncle elongated
Peduncle shortened
Peduncle flattened
Spikelet inflorescence.

✓ PEDUNCLE ELONGATED:

There are following types of this inflorescence:

1. **RACEME:**
   In this inflorescence the flowers are pedicellate & bisexual e.g. *Serbania sesban.*
2. **SPIKE:**

In this type the flowers are sessile & bisexual e.g. *Amaranthus.*

3. **CATKIN:**
In this type the flowers are sessile & unisexual e.g. mulberry.
4. **SPADIX:**
In this inflorescence the flowers are surrounded by a large bract called spathe e.g. banana.

✓ PEDUNCLE SHORTENED:

There are two types of this inflorescence.

1. **CORYMB:**
In this inflorescence the flowers have the pedicels of unequal length & all these pedicels originate from different points. The lower flowers have large pedicels while the upper flowers have short pedicels e.g. Iberis
2. **UMBEL:**
In this type all the pedicels of flowers have equal length & they originate from the same point e.g. Corriander.

✓ PEDUNCLE FLATTENED/HEAD OR CAPITULUM

The flattened peduncle has a mass of small sessile flower (florets) with one or more whorls of bracts at the base forming an involucre.
Mostly there are two types of florets on head:
Ray florets:
These are marginal florets.
Disc florets:
There are central florets e.g. *Helianthus annus* (sunflower) *& Tagetes erectus* (marry gold)

✓ SPIKELET INFLORESCENCE:

- It is a kind of racemose inflorescence .
- There are three types of bracts at its base called glumes
- The lower two glumes are without flowers are called empty glumes. The third glume has flower in its axile & called lemma.
- Just opposite to lemma, there is small bractiole called palea
- This type of inflorescence is found in family Poaceae.

CYMOSE:

The inflorescence in which the apical growth of branch is stopped is called cymose
In this inflorescence, the arrangement of flowers is basipetal (i.e. old flowers inside & young flowers outside) .The opening of flowers is centrifugal.

Types of cymose inflorescence:

There are two kinds of cymose inflorescence

✓ UNIPAROUS (MONOCHASIAL)CYME:

In this inflorescence main axis soon ends into a flower & produces only one lateral branch at a time ending in a flower. There are two types of uniparous cyme i.e. scorpoid cyme and helicoids cyme.

1. **SCORPOID CYME:**
In this type the succeeding branches (flowering branches) are produced on alternate sides e.g. cotton
2. **HELICOID CYME:**

In this type of cyme the succeeding branches are produced on the s ame side e.g sundew.

✓ **BIPAROUS (DICHASIAL) CYME:**

In this type of cyme, the main axis terminates into a flower & produces two flowers on either sides. This mode is followed by each succeeding flowers. e.g. pink- night jasmine.

✓ **COMPOUND CYMOSE (VERTICELLASTER):**

In this type of inflorescence, initially biparous cyme appears which is followed by uniparous. This inflorescence is the characteristic feature of family Labiateae (mint family)

TYPES OF PLANT ON THE BASIS OF SEX

MONOECIOUS: The plants having both type of flowers i.e., staminate & carpellate on the same plant body are called monoecious e.g. *Achyranthus aspera & Zea mays*

DIECIOUS: These plants bear staminate & carpellate flowers on separate plant bodies. e.g papaya.

SEED DORMANCY:

DEFINITION:

Dormant means sleeping or resting, mostly this term is used for ungerminating seeds.

SIGNIFICANCE OF SEED DORMANCY:

Seed dormancy increases the chances for the germination of seed at a particular time & place most advantageous to the seedling.

BREAKING OF SEED DORMANCY:

Breaking dormancy generally requires certain environmental conditions.

- Seeds of desert plants germinate only after a substantial rain fall.
- Many seeds require intense heat to break dormancy.
- Some seeds require exposure of cold.
- Some types of seeds require light for germination.
- Some seeds have hard seed coats which need a chemical treatment to dissolves. Therefore, when they pass through the digestive tract of grazing animals, the seed coat is dissolved & the seed is ready to germinate.

PARTHENOCARPY:

(Formation Of Seedless Fruits)

The formation of fruit by an ovary without fertilization is called parthenocarpy e.g. banana & seed less grapes are parthenocarpic fruits.

GERMINATION OF SEED:

DEFINITION:

The process in which a dormant embryo is converted into a seedling is called germination of seed.

TYPES OF SEED GERMINATION:

There are three types of seed germination:

Epigeal germination.
Hypogeal germination
Vivipary germination

❖ **EPIGEAL GERMINATION:**

The germination in which the cotyledons come out of the soil due to the enlargement of hypocotyl is called epigeal germination. Example: germination of castor oil seed.

❖ **HYPOGEAL GERMINATION:**

The germination in which the cotyledons remain inside the soil is called hypogeal germination. Example:- pea, maize etc.

VIVIPARY GERMINATION:

Vivipary is a special type of seed germination in which the seed starts to germinate inside the fruit which is still attached with the parent plant & due to the increase in the weight of seedling the fruit falls on the ground & the seedling is converted into a new plant. Example:- coconut, palms, etc.

TRANSITION TO FLOWERING STAGE

(SEED TO SEEDLING)

Germination of a seed produces a seedling. After germination primary growth occurs in the plant in this growth apical meristem takes part. In this way a young seedling becomes a young plant with soft stem & leaves. Some plants undergo secondary growth. In this growth they increase their breadth. These growths are regulated by some hormones. e.g axons. Then other hormones become activated to produce reproductive parts i.e. flowers. These hormones are called flowering hormones e.g. florigen.

VERNALIZATION

DEFINITION:

Promotion of flowering by a cold treatment given to the imbibed seeds or young plants is known as vernalization.

EXPLANATION:

Many plants require cold treatment for germination e.g. pine seeds will not germinate if not exposed to cold temperatures similarly, turnip & sugar beet will not produce flowers if not exposed to cold winter temperatures.

According to scientist such as Garner & Lysenko if the seeds of winter wheat varieties are subjected to low temperature of 0.5°C for a few weeks & then sown in spring will bear the fruit in the same year. In other words they will behave as spring variety

This phenomenon which shortens the vegetative period & hastens flowering is called vernalization.

PHOTOPERIODISM

DEFINITION:

The relative length of day & night to which plant is exposed is called photoperiod & the response of a plant due to this photoperiod is called photoperiodism. There are three types of plants on the basis of photoperiodism.

1. **LONG-DAY PLANTS:**

Those plants which require long days & short night for flowering are called long day plants.

There plants flower only when the light period exceeds a certain critical length in each 24-hr cycle.

Examples: Reddish, spinach, petunias, lettuce

2. SHORT-DAY PLANTS:

Those plants which require short days & long nights for flowering are called short-day plants.

Short day plants flower only when the light period is shorter than a critical length in each 24-hr cycle. For cocklebar this is 14 ½ hrs.

Examples: Chrysanthemum, cocklebar

3. DAY-NEUTRAL PLANTS:

Those plants which are not affected by the change in the duration of day light are called day-neutral plants. They produce flowers throughout the year.

Examples: Tomato, cotton.

FLOWERING HORMONE FLORIGEN & PHYTOCHROME

PHYTOCHROME:

Phytochrome comprises of protein & a pigment. It is distributed through out the plant in minute quantities. It was isolated in 1960 & it exists in two interconvertible forms:

Phytochrome 660 (P^{660})

Phytochrome 730 (P^{730})

❖ **PHYTOCHROME 660 (P^{660})**

It absorbs red light

❖ **PHYTOCHROME 730 (P^{730})**

It absorbs light in the far red region of spectrum.

❖ **FLORIGEN:**

Florigen is the flowering hormone. This hormone is synthesized in leaves & then it is transferred into the apical regions. Therefore, most of the flowers are formed in the apices.

FERTILIZATION IN VITRO(IVF)

VIVO: inside the body

VITRO: outside the body

This field involves dissecting out whole ovules & placing them in a suitable nutrient solution. If it is done carefully the egg (zygote) will develop into a mature embryo. Embryo culture techniques are important in the development of new crop (Importance).

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REPRODUCTION IN ANIMALS

The process in which one or two parent organisms form a new individual is called Reproduction.

TYPES OF REPRODUCTION:

There are two main modes of reproduction in animals.

(i) Asexual Reproduction.

(ii) Sexual Reproduction.

(1) ASEXUAL REPRODUCTION:

This is a primitive type of reproduction in which a new individual is formed by just a single parent i.e., no involvement of gametes and fertilization.

There are following types of asexual reproduction.

(i) *FISSION:*

This is the simplest method of asexual reproduction in which the parent body divides into two or more parts each of which develops into a new individual.
There are two types of fission.

BINARY FISSION:
In binary fission the parent body forms two offsprings.

MULTI FISSION:
In multiple fission the parent body divides into more than two daughter organisms.
EXAMPLES:
Amoeba, Paramecium, Plasmodium.

(ii) *BUDDING:*

In this reproduction, a small outgrowth develops on some part of the parent body and is called a bud. This bud increases its size and finally it is separated from the parent body and starts its independent life.
EXAMPLES:
Hydra, Corals.

(iii) *REGENERATION:*

This is the process of re-growing the missing parts. It is common in worms and echinoderms. The sponges also pass through a same process called fragmentation in which their body divides into many small pieces or fragments. Then each fragment develops into a new organism.

(iv) *PARTHENOGENESIS:*

The formation of a new animal by an unfertilized egg is called Parthenogenesis.
EXAMPLE:
Parthenogenesis is commonly found in some insects like honey bees, ants etc

TWINS

Twins are the two children which develop and are born together.
There are two types of twins.

(a) IDENTICAL OR MONOZYGOTIC TWINS:

Identical twins are exactly alike and of the same sex because both of them develop from just one zygote.

(b) FRATERNAL OR DIZYGOTIC TWINS:

Internal twins are the children which develop from two independent eggs and each egg is fertilized by a separate sperm. There twins are not identical.

(2) SEXUAL REPRODUCTION:

It is the type of reproduction which involves sex cells. The male gametes or sperm fuses with a female ovum to form a zygote which develops into a new individual.

SIGNIFICANCE OF SEXUAL REPRODUCTION:

- Sexual reproduction is important to avoid genetic monotony which is the result of asexual reproduction.
- Sexual reproduction produces an endless variety of organisms.
- This diversity of characteristics in a species increases the chances of survival.
- The genetic variation plays an important role in the identification of individuals.

NECESSITIES OF SEXUAL REPRODUCTION:

Sexual reproduction requires:

(i) Gametogenesis.
(ii) Mating and fertilization.

GAMETOGENESIS:

Formation of gametes is called gametogenesis. In animals, the gametes are produced in specific organs which are called gonads. There are two types of gonads.

(i) Testes or male gonads.
(ii) Ovaries or female gonads.

TESTES:

Testes form male gametes which are called sperms.

OVARIES:

Ovaries form female gametes or eggs.

❖ SPERMATOGENESIS:

It is a process of cell division by which sperms are formed from germ cells present in testes. This process is competed in following steps:

STEP # 1:
Germ cells in testes first transform mitotically into spermatogonia and then into primary spermatocytes.
STEP # 2:
Each primary spermatocyte divides meiotically into two secondary spermatocytes.
STEP # 3:
Secondary spermatocytes also divide to form genetically different haploid spermatids.
STEP # 4:
Each spermatid develops into a sperm.
DURATION OF OOGENESIS: This process is completed in about ten weeks.

❖ OOGENESIS:

It is a process of cell division by which ova are formed from germ cells present in the ovaries.
This process is completed in the following steps:

STEP # 1:
Germ cells in ovary divide mitotically to form oogonia which develop into primary oocytes.
STEP # 2:
The primary oocytes undergo first meiotic division to form two unequal cells, a large secondary oocyte and a smaller polar body.
STEP # 3:
Both secondary oocyte and polar body further divide to form a large haploid ovum or egg and three haploid polar bodies (non-functional cells).
DURATION OF OOGENESIS: This process completes is about a month.

MATING AND FERTILIZATION:

Mating is the process in which male and female contribute their gametes for the process of fertilization. There are two types of fertilization.

EXTERNAL FERTILIZATION:

The process of fusion of a sperm and ovum outside the body of female in an aquatic medium is called external fertilization.
Example: Fertilization in amphibians and sessile animals.

INTERNAL FERTILIZATION:

The fertilization in which the eggs are fertilized inside the body of the female is called internal fertilization.
Example: Fertilization in terrestrial animals.

SEX TYPES IN ANIMALS:

There are two sex types in animals.

(i) **HERMAPHRODITE:**

Those animals in which both sexes are present in one body are called hermaphrodite.
Example: Tapeworm, Earthworm etc.

(ii) **UNISEXUAL:**

Those animals in which only one sex is present inside a body are called unisexual.
EXAMPLE: Mammals, birds etc.

OVIPARITY:

The egg laying animals are called oviparity animals.
EXAMPLE: Fishes, Reptiles, Birds.

VIVIPARITY:

The animals which give birth to their young ones are called viviparous.
EXAMPLE: Most mammals.

MALE REPRODUCTIVE SYSTEM

Male reproductive system in human is composed of following organs.

TESTES:

Testes are the primary sex organs in male. They are oval organs located outside the body in a thin walled pouch called scrotum. Each testis is about 4 to 5cm long and 2.5cm wide.

INTERNAL STRUCTURE:

Each testis is surrounded by a thick, fibrous capsule which is composed of white connective tissue.
Extension of the capsule project into the interior of the testis and divide each testis into about 250cone shaped. The lobules contain seminiferous tubules in which sperms develop.

FUNCTIONS:

1: SPERMATOGENESIS:

The formation of sperms is called spermatogenesis..

2: HORMONE PRODUCTION:

Testes prepare and secrete a hormone testosterone. This is the male sex hormone.

DUCTS:

The male reproductive system is composed of following types of ducts.

1: EPIDIDYMIS:

Epididymis is a tightly coiled series of thread like tubules that form a comma shaped structure on the posterior side of testis. It is 6meters long.

FUNCTION:
In epididymis, sperms complete their maturation and are stored for about 20days.

2: VAS DEFERENS:
It is a thick walled, muscular cord like organ.
FUNCTION:
Their thick walls of smooth muscles create peristaltic movement, which rapidly squeeze the sperms from epididymis to the urethra.

3: URETHRA:
Urethra extends from the base of the urinary bladder to the tip of the penis.
FUNCTIONS:
It conducts either urine or semen which passes through the penis to the outside of the body.

EXTERNAL GENITILIA:

The external genitilia of the male include the scrotum and the penis (male coupulatory organ).

ACCESSORY GLANDS AND SEMENS:

1:SEMINAL VESICLE:
The seminal vesicles are two copulated sacs about 5cm long located at the base of urinary bladder.
FUNCTION:
It produces about 60% of the fluid volume of semen. Its thick, yellowish secretion is rich in fructose, vitamin C, prostaglandins and other substances which nourish and activate the sperm.

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2: PROSTATE GLAND:
It is a single gland, encircles the upper part of the urethra just below the urinary bladder.
FUNCTION:
Prostate gland secretes a milky fluid that plays a role in activating sperms.

3: BULBOURETHRAL GLANDS (COWPER'S GLAND):
These are tiny, pea shaped glands inferior to the prostate glands.
FUNCTION:
They produce a thick, clear which drains into the urethra before semen.

SEMEN:

Semen is a milky white, some what sticky mixture of sperm and accessory glands secretion.

VOLUME:	2 – 5ml
NUMBER OF SPERMS:	50 – 100 millions/ml
pH :	7.2 – 7.6

FEMALE REPRODUCTIVE SYSTEM

The female reproductive system consists of two types of organ.

(i) Primary sex organ.
(ii) Accessory organ.

PRIMARY SEX ORGAN:

In female reproductive system ovaries are the primary sex organs. There are two ovaries in a female body. They lie on either of uterus.

EXTERNAL STRUCTURE OF OVARY:

Shape: Ovaries are almond shaped.
Size: Length is 4cm, width is 2.5cm, thickness is 1.5cm approximately.
Attachment: Ovaries are attached to the uterus by the ovarian ligaments.

INTERNAL STRUCTURE OF OVARY:

Ovary is composed of two basic parts.
Cortex: Cortex is the outer part of the ovary.
Medula: It is the inner part of the ovary. It is composed by blood vessels, nerves and loosely packed fibrous tissues.

FUNCTIONS OF OVARY:

1. OOGENESIS:

The formation of eggs or ova is called oogenesis (Eggs or ova are the female gametes). In the two ovaries about 200,000 eggs are found, how ever, only 450 eggs become mature in the fertile period of life.

2. HORMONES: Ovaries produces two hormones.

- **Oestrogen:** It is secreted from follicles.
- **Progesterone:** It is secreted from corpus luteum.

These hormones produce female secondary characters.

ACCESSORY ORGANS:

They include following organs:

(i) Fallopian tubes.
(ii) Uterus.
(iii) Vagina.
(iv) External genitilia.

1:- FALLOPIAN TUBES:

Two fallopian tubes are present attached to either side of the uterus.
Size: Length of each tube is about 10cm.
Basic Structure: They are internally lined with cilia which move the egg towards uterus. The distal end of each tube is expanded and has finger like projections called fimbriae which partially surround the ovary.
Functions:

- It receives egg from ovary.
- It provides a suitable place for the fertilization.

2:-UTERUS:

It is pear shaped muscular organ living with vascular tissues. Its walls are composed of 3 layers.
Epimetrium: Outer most serous layer.

Myometrium: It is the middle layer composed of smooth muscles. It plays a vital role during the delivery of the baby.

Endometrium: It is the inner most spongy layer containing vascular tissues. It receives fertilized egg (implantation). If the egg is not fertilized, it shed and menses are produced. Lower part of uterus is called cervix. Its measurement is about 2.5cm.

3:-VAGINA:

Vagina is an elastic, fibro-muscular tube like organ. It is 6 – 10cm in length.

Functions:

- ❖ It receives the sperms through the penis during mating.
- ❖ It is also called birth canal because the baby delivers through it.

3:- EXTERNAL GENITILIA:

In female the external genitilia is called vulva. It has two openings i.e., urethral and vaginal.

MENSTRUAL CYCLE

It includes all the cyclic changes in the endometrium of the uterus. These changes take place once in a month. At the end of their cycle the endometrium sheds and blood with mucus and epithelial tissues are released through vagina. This is called menstruation. The menstrual cycle is sub-divided into following phases:

(i) Menstruation.
(ii) Proliferative phase (Follicle phase).
(iii) Ovulation.
(iv) Secretary phase (Corpus luteum phase).

- ❖ **MENSTRUCTION (DAY 1 – 5):**

During this interval, the thick endometrial-lining of the uterus is sloughing off or becoming detached. This is accomplished by bleeding for 3 to5 days. The detached tissues and blood pass through vagina as the menstrual flow. The average blood loss during this period is 50-150ml.

- ❖ **PROLIFERATIVE PHASE (DAY 6 – 13):**

In the phase one of the developing follicles matures more rapidly. This follicle is called graffian follicle. The graffian follicle secretes oestrogen. Due to the rising oestrogen level, the endometrial blood supply is increased. So it again becomes thick and spongy.

- ❖ **OVULATION (DAY 14):**

At the end of the Proliferative phase the graffian follicle ruptured and the oocyte comes out of it enters into the fallopian tube. This release of oocyte from graffian follicle is called ovulation.

- ❖ **SECRETORY PHASE (DAY 15 – 28):**

After ovulation the graffian follicle becomes filled with a fatty yellow mass called the corpus luteum. It secretes a hormone called progesterone. Progesterone is responsible for the further development of the endometrium. It causes endometrial glands to increase in size and to begin secreting nutrients into the uterine cavity. These nutrients will sustain a developing embryo until it is implanted. If fertilization does not occur, the corpus luteum begins to degenerate towards the end of this period. In this condition it is called corpus albicans. Due to the degeneration of the corpus luteum the progesterone level suddenly decreases, at this stage the endometrium sheds and menses start again.

OESTROUS CYCLE

When eggs mature during breeding season, the hormonal secretion in females initiates certain behavioral changes, indicating their readiness for mating and the animal is said to be in heat. This occurs in a cyclic manner called the oestrous cycle.

HORMONAL CONTROL IN FEMALE REPRODUCTIVE SYSTEM

In female, the reproductive hormones are secreted from different sites. The details of these sites are as follows:

(i) Hypothalamus.
(ii) Pituitary gland.
(iii) Ovary.

HYPOTHALAMUS:

It is the lower part of the brain. It secretes one hormone.

GONADOTROPIC RELEASING HORMONE (GnRH):

It controls the secretion of the reproductive hormones from pituitary glands.

PITUITARY GLAND:

It secretes following hormones.

1:- FOLLICLE STIMULATING HORMONE (FSH):

SITE OF SECRETION: It is secreted from the anterior lobe of pituitary gland.
TARGET SITE: Immature follicles.
FUNCTIONS:
* Maturation of follicles into Graffian follicles.
* Stimulates the secretion of oestrogen.
* Its decreased level induces ovulation.

2:- LUTEINIZING HORMONE (LH):

SITE OF SECRETION: Anterior lobe of pituitary gland.
TARGET SITE: Graffian follicle.
FUNCTIONS:
* Its increased level induces ovulation.
* Stimulates the development of corpus luteum.
* Controls the secretion of progesterone.

3:- PROLACTIN:

SITE OF SECRETION: Anterior lobe of pituitary gland.
TARGET SITE: Mammary glands.
FUNCTIONS:
* Maintenance of corpus luteum.
* Stimulates milk production.

4:- OXYTOCIN:

SITE OF SECRETION: Posterior lob of pituitary gland.
TARGET SITE: Uterus and mammary glands.
FUNCTIONS:
* Contraction of uterus during delivery.
* Development of mammary glands, milk production and secretion.

OVARY:

The ovaries secrete two important hormones.

1:- OESTROGEN:

SITE OF SECRETION: It is secreted from the developing follicle during the proliferatine phase.

TARGET SITE:- Endometrium of uterus.

FUNCTIONS:

* Repairs and develops endometrium.
* Stops the secretion of FSH and enhances the secretion of LH from pituitary gland at the 14^{th} day of the cycle.

2:- PROGESTERONE:

SITE OF SECRETION: Corpus luterm.

TARGET SITE: Endometrium of uterus and mammary glands.

FUNCTIONS:

* Completes preparation and maintains the endometrium for pregnancy.
* Stimulates the development of mammary glands.

HORMONAL CONTROL BY PLACENTA:

PLACENTA:

The tissue attaching the embryo to the wall of uterus is called placenta. It secretes a hormone called "human chorionic gonadotropin (HCG).

FUNCTIONS:

HCG acts like LH and stimulates and maintains corpus luteum within the ovary to keep on secreting progesterone. Placenta also secretes oestrogen.

CONCEPTION AND PREGNANCY

Fertilization in human beings is more commonly called conception i.e., to conceive a baby.

After fertilization, the zygote divides and forms a ball of cells called blastocyst which travels down the oviduct and reaches the uterus to be embedded in its wall. This process is called implantation and it marks the start of pregnancy.

PLACENTA:

The tissue attaching the embryo to the wall of uterus is called placenta.

FUNCTIONS:

CO_2 and waste from the embryo diffuse out through the placenta to the mother.

Placenta also secretes progesterone hormone for maintaining pregnany.

AMNION:

In reptiles, birds and mammals, when the embryo becomes implanted in the uterine wall, a clear, extra, embryonic membrane, the amnion develops and surrounds the embryo. The cavity inside the amnion is filled with a fluid which is called amniotic fluid. This cavity is known as amnion sac.

CHORION AND ALLANTOIS:

Chorion and allantois are two other membranous sacs associated with most of the amniotic embryos.

FUNCTIONS:
These membranes protect the embryo and assist it in nutrition and excretion.
FUNCTIONS OF AMNION:
The amniotic fluid keeps the embryo moist and it also protects the embryo by external jerks.

UMBILICAL CORD:

A rope like structure formed from the extra embryonic membrane, the allantois is called umbilical cord.
FUNCTIONS:
It connects the embryo to the placenta.

BIRTH:

In human beings the development of fetus is completed in about 9months (40weeks). After the completion of development, the baby is ready to born. The muscles of the uterus begin to contract and relax due to oxytocin. These strong contractions of the muscles of the uterus are called labour.

LACTATION:

After the birth of the baby as the umbilical cord is cut, food supply to the new born is disconnected. It is now fed on a nutritious fluid, the milk which is produced in the mammary glands of the mother. The milk production in mammary gland is controlled by prolactin.

TEST TUBE BABIES:

Approximately 10% of the couples fail to have children. This condition is called infertility. There are several causes of infertility. In some females, infertility is caused due to the blockage of oviducts so that the sperms cannot reach the egg. This sort of infertility is overcome by a technique called invitro fertilization.

INVITRO FERTILIZATION:

STEP # 1:
The oocytes are sucked up from the ovary of the woman before ovulation.
STEP # 2:
These eggs are fertilized outside her body in a laboratory dish with the sperm.
STEP # 3:
Eggs thus fertilized invitro are allowed to develop for a few days in a laboratory and then it is transferred into the uterus for implantation where it undergoes normal development and is born in a natural way.

SEXUALLY TRANSMITTED DISEASES:

1:- GONNORHEA:

PATHOGEN:
It is a disease caused by a bacterium *Neisseria gonorrhoeae* which is introduced in the body through a sexual contact usually through genitals and oral contact.
COMPLICATIONS:
The bacterium causes wounds in genital tubes and the infected males experience burning sensation during urination with discharge of thick white pus from urethra. In female infectees oviducts become damaged and blocked. If untreated, it can cause infertility in both males and females. An infected mother can transmit these bacteria to her new born baby while he or she is being delivered. These babies more often suffer eye infections and can become blind if not treated immediately.

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2:- SYPHILIS:

PATHOGEN:
It is caused by a Spirochaete bacterium *Treponema pallidium*.
PATHOGENICITY:
These bacteria not only damage the reproductive organs but also affect nervous system and skeletal system in addition to cause a large number of lesions.
COMPLICATIONS:
These conditions often become fatal not only to the infected men and women but also to new born babies.
REMEDY:
Prolonged antibiotic treatment is the probable remedy.

3:- GENITAL HERPES:

PATHOGEN:
It is caused by a virus called Herpes simplex.
COMPLICATIONS:
It is characterized by painful blisters and ulcers on and around external genital organs. Sexual partners or new born baby receives this infection from body fluids or genital fluids.
REMEDY:
Use of antibiotics protects from the complications of this infection but the disease itself is not cured.

4:- AIDS

INTRODUCTION:
Acquired immune deficiency syndrome is a fatal disease caused by HIV (Human Immuno-Deficiency virus).
PATHOGENICITY:
HIV infection destroys the patient's immune system and exposes infected person to all types of infections.
MODE OF TRANSMISSION:
Genital and other body fluids are a major source of infection.
Unscreened blood transfusions.
Reuse of syringe needles.
New born can also become infected through placenta of HIV I
PREVENTIVE MEASURES:-
* The vaccine for its cure is not yet available.
* To reduce the chance of infection of these sexually transmitted disease is that both the husband and wife should restrict to each other.

Chapter 5 GROWTH & DEVELOPMENT

GROWTH:

A permanent irreversible increase in size, weight, shape & structure usually accompanied by a permanent change of form is called growth.

DEVELOPMENT:

Zygote is actually a foundation cell of a new organism, thus a single called zygote undergoes a series of progressive changes after which it becomes a multicellular adult. There progressive changes are collectively known as development.

EMBRYOLOGY:

The study of the changes from a zygote to a complete individual is called embryology.

GROWTH & DEVELOPMENT IN PLANT:

The growth regions in a plant body are called meristems.

TYPES OF MERISTEM:

There are three types of meristems.

1. **Apical Meristems:**

These meristems are found in the apical regions of a plant.

Example: - Root & Shoot apices

2. **Lateral Meristem:**

This meristem is present b/w the vascular bundles of the stem of gymnosperms & most dicots. It is commonly known as cambium.

3. **Intercalary Meristem:**

The meristem which is found at the base of internodes is called intercalary Meristem.

FUNCTIONS OF MERISTEM:

1. **APICAL MERISTEMS:**

This meristem is responsible for primary growth. In this growth the length of a plant is increase.

2. LATERAL MERISTEMS:

The lateral meristem or cambium performs the function of secondary growth. In this growth the breadth of the plant increases.

3. INTERCALARY MERISTEMS:

The intercalary meristem forms the lateral organs such as braches, flowers etc.

PHASES OF GROWTH:

There are three phases of growth.

1. The formative phase.
2. Elongation phase.
3. Maturation or Differentiation phase.

1. THE FORMATIVE PHASE:

- This is restricted to the tips of roots & shoots.
- In this region the cells constantly divide & thus increase in number.
- The cells in these regions are closely packed together & they have thin cellular wall, dense cytoplasm, small vacuoles & large nuclei.

2. ELONGATION PHASE:

- This phase occurs immediately behind the formative region.
- The cells of this region are unable to divide but they are large in size because they are in turgid condition.
- In the root, the region of elongation extends over a few millimeters & in the stem over a few centimeters.

3. MATURATION OR DIFFERENTIATION PHASE:

- This phase is found behind the region of elongation.
- Here the thickening of the cell walls takes place the elongated cells are modified into permanent ones.
- In this phase the cells are adopted to perform particular functions.

CONDITIONS FOR GROWTH:

1. EXTERNAL CONDITION:

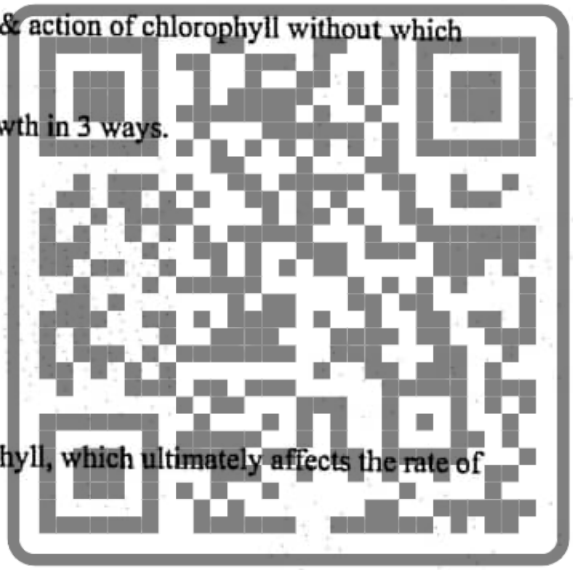
Following are the main external conditions, which alter the rate of growth either positively or negatively.

(i) Temperature:

- Temperature plays an important role in growth because most enzymes show their maximum activity at an optimum temperature (b/w 25°C to 37 °C)
- Therefore metabolic function of cell, formation of new protoplast & cell division take place rapidly at the optimum temperature.

(ii) Light:

- Light is required for the synthesis & action of chlorophyll without which photosynthesis cannot take place.
- Usually light affect the rate of growth in 3 ways.
  - (a) Intensity of light.
  - (b) Duration of light.
  - (c) Quality of light.



(a) Intensity of Light:

High intensity of light destroys to chlorophyll, which ultimately affects the rate of photosynthesis.

(b) Duration of Light:

Duration of light affects the growth of vegetative & reproductive structures.

(c) Quality of Light:

- The quality of light also has influence on growth rate such as red light favours elongation of cells & blue light enhances the cell division but retards cell enlargement.
- U.V. light destroys the protoplasm & retard the growth.

(iii) Oxygen:

The supply of oxygen is required for energy production by respiration without oxygen metabolism & growth are stopped.

(iv) Carbondioxide:

CO_2 is necessary for photosynthesis & food production. If this process will continue, more food & other compounds for the synthesis of new protoplasm will be produced.

(v) Nutrients:

Efficiency & deficiency of different nutrients play an important role in the growth. For example: Plants growing in Nitrogen deficient soil cannot prepare proteins & show stunted growth & development. *Prep. By:- Raza Mehdi*

2- INTERNAL FACTORS:

Internal factors affecting growth include the relative quantities of different hormones present in the body & the genetic constitution of the organism.

Growth Correlation

"The growth of a plant organ is related with the growth of other organs which takes place in different directions, this relationship between the growth of organism is known as growth correlation"

GROWTH & DEVELOPMENT IN ANIMALS

DEVELOPMENT OF CHICK:

1. EGG:

- The egg of a hen is polylecithal type (i.e. it contains large amount of yolk).
- It is released from the ovary as primary oocyte with a diameter of above 3 cm.
- The protoplasm is restricted to a very small area called Blastodisc or germinal disc.

FERTILIZATION:

- It is the process of fusion of sperm with the ovum to form a single diploid cell, which is called zygote.

- In hen the fertilization is internal & after the fertilization secondary oocyte becomes a mature ovum.
- It releases two polar bodies, which degenerate later on.
- The fertilized ovum during its way through the oviduct is covered by Albumin outside its vitelline membrane.
- Outside the Albumin there are two shell membranes & hard porous proteinaceous calcareous shell.
- This fertilized egg is laid 24 hours after the fertilization.

3- INCUBATION:

- The development of chick inside the ovum requires 36 – 38 °C temperature.
- This temperature is naturally provided by the mother hen or artificially in incubator.
- At this temperature the chick completes its development & finally its hatching takes place in 21 days.

STAGES OF DEVELOMENT:

1. CLEAVAGE:

- It is a series of repeated mitotic divisions that takes place in the fertilized ovum.
- The cleavage in birds is restricted to the blastodisc lying on the top of the yolk towards the animal pole of the zygote.
- This type of cleavage is termed as discoid cleavage.
- In fish, reptiles & birds flue cleavage is meroblastic type or incomplete type.
- The first two cleavages occur at right angle to each other in vertical plane.
- The third cleavage occurs in horizontal plane & as a result & blastomeres are formed.
- The rest of the cleavages are irregular & form a large number of cells all over the germinal disc, which is termed as blastoderm.

2. MORULA:

- Due to the cleavages the embryo becomes a rounded mass of closely packed blastomeres, which resembles a mulberry & therefore is called Morula.

2. BLASTULA:

- It is the embryonic stage, which contains a fluid filled cavity, which is called Blastocoels.
- In chick it appears when the Blast dermal cells split into two layers, the upper of **epiblast** & the lower layer **hypoblast.**
- In b/w these layers the blastocoel appears.
- The marginal cells of blastoderm are associated with yolk & form the zone of function or area opaca while the central region is termed as area pellucida.

4- GASTRULA:

- Gastrula is the next stage after Blastula & the process of its formation is called Gastrulation. This is the process in which besides cell division, cell migration & their rearrangement at definite locations in the embryo occur.
- Due to the arrangement of cell 3 germinal layers are formed i.e. ectoderm, Mesoderm & Endoderm.

1- ENDODERM FORMATION:

- It is represented by the rearrangement of the cells of the area pellucida of Blastoderm.
- Some cells of the hypoblast of the area pellucida migrate downward & spread over the yolk to form a floor of the sub germinal cavity. This floor is known as endoderm.
- This type of gastrulation is without invagination & archenteron formation.

2- MESODERM FORMATION:

- In chick the formation of Mesoderm & Notochord does not involve invagination of the epiblast.
- The epiblast moves downward in the middle of blastodisc, then separates & move inward towards the yolk.
- Due to this activity of epiblast a groove is produced which is called **primitive Streak**.
- The primitive streak has a swelling at its anterior end called **primitive knot**.
- As more cells are added the primitive streak elongates. It is functionally equivalent to the dorsal lip of the blastopore of frog.
- When a number of cells of epiblast pass through into the blastocoel to form a new layer of cells called Mesoderm.

3- ECTODERM FORMATION:

The remaining cells of epiblast after the migration of mesoderm form the surface layer or ectoderm.

NOTOCHORD FORMATION & DEFFERENTIATION OF MESODERM:

- The cells of the primitive streak migrate inward into the sub germinal cavity to form a rod of cells called Notochord.
- The Mesoderm on each side of the Notochord gives rise metamerically arranged somites or epimeres which later gives rise muscles axial skeleton & connective tissues.
- Below the epimere the segment of Mesoderm is Mesomere or Nephrostome.
- The rest of the Mesoderm is the hypomere or lateral plate. After 24 hrs of incubation the lateral plate forms an outer layer (somatic layer) & an inner layer (splanchnic layer)
- The space formed in b/w these two layers is called coelom.
- The somatic layer fuses with the ectoderm & the splanchnic layer with endoderm to form somatoplure & splanchnoplure respectively.

NEURULATION:

- During the formation of Notochord some of the ectodermal cells of area pellucida lying above the Notochord divide rapidly to form a neural plate on the dorsal surface of the Gastrula. The Neural plate sinks inside the embryo to form a neural groove the mid dorsal line.
- Both the edges of the neural groove move towards each other & fused together to form a neural tube.
- The embryo is now termed as Neurula & the process of its formation is called Neurulation.

CELL DIFFERENTIATION & ITS MECHANISM:

- All the cells of embryo arise from the same fertilized ovum so all of them have same number & kind of genes.
- From the process of Gastrulation & onward some of the genes are activated & others are switched off, some even forever.

MECHANISM OF DIFFERENTIATION:

- During the differentiation the genetic expression is ultimately influenced by the cytoplasmic chemical composition.
- Therefore we can say that the cytoplasm of unfertilized egg is responsible for later differentiation of embryonic cells into tissues.

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EMBRYONIC INDUCTION & ITS MECHANISM

Hans Spemann a classical embryologist who received Nobel Prize in 1935 & his colleague Hilde Mangold in 1924 performed an experiment on embryonic induction.

Experiment # 1

They cut the presumptive nervous tissues just above the notochord & transplanted into the belly region of the embryo.

Result: - They found that neural tissue failed to develop at the ectopic site.

Experiment # 2

In another experiment they cut away the presumptive notochord tissue & grafted it under the presumptive belly ectoderm.

Result: The belly ectoderm developed into the neural tissue.

Conclusion: They concluded that an embryonic tissue influences upon the other embryonic tissue through transmitting some chemical stimulus. This phenomenon is called embryonic Induction.

ROLE OF NUCLEUS IN DEVELOPMENT

Introduction: The role of Nucleus in development was studied in a unicellular alga *Acetabularia* which consists of Rhizoid for attachment & a cytoplasmic stalk with a disc like cap at its terminal end. On the basic of cap there are two species of *Acetabularia*.

1- *Acetabularia mediterranea* (disc –shaped cap)
2- *Acetabularia cranulata* (lobed cap)

EXPERIMENT:

Haemmerling cut off a stalk containing cytoplasm of A.*cranulata* & grafted it on nucleus containing Rhizome of A. *mediterranea* & vice versa.

Result: The caps of the previous type (according to nucleus) were regenerated on both of the grafted stalked species of *Acetabularia*.

Conclusion: It indicates that the process of development of cap was regulated by the nucleus rather than the cytoplasm.

ROLE OF CYTOPLASM IN DEVELOPMENT

Introduction: The role of cytoplasm in the development was studied in the embryo of frog. The unfertilized ovum of frog has an upper pigmented cytoplasmic half & a lower yolky half. After fertilization just opposite to the point of entrance of sperm-nucleus in the ovum. Some of the pigments of cytoplasm shift upward leaving behind a gray area in the form of a crescent called **Gray Crescent.** As a result of first cleavage the zygote divides vertically into two cells through the centre of gray crescent.

If the two daughter cells (after the first cleavage) are carefully separated from each other so each of them develops into a normal tadpole larva.

EXPERIMENT:

Hans Spemann (1930) misguided the normal plane of first cleavage so one of the two daughter cells received entire crescent while the other non-crescent both of the daughter cells were separated & allowed to develop. The cell with gray crescent developed into a tadpole while the other turned into a mass of cells & died.

CONCLUSION:

This experiment indicates that cytoplasm containing gray crescent is required for the normal development of frog.

AGING

Definition: "The body of multicellular animals undergoes a process of progressive detoriation. This process is known as aging". The science of Aging is known as Gerontology.

CAUSES OF AGING:

1- **GENETIC ORIGIN :**

- According to **Lenard Hayflick & Paul Moor Head,** the aging is genetically programmed.
- They cultured normal embryonic human cells. It was found that all the cell lines proceeded to divide 50 times than stopped & then entire population died off.
- It proved that normal cells have a limited potential of division.

2- **GENE MUTATION:**

- With the passage of time due to the accumulation of Gene mutations the capacity of self-repair of DNA during its replication is lost.
- This results in progressively inadequately function cells that cause the aging.

REDUCTION OF AGING:

- It is observed that low fat diet, aerobic, low impact exercises may likely to reduce some effects of aging.

REGENERATION

Definition: "It is the ability of living organism to construct its lost parts of the body."

Example: Salamanders & lizards can regenerate their tails.

ABNORMAL DEVELOPMENT

Definition: "Deviations in the normal structure & functions of an organism during the embryological development is called abnormal development."

The study of such abnormalities is called Teratology.

Examples:

* Microcephaly small head
* Cleft lip & palate (Hare lip)
* Polydactyly Many digits.
* Dextracardia Heart toward right side

Chapter 6 CHROMOSOMES AND DNA

CHROMOSOMES:

The term chromosome (Gr: Chroma = coloured, Soma = body) is used for the thread like coloured bodies which are found inside the nucleus. This term was introduced by a German embryologist Walther Fleming in 1882 while examining rapidly dividing cells of salamander larvae after treating with **Perkin's Aniline** dye. The chromosomes contain hereditary characters in the form of genes, present in pairs in an individual and their number remains constant generation after generation in a given species.

The number of chromosomes varies from species to species.

Examples:

1. Penicillium = 2 chromosomes
2. Mosquito = 6 chromosomes
3. Drosophila = 8 chromosomes
4. Garden Pea = 14 chromosomes
5. Frog = 24 chromosomes
6. Human = 46 chromosomes
7. Sugar Can = 80 chromosomes
8. Fern = 1000 chromosomes

STRUCTURE OF CHROMOSOMES:

- Chromosomes can only be seen when the cells are dividing.
- Each chromosome consist of two very thin thread called chromatids.
- They share a common point of attachment called centromere.
- Centromere is small spherical zone on the chromosome, within centromere a disc shape protein structure called **kinetochore** is present to which the spindle fibers attached during cell division
- Each chromatid of a chromosome consist of one or more thin threads called chromonema which contain deeper staining regions along their lengths, given the threads like appearance of strings of beads. These regions are called chromomeres.
- The two chromatids of same chromosome are called sister chromatics and the chromatics of different chromosomes are called non-sister chromatids.

TYPES OF CHROMOSOMES:

There are four types of chromosomes.

1. Telocentric (Terminal centromere)
2. Acrocentric (Sub-Terminal centromere)
3. Sub-Metacentric (J-shaped chromosomes)
4. Meta centric (V-shaped chromosomes)

HOMOLOGOUS CHROMOSOMES:

Those chromosomes which are morphologically similar with same set of genes are called **"Homologous chromosomes"**

AUTOSOMES:

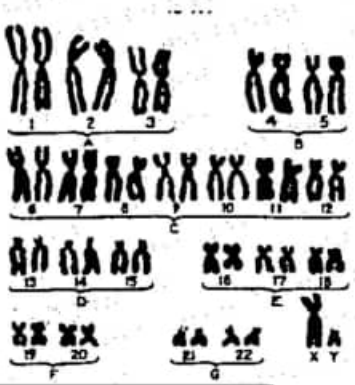
All the chromosomes in a cell except the sex chromosomes are called **"Autosomes"**.

SEX-CHROMOSOMES:

Those chromosomes in a cell by which the sex of organism can be determined are called **"Sex chromosomes"**.

KARYOTYPE:

The particular array of chromosomes that an individual possesses is called its **"Karyotype"**.



The karyotype of individual is often examined to detect genetic abnormalities, such as those arising from extra or lost chromosomes.

CHEMICAL COMPOSITION OF CHROMOSOMES:

- Chemically the chromosome is composed of deoxyribonucleo protein.
- Deoxyribonucleo protein is composed of DNA and Protein.
- The most abundant chromosomal proteins are called Histones.
- DNA is made up of billions of units called nucleotides and there are three components of nucleotides i.e.,

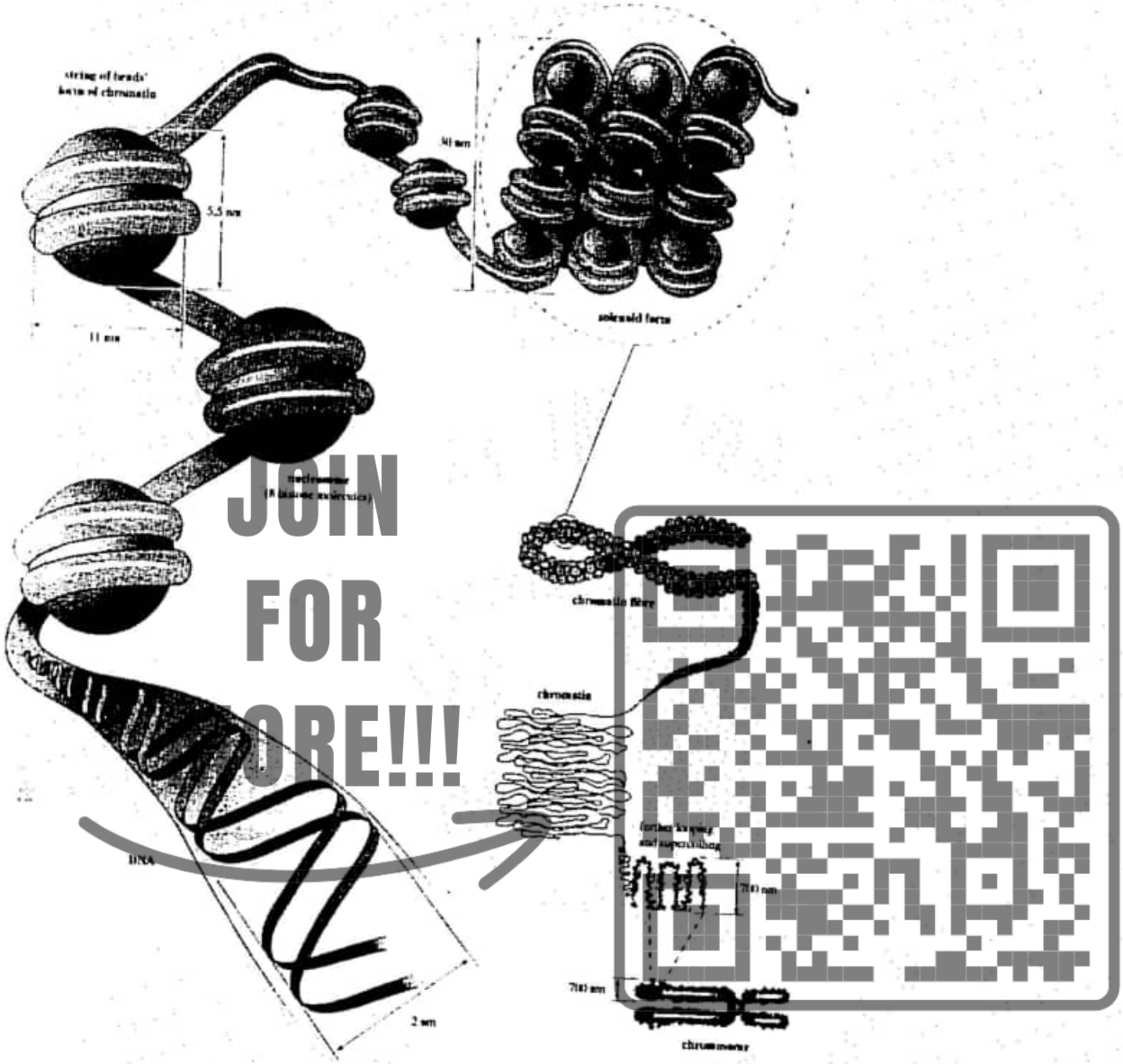
1. Phosphate group.
2. Deoxyribose sugar.
3. Nitrogenous base.

ULTRA STRUCTURE OF CHROMOSOME:

- Eukaryotic chromosomes are composed of chromatin, a complex of DNA and protein.
- Most eukaryotic chromosomes are about 60% protein and 40% DNA.
- A significant amount of RNA is also associated with chromosomes.
- The of chromosomes exist as one very long double stranded fiber, a duplex.
- If a strand of DNA from a single chromosome were laid out in a straight line, it would more than 7 feet long.
- The DNA is coiled, thus filling into a much smaller space. The coiling of DNA takes place in a following manner.

i) Every 200 nucleotides, the DNA duplex is coiled about a complex of Histones these Histones are rich in Arginine and Lysine amino acids.
ii) Each of these Histones from the core of an assembly called a nucleosome.
iii) The Histones are positively charged therefore DNA is strongly attached to the Histones.
iv) Further coiling of the DNA occurs when the string of nucleosome wraps up into higher order coils called super coils.

v) Highly condensed proteins of the chromatin are called Heterochromatin, while the lower condensed proteins of chromatin are called Euchromatin.



CHROMOSOMES AS CARRIER OF GENES:

1. The chromosomes can be separately identified visually, but the genes are very small units and so far have not been seen even with best microscope.
2. The chromosomes and gene behave as hereditary units but the genes can not be considered outside the chromosomes.
3. At the time of meiosis the separation of homologous chromosomes take place which result in the segregation of gene pairs.
4. In the genotype of every individual one member of each pair of genes is contributed by one parent and the other by the other parent.

CHROMOSOMAL THEORY OF HEREDITY:

The chromosomal theory of inheritance was first formulated by the American biologist Walter Sutton in 1902.

The main postulates of this theory are as under.

- Reproduction involves the initial union of only two cells, egg and sperm. If Mendel's model is correct then these two gametes must make equal hereditary contributions. Sperm, however contains little cytoplasm, therefore the hereditary material must reside within the nuclei of the gametes.
- Chromosomes segregate during meiosis in a manner similar to that exhibited by the elements of Mendel's model.
- Gametes have one copy of each pair of homologous chromosomes, diploid individuals have two copies.
- During meiosis each pair of homologous chromosomes orients on the metaphase plate independent of any other pair.

DNA AS A HEREDITARY MATERIAL:

The material which transmits the parental characters into the coming generation is called **"Hereditary material"**

❖ THE HEREDITARY MATERIAL OF BACTERIA:

Fred Griffith in 1928 provided the evidence of hereditary material in bacteria. In this regard he discovered the mechanism of transformation in bacteria (*Streptococcos pneumoniae).*

Transformation:

The process in which a bacterium takes the naked DNA of dead bacterium is called **Transformation.**

Fred Griffith did his experiments on two strains of *Strept. Pneumoniae* i.e., S-III and R-II strains.

S-III STRAIN: Smooth colonies on culture medium, capsulated, virulent.

R-II STRAIN: Rough colonies on culture medium, non-capsulated, non-virulent.

EXPERIMENTS	:	RESULTS
S-III injected in Mice	:	Died
R-II injected in Mice	:	Alive
S-III (Boiled injected in Mice)	:	Alive
S-III (Boiled) + R-II injected in Mice	:	Died

In transformation was confirmed by Avery, Macleod, and McCarty in 1944. They performed the following experiment.

S-III (Boiled) + Endonuclease + R-II injected in Mice and they remained alive.

Conclusion:

Endonuclease enzyme is called the DNA cutter enzyme, and by the use of this enzyme it was confirmed that the hereditary material of bacterium is DNA.

❖ THE HEREDITARY MATERIAL OF VIRUS:

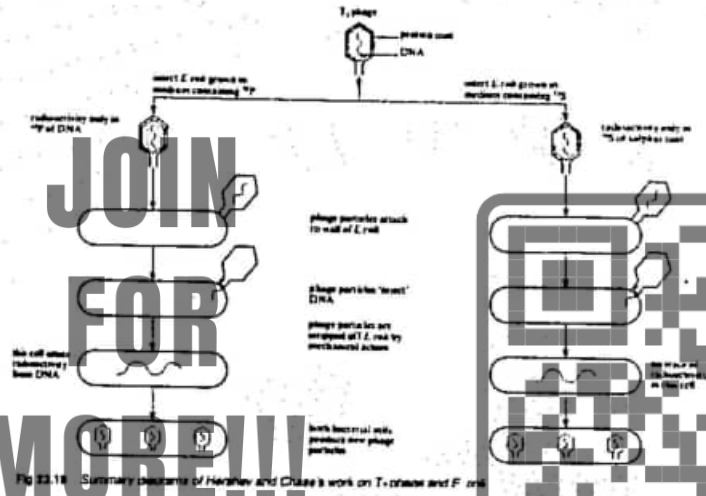
In virus the hereditary material was detected by Hershey and Chase in 1952.Hershey and Chase began a series began a series of experiments involving a particular type of virus which specifically attacks bacterial cells and is called a **bacteriophage.** Bacteriophage T_2 attacks the bacterium *Escherichia coli (E. coli)* which lives in the human gut. The phage causes *E. coli* to produce large numbers of T_2-phage particles in a very short time.

The essence of Hershey and Chase's experiment involved growing T_2-phage particles in *E. coli* which had been grown on a medium containing radioactive isotopes of either sulphur (^{35}S) or phosphorus (^{32}P). The phage protein contains sulphur but not sulphur, phosphorus, and the DNA contains phosphorus but not

sulphur. Therefore the phage particles formed in *E. coli* labeled with radioactive sulphur had incorporated this into their protein coats, whereas those formed in phosphorus-labeled *E. coli* contained radioactively labeled ^{32}P DNA. The labeled T_2-phage particles were allowed to infect non-radioactively labeled *E. coli* and after a few minutes the cells were agitated in a blender or liquidizer which stripped off the phage particles from the bacterial walls. The bacteria were then incubated and examined for radioactivity.

Conclusion:

On the basis of these results Hershey and Chase concluded that it was the phage DNA and not the protein which entered the bacterial cell and gave rise to large numbers of phage progeny. The experiments demonstrated that DNA is the hereditary material.

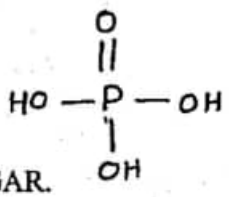


BRIEF REFERENCE OF DNA STRUCTURE:

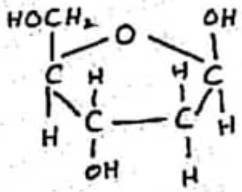
DNA is a very complex molecule which is composed of numerous units which are called nucleotides.

- **Nucleotides**
  - **Phosphoric acid**
  - **Nucleoside**
    - **Deoxyribose Sugar**
    - **Nitrogenous Bases**
      - **Purine Bases**
        - Adenine
        - Guanine
      - **Pyrimidine Bases**
        - Cytosine
        - Thymine

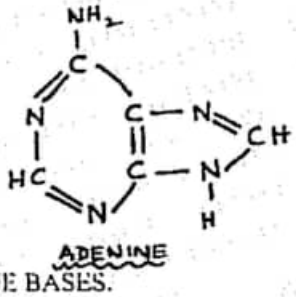
1. PHOSPHORIC ACID

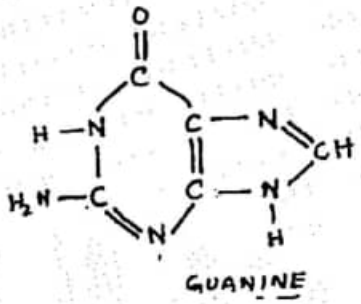


2. DEOXYRIBOSE SUGAR.

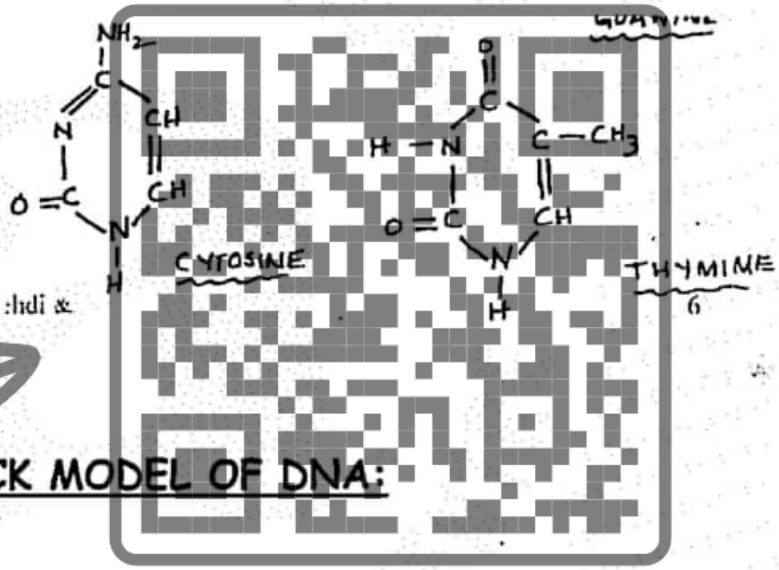


3. PURINE BASES.





4. PYRIMIDINE BASES.



WATSON AND CRICK MODEL OF DNA:

INTRODUCTION:

James D. Watson and Francis H. Crick in 1953 suggested a model of DNA, which was based on X-Ray diffraction data provided by Maurice H.F. Willikins. For their pioneer work all the three scientists received Noble Prize in 1962.

STRUCTURE OF DNA:

- Watson and Crick suggested a ladder like organization of DNA.
- Each molecule of DNA is made up of two polynucleotide chains which twisted around each other and form a double helix.
- The uprights of the ladder are made up of sugar and phosphate parts of nucleotide and the rungs are made up of paired nitrogenous bases.
- The pairs are always as follows:
  i) Adenine always pairs with thymine and Cytosine with Guanine.
  ii) The two polynucleotide chains are complimentary to each other and held together by hydrogen bonds.
  iii) There are two hydrogen bonds between Adenine and Thymine (A=T) and three between Cytosine and Guanine (C≡G).

iv) Both polynucleotide strands remain separated by 20 A° distance.
v) The coiling of double helix is right handed and complete turn occurs after 34 A° In each turn 10 nucleotide pairs are present; therefore the distance between two pairs is about 3.4 A°.

REPLICATION OF DNA:

The mechanism in which DNA prepares its copies is called **"DNA replication"**.

MECHANISM:

- The Watson – Crick Model suggested that the bases for copying the genetic information are complimentary.
- One chain of the DNA molecule may have any conceivable base sequence but the sequence completely determine that's of its partner in the duplex.
- Each chain in the duplex is a complimentary mirror image of the other.
- To copy the DNA molecule, one need only unzip it and construct a new complimentary chain along each naked strand.

REPLICATION IS SEMI CONSERVATIVE:

- The DNA replication suggested by the Watson-Crick Model is called ***semi conservation*** because after one round of replication, the original duplex is not conserved; instead, each strand of the duplex becomes part of another duplex.
- This prediction of the Watson-Crick Model was tested in 1958 by Mathew Meselson and Frank Stahl. These two scientists grew bacteria for several generations in a medium containing the heavy isotope of Nitrogen (N_{15}). So the DNA of the bacteria was eventually denser than normal. They then transferred the growing cells to a new medium containing the lighter isotope (N_{14}) and harvested the DNA at various intervals.
- At first the DNA that the bacteria manufactured was all heavy. But as the new DNA that was being formed incorporated the lighter nitrogen. Isotope, DNA density felt.

GENES (THE UNIT OF HEREDITARY INFORMATION):

- In 1902 a British physician, Archibald Garrod worked with William Bateson. He noted that certain diseases with his patients were more prevalent in their families.
- Garrod concluded that these disorders were Mendelian traits and that they had resulted from changes in hereditary information that had occurred in the past of an ancestor of the affected families.
- He examined many disorders in traits e.g. Alkaptonuria.
- **ALKAPTONURIA:** In this disease the urine of patient becomes black on exposure to air. Such urine contained homogentisic acid (Alkapton), which is oxidized when exposed to air. Garrod concluded that the patients of this disease lack those enzymes which are responsible for the breakdown of the above amino acid.

GENOME:

"The total genomic constitution of an individual is known as genome".

Diploid (2N) → 2 genome.
Haploid (1N) → 1 genome.

THE ONE GENE-ONE ENZYME HYPOTHESIS:

George Beadle and Edward Tatum provided definite evidence of this hypothesis.

Creative genetic differences:

- Beadle and Tatum used a saprophytic fungus Neurospora (Red bread mold) for their experiment.
- The spores of this fungus can grow in the simple medium prepared by Beadle and Tatum for the preparation of this medium they used sugar, some salts and a vitamin (Biotin).
- Then they allowed induced mutations by exposing Neurospora spores to X-Rays.
- Then they allowed the progeny to grow in the previous medium but they observed that there is no germination in spores.
- This indicate that there is the effect of such substances which are essential for the germination of spores, and these essential substances are separated by the help of DNA but when X-Rays were applied on DNA they produced certain changes, these changes are known as mutation. The individual in which mutation take place in known as Mutant.

Identifying mutant strains of neurospora:

- Beadle and Tatum discovered three different strains of Neurospora by the following method.

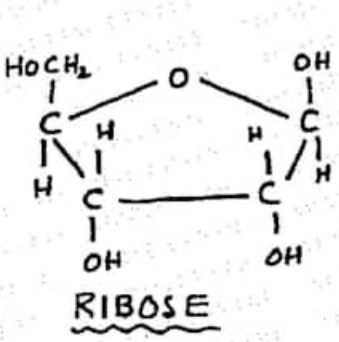
1. MUTANT 1: These spores start germination when Orinithine, Citrulline and Arginine amino acids were added in the growth medium.
2. MUTANT 2: These spores germinate when Citrulline and Arginine amino acids were added in the medium.
3. MUTANT 3: They need only the addition of Arginine amino acid in the medium.

Conclusion:

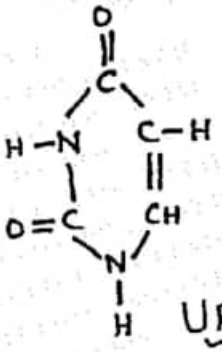
The geneticists concluded that genes produced their effects by specifying the structure of enzymes, and that each gene in codes the structure of the single enzyme. They called this relationship the one gene one enzyme hypothesis.

RIBONUCLEIC ACID (RNA)

- RNA is a type of nucleic acid which is found every where in the cell.
- It mostly has a single helix structure.
- It contains ribose sugar ($C_5H_{10}O_5$).
- It contains Uracil instead of Thymine.



RIBOSE



URACIL

TYPES OF RNA:

There are three types of RNA.

1. ***RIBOSOMAL RNA (rRNA)***: The class of RNA found in ribosomes is called ribosomal RNA.

FUNCTION: During polypeptide synthesis it provides the site on the ribosome where the polypeptide is assembled..

2. ***TRANSFER RNA (tRNA)***: A second class tRNA is called transfer RNA is much smaller. Human cell contains more than 40 different kinds of tRNA molecules.

FUNCTION: During polypeptide synthesis tRNA molecules transport the amino acid into the ribosome for the synthesis of polypeptide chain.

3. ***MESSENGER RNA (mRNA)***: It is along strand of RNA that passes from the nucleus to the cytoplasm.

FUNCTION: During polypeptide synthesis mRNA molecules bring information from the chromosome to the ribosomes to direct the assembly of amino acids into a poly peptide.

GENE EXPRESSION

A gene performs its function by the following manner.

1. An active gene produces an mRNA which is attached with ribosome and directs the formation of a polypeptide chain.
2. Many polypeptide chains are combined to form a specific protein.
3. This protein forms a specific enzyme.
4. Then this enzyme produces different phenotypic effects. These effects are called ***"Gene expression"***.

The process of gene expression occurs in two phases.

1. TRANSCRIPTION:

The first stage of gene expression is production of a RNA copy of the gene, with the help of an enzyme RNA polymerase this process is known as ***Transcription***.

STEPS OF TRANSCRIPTION:

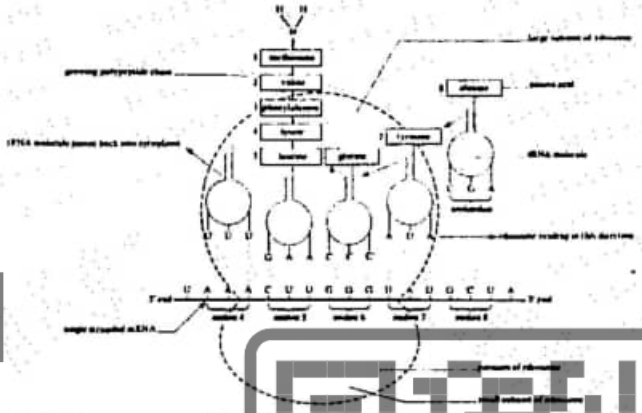
- Transcription is initiated when a special enzyme called RNA polymerase binds to a particular sequence of nucleotide on one of the RNA strands. This strand is known as ***template strands*** or ***Anti-sense strands***, while the other strand is called ***coding*** or ***sense stand***.
- The sequence of nucleotide where the enzyme binds at that end of the edge of the gene.
- Starting at the end of the gene the RNA polymerase proceed to assemble a single strand of RNA with a nucleotide sequence complementary to that of the template strand.
- When the enzyme arrives to a special stop signal at the far edge of the gene, it disengages from the DNA and releases the newly assembled RNA chain.

2. TRANSLATION:

"The synthesis of a polypeptide by ribosomes, which use the information contained in and mRNA molecule to direct the choice of amino acids. This process of mRNA directed polypeptide synthesis by ribosomes is called Translation".

STEPS OF TRANSLATION:

- Translation begins when rRNA molecule within the ribosome binds to one end of mRNA strand.
- When it has bound to the mRNA molecule a ribosome proceeds to move along the mRNA molecules in increments of three nucleotides.
- At each step it adds an amino acid to a growing polypeptide chain.
- It continues to do this until it encounters a **"Stop"** signal that indicates the end of the polypeptide.



GENETIC CODES

"The genetic codes are the sets of three nucleotide on mRNA to bring particular amino acids in ribosome for the formation of polypeptide chain".

TYPES OF GENETIC CODES:

CASE # 1: In the form of single codon.
There will be only four types of genetic codes for 20 amino acids.

A : G : C : U

CASE #2: In the for of double codon.
Then there will be 16 types of genetic codes.

	A	G	C	U
A	AA	GA	CA	UA
G	AG	GG	CD	UG
C	AC	GC	CC	UC
U	AU	GU	CU	UU

CASE # 3: In the form of triple codon.
In this condition 64 different types of codes will be present.
AUG = Start (Methionine)
UAA, UGA, UAG = stop.

replace U.

First base	Second base U	Second base C	Second base A	Second base G	Third base
U	UUU phe	UCU ser	UAU tyr	UGU cys	U
	UUC phe	UCC ser	UAC tyr	UGC cys	C
	UUA leu	UCA ser	UAA c.t.*	UGA c.t.*	A
	UUG leu	UCG ser	UAG c.t.*	UGG trp	G
C	CUU leu	CCU pro	CAU his	CGU arg	U
	CUC leu	CCC pro	CAC his	CGC arg	C
	CUA leu	CCA pro	CAA gln	CGA arg	A
	CUG leu	CCG pro	CAG gln	CGG arg	G
A	AUU ileu	ACU thr	AAU asn	AGU ser	U
	AUC ileu	ACC thr	AAC asn	AGC ser	C
	AUA ileu	ACA thr	AAA lys	AGA arg	A
	AUG met	ACG thr	AAG lys	AGG arg	G
G	GUU val	GCU ala	GAU asp	GGU gly	U
	GUC val	GCC ala	GAC asp	GGC gly	C
	GUA val	GCA ala	GAA glu	GGA gly	A
	GUG val	GCG ala	GAG glu	GGG gly	G

*c.t., chain termination codon, equivalent to a full stop in the message.

MUTATION:

"The abrupt change in the genetic material of an organism is called Mutation".

TYPES OF MUTATION:

There are two main types of mutation.

1. Chromosomal Mutation.
2. Gene Mutation.

CHROMOSOMAL MUTATION:

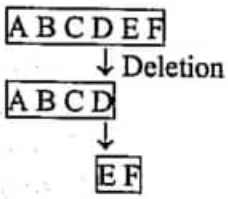
The change in amount, arrangement and the nature of genetic material on a chromosome is called chromosomal aberration. This mutation is visible under the microscope.

TYPES OF CHROMOSOMAL ABERRATION:

There are following types of this mutation.

DELETION:

In deletion a small segment of a chromosome is missing.



Effects of deletion:

1. **PSEUDO-DOMINANCE:**
   Deletion may cause pseudo dominance in heterozygous.

2. **LETHAL EFFECT:**
   If deletion takes place in both homologous chromosomes then it has the lethal effect on the organism.

DUPLICATION:

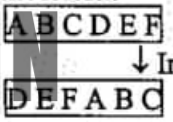
The repetition of a chromosomal segment on a chromosome is called duplication.

Effects of duplication:

Due to the duplication different physiological and morphological functions are disturbed.

INVERSION:

When the arrangement of genes on a chromosome is changed then the mutation is called inversion.

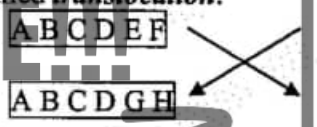


Effects Of Inversion:

Inversion reduced crossing over.

TRANSLOCATION:

The transfer of segment of chromosome to a non-homologous chromosome is called ***translocation***.



EFFECTS OF TRANSLOCATION:

Translocation may give rise to varieties within species.

GENE MUTATION:

When one or few nucleotides are changed on DNA then the mutation is called Gene mutation or Point mutation.

This mutation is invisible under the microscope.

DNA DAMAGE; (CAUSES OF MUTATION)

There are three major important causes of DNA damage, they arc:

- Ionizing radiation
- Ultra violet radiation
- Chemical Mutagens

IONIZING RADIATION:

- High energy radiation such as X-Rays and Gama rays are highly mutagenic. Nuclear radiation is also of this sort.
- These radiations release unpaired electrons which are called free radical.
- These free radicals are highly reactive chemically, reacting violently with the other molecules of the cell including DNA.

ULTRA VIOLET RADIATION:

- Ultra violet radiation is the component of sunlight.
- When molecules absorb UV radiation a little damage is produce in these molecules.
- Mostly certain organic ring compounds are affected by UV-radiation.

CHEMICAL MUTAGENS:

- The chemicals that act on DNA fall into three classes.
  1. Chemicals that look like DNA nucleotides that pair incorrectly with the DNA molecule.
  2. Chemicals that remove the amino group from Adenine or Cytosine causing them to impair.
  3. Chemicals that add hydrocarbon groups to nucleotide bases, also causing them to impair.

HEREDITARY DISEASES DUE TO DNA DAMAGE:

1) SICKLE CELL ANAEMIA :

Sickle cell anaemia is a hereditary disorder in which the affected individuals are unable to transport Oxygen to their tissues properly because the molecules with red blood cells that carry oxygen, molecules of the protein hemoglobin, are detective.

EXPLANATION:

This disorder occurs due to the presence of abnormal hemoglobin (Glutamic acid is replaced by Valine in β-chain at 5th position).

The hemoglobin plays an important role to maintain the normal biconcave shape of red blood cells. But when the hemoglobin becomes abnormal the RBCs becomes sickle or crescent shaped.

EFFECTS OE SICKLE CELL ANAEMIA:

- The abnormal hemoglobin has low binding capacity with oxygen.
- These RBCs form clumps in blood vessel and cause their obstruction. This obstruction may result in hemorrhage.

2) PHENYLKETONURIA:

- Phenylketonuria is a hereditary condition in which the affected individuals are unable to break down the amino acid Phenylalanine.
- In this condition Phenylalanine is instead converted to other chemicals that accumulate in the blood stream.
- Although the accumulation of this amino acid is not harmful to an adult but it produces harmful effects in infants because the derivative of this amino acid interfere in the development of brain cells and infant with this disorder suffers severe mental retardation and affected individuals rarely live more than 30 years.
- Phenylketonuria is a recessive disorder caused by a mutant allele of the gene encoding the enzyme that normally breaks down phenylalanine. Only individual homozygous for the mutant allele developed the disorder.

Chapter 7 CELL CYCLE

CELL DIVISION:

There are three types of cell division

- Amitosis
- Mitosis
- Meiosis

KARYOKINESIS:

Division of nucleus is called karyokinesis

CYTOKINESIS:

Division of cytoplasm is called cytokinesis.

AMITOSIS

DEFINITION:

The cell division in which the nuclear spindle is not formed is known as amitosis.

EXPLANATION:

Amitosis is also called the direct cell division. In this cell division first the nucleus of the cell becomes dumbbell shaped & finally it splits into two nuclei. In this way karyokinesis is completed.

Then an invagination appears in the centre of the cell which becomes deep & at the end it divides the parent cell completely into the two daughter cells.

EXAMPLES OF AMITOSIS:

This type of cell division is found in bacteria, diseased tissues like cancer & tumor.

CELL CYCLE

DEFINITION:

The cell undergoes a sequences of changes which involves period of growth , replication of DNA followed by cell division. This sequence of changes is called cell cycle.

It comprises of two phases:

(1) Interphase
(2) Mitotic phase (mitosis)

(1) INTERPHASE:

The period of cell cycle b/w two consecutive divisions is termed as interphase. It may be divided into the following sub stages:

- G_1 (Gap-1) phase
- S (Synthesis) phase
- G_2 (Gap-2) phase

G_1 PHASE:

⟶ Cell grows in size.
⟶ Specific enzymes are synthesized.

⟶ DNA base unit are accumulated for DNA synthesis.

⟶ Post-mitotic cell can exist a phase in which the cell may remain for weeks, days or in some cases (e.g., nerve cells & cells of the eye lens) even the life time of the organism.

⟶ 25-50% of interphase

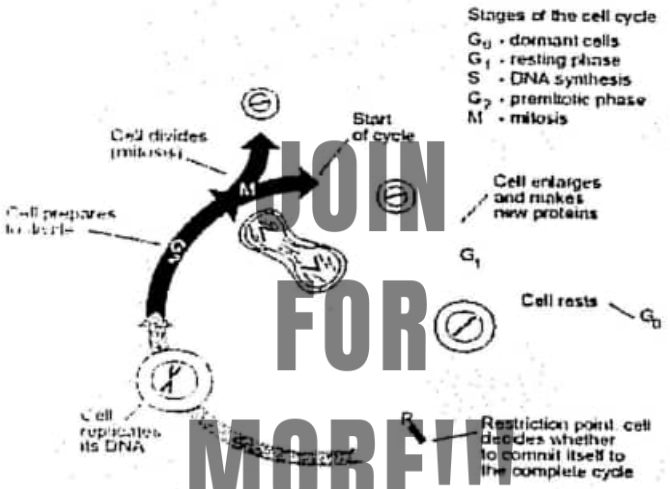
S PHASE:

⟶ In this phase DNA synthesis takes place.

⟶ Nuclear contents get doubled ⟶ 35-40% of interphase.

G_2 PHASE: - (PRE MITOTIC PHASE):

⟶ Cell prepares itself for division e.g., energy storage for chromosomal movement, mitosis, specific proteins, RNA & microtubules sub-units (for spindle fibre) synthesis.



DURATION FOR CELL CYCLE:

⟶ **HUMAN CELLS:**

- ❖ 24 hrs (average time) for cell cycle.
- ❖ Mitosis = 30 minutes
- ❖ G_1- Phase = 9 hrs
- ❖ S- Phase = 10 hrs
- ❖ G_2- Phase = 4.5 hrs.

⟶ **YEAST CELL:**

- ❖ 90 minutes are required for cell cycle.

MITOTIC PHASE (MITOSIS)

DEFINITION:

The cell division in which the number of chromosome in the daughter cells remain equal to that of their parent cells is called mitosis.

SUB STAGES OF MITOSIS:

There are four sub stages of mitosis.

⟶ prophase

⟶ metaphase

⟶ anaphase

⟶ telophase.

(i) **PROPHASE:**

⟶ The chromatin-material is condensed by folding & the chromosomes appear as thin threads (0.25 μm - 50μm)

⟶ The chromosomes become shorter & thicker.

⟶ Each chromosome is infact a pair of fine threads called chromatids. The two chromatids of each chromosome are held together at Centromere (kinetochore) which is visible as a circular zone in each chromosome.

⟶ The spindle fibres start to appear. In animal cell the spindle fibres are produced by centriotes.

⟶ All the spindle fibres collectively form a spindle shaped structure called nuclear spindle or mitotic apparatus which is composed of three types of fibres.

❖ **Continuous spindle fibres:**
Running from pole to pole.

❖ **Discontinuous Spindle fibres:**
Running from pole to equator.

❖ **Astral fibres:**
Short fibres radiating from the centrioles only at poles.

⟶ Higher plants & some insects lack centrioles so the nuclear spindle develops without them.

⟶ In late prophase the nucleolus & nuclear men frame disappear.

⟶ In the spindle of animal cell astral fibres are present (amphiastral), while in a plant cell spindle does not contains astral fibres (an-astral).

(ii) **METAPHASE:**

⟶ The nuclear spindle is fully developed & the chromosomes are arranged at the equatorial plane of the nuclear spindle.

⟶ Then each chromosome is attached with the discontinuous fibres with the help of its centromere.

⟶ Each Centromere gets two fibres each from opposite poles.

⟶ Due to the contraction of spindle fibres the Centromere divides & the chromatids of chromosome get separated.

(iii) **ANAPHASE:**

⟶ Due to the contraction of discontinuous fibres, stretching of interzonal fibres & some cytoplasmic activities, one set of chromatids migrates towards each pole of the spindle.

(iv) **TELOPHASE:**

⟶ When the two sets of chromatids reach the opposite poles, the fibres of the spindle start disappearing.

⟶ The nuclear membrane & the nucleolus start reappearing & new daugher nuclei are formed.

⟶ This completes the process of karyokinesis.

⟶ Karyokinesis is then followed by cytokinesis.

CYTOKINESIS:

The division of cytokinesis is called cytokinesis. There are two types of cytokinesis.

CELL-PLATE FOMATION:

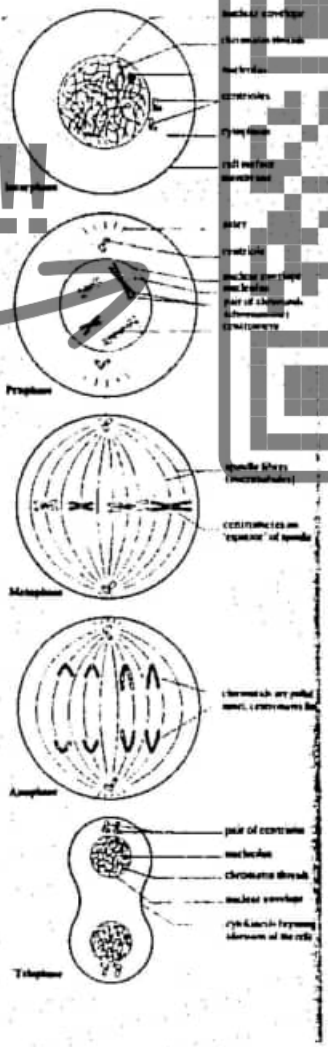
In plant cells the division of cytoplasm begins with the formation of a structure called cell-plate at the equator. It grows outward dividing the mother cell into two daughter cells.

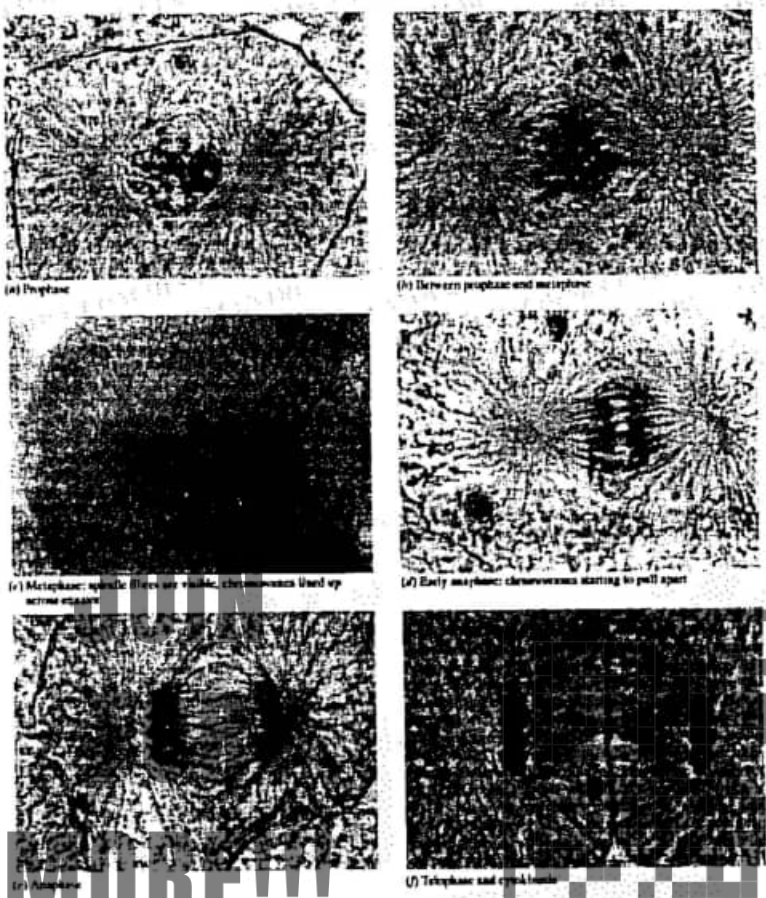
FURROWING:

In animal cells a furrow or cleavage appears in the cytoplasm at the outer side in the equatorial plane. It deepens inward, thus dividing the cell into two.

SIGNIFICANCE OF MITOSIS

* Mitosis is a cell division in which unchanged genetic information is transferred from parent cell to daughter cells.
* The zygote develops into a complete individual by the process mitosis.
* It is important for the replacement of broken cells like RBCS repairs of injured tissues, regeneration of organs, etc.
* Growth takes place by mitosis.
* Mitosis helps in asexual reproduction.





MEIOSIS

DEFINITON:

The cell division in which the number of chromosomes in the daughter cells is reduced to half as compared to the parent cell is called meiosis.

The process of meiosis is composed of following two divisions.

MEIOSIS-I:

This division is also called first meiotic division, which is composed of the following stages.

- PROPHASE-I
- METAPHASE-I
- ANAPHASE-I
- TELOPHASE-I

(i) PROPHASE-I:

This is a very prolong phase & differs from the prophase of mitosis, because in this, chromosomes behave as homologous pair. Prophase-I further consists of the following stages.

- LEPTOTENE
- ZYGOTENE
- PACHYTENE
- DIPLOTENE
- DIAKINESIS

(a) LEPTOTENE:

The chromosomes become visible, shorten & thick. The size of the nucleus increases & homologous chromosomes start getting closer to each other (Each chromosome presents beaded appearance due to the presence of dense granules of chromomeres at irregular intervals along its entire length.

(b) ZYGOTENE:

The homologous chromosomes come very close to each other & make their pairs. This pairing of chromosomes (homologous) is called Synapsis. The pairs of homologous chromosomes are called bivalents.

(c) PACHYTENE:

- ❖ Each chromosome of a bivalent forms two sister chromatids. This is called duplication.
- ❖ Now the bivalents are called tetrads.

(d) DIPLOTENE:

- ❖ The non-sister chromatids of a tetrad wrap around each other & then they are fused at one or more places called chiasmata.
- ❖ Due to the chiasmata the homologous chromosomes exchange their segments (genetic material). This process is called crossing over.
- ❖ The paired chromosomes repel each other & begin separate.
- ❖ However the separation is uncompleted because homologous chromosomes remain united by their points of interchange (chiasmata).

(e) DIAKINESIS:

- ❖ The separation process of bivalents remains continue by a process called terminalization. In this process the chiasmata move from Centro mere towards the end of the bivalent.
- ❖ The nuclear membrane & nucleolus start to disappear & the spindle fibres are formed.

(ii) METAPHASE-I:

- ❖ Nuclear membrane completely disappears.
- ❖ Nuclear spindle develops & the discontinuous spindle fibres are attached to the centromere of homologous chromosomes.

(iii) ANAPHASE-I:

- ❖ The spindle fibres contract & the homologous chromosomes move towards the opposite poles.
- ❖ The two chromatids of each chromosome remain undivided & their movement to the opposite poles helps in removing the remaining chiasmata.
- ❖ At the end of this phase the chromosomes are separated into two haploid sets, one set being present at each pole.

(iv) TELOPHASE-I:

- ❖ Nuclear membrane reorganizes around each set at two poles.
- ❖ Nucleoli reappear thus two nuclei each with haploid number of chromosomes are formed.
- ❖ The spindle fibres usually disappear.
- ❖ Cytokinesis may takes place & two daughter cells are formed.

MEIOSIS-II:

After telophase-I, two daughter cells pass through a small inter phase, but in contrast to the interphase of mitosis, there is no replication of chromosomes. The meiosis-II is almost similar to mitosis & induces the same stages.

- PROPHASE-II
- METAPHSE-II
- ANAPHASE-II
- TELOPHASE-II

(i) PROPHASE-II:

The nuclear membrane disappears & the spindle is formed at right angles to the spindle of the 1st division. The chromosomes become short & thick.

(ii) METAPHASE-II:

- Nuclear spindle is formed
- Chromosomes are arranged at the equatorial plane.
- The discontinuous spindle fibres get attached to ` centromere.

(iii) ANAPHASE-II:

- Each centromere divides & separates the two chromatids, which migrate to the opposite poles.

(iv) TELOPHASE-II:

- A nuclear membrane appears around each group of chromatids (now called chromosomes) forming a nucleus
- This is followed by cytokinesis
- Thus the two meiotic divisions result in the formation of four haploid daughter cells.

SIGNIFICANCE OF MEIOSIS:

- Meiosis is responsible for the formation of haploid gametes.
- Crossing over during meiosis brings about re-shuffling of genes, resulting in new combinations of character in the offspring.
- Separation of homologous chromosomes & their random distribution into different cells also bring about genetic is variation which are the raw material for evolution.

DIFFERENCE B/W MITOSIS & MEIOSIS:

MITOSIS	MEIOSIS
The daughter cells receive the same number of chromosomes.	The daughter cells receive the half number of chromosomes.
It takes place in the somatic cells of the body.	It takes place in the reproductive cells of the body.
The parent cell divides one time.	The parent cell divides two times.
Two daughter cells are formed.	Four daughter cells are formed.
There is no crossing over.	Crossing over takes place.

MEIOTIC ERRORS: (NON-DISJUNCTION)

- Non-disjunction is an abnormality during meiosis in which chromosomes fail to separate during anaphase & telophase & does not finish with equal distribution of chromosomes among all the daughter nuclei.

MEIOTIC ERRORS: (SYNDROME)

- It is a condition, which produces multiple abnormalities in the offspring.
- Down syndrome (mongolism)
- Kline filter's syndrome (homosexual)
- Turner's syndrome

DOWN'S SYNDROME: (MONGOLISM)

Introduction:

It is an autosamal non-disjunction in man, in which 21st chromosome fails to segregate, resulting in gametes with 24 chromosomes. This gamete fertilizes with normal gamete, so the new individual will have 47 chromosomes (2n+1). Non-disjunction appears to occur in the ova & related to the age of mother.

Morphological & physiological abnormalities:

These individuals have flat, broad face, slant eyes with the skin fold in the inner corner & protruding tongue, mental retardation & defective development of central nervous system.

KLINEFILTER'S SYNDROME: (HOMOSEXUAL)

Introduction:

These individuals have additional sex chromosomes e.g. 47 chromosomes (44 autosomes + xxy). They are phenotypically male.

Morphological & physiological abnormalities:

- Testicular atrophy
- Mental retardation
- No spermatogenesis
- Nonfertile.

TURNER'S SYNDROME:

Introduction:

These individuals have one missing x chromosome with only 45 chromosomes (44 autosomes + x chromosome). These individuals have female appearance.

Morphological & Physiological Abnormalities:

- Ovaries are totally absent.
- Due to the absence of ovulation they are non-fertile.
- Short stature
- Small nails, which are deeply seated in nail base.

CELL DEATH:

1. NECROSIS:

The death of living cells due to tissue injury is called necrosis.

2. APOPTOSIS:

Apoptosis is a type of orderly and preprogrammed cell death in which the cell responds to certain signals by initiating a normal response that leads to the death of cells.

Mechanism: Apoptosis appears to be mediated primarily by the release of Ca++ ions and the activation of certain protein-Kinases and required activation of a set of gene.

Example: During embryonic development, the growth of the cells in the spaces between the fingers; under apoptosis.

CANCER CELLS:

- In cancer cells the mitotic rate is not inhibited and the cells tend to pile up amitotically, forming irregular masses which are several layers deep.
- The cancer cells show less adhesion to the solid support and among themselves and motility is more pronounced.

CAUSES OF CANCER:

- The cancer cells are developed by the mutation of cellular gene that controls cell growth and cell mitosis.
- The mutation of the above gene can be increased when a person is exposed to certain chemicals, physical or biological factors such as ionizing radiation, X-rays, gama rays and ultraviolet rays.
- In many families there is a strong hereditary tendency to develop a cancer.
- Some types of cancers may also develop due to certain type of viruses e.g. Leukemia.

Chapter 8 VARIATION AND GENETICS

Definition:

The study of heredity, variations & environment is called genetics.

Heredity:

Those characters which are transferred from the parents to their offsprings are called heredity.

Inheritance:

The transmission of characters from the parents to the off spring is called inheritance.

Variations:

The differences between the two offsprings of the some parents are called variations.

Genes:

Genes are the unit of heredity which is located on the chromosomes.

Allele:

Pair of gene related to the same character is called alleles.

Homozygous:

If an individual has identical alleles of a character, then it is called homozygous.

Heterozygous:

The individual having non identical alleles of a character is called heterozygous.

Dominant:

The gene which masks the phenotypic expression of another gene is called dominant.

OR

The gene which expresses itself both in homozygous and heterozygous condition is called dominant.

Recessive:

The gene which is unable to express itself in the presence of another gene is called recessive.

OR

The gene which can only express itself in homozygous condition is called recessive.

Genotype:

The makeup of genes in an individual is called its genotype.

Phenotype:

The physical appearance of an organism is called its phenotype.

GREGOR JOHANN MENDEL (1822 – 84)

"Father of genetics"

TRAITS	DOMINANT	RECESSIVE
Height of plant	Tall	Dwarf
Colour of seed (cotyledon)	Yellow	Green
Shape of seed	Round	Wrinkled
Colour of pod	Green	Yellow
Shape of pod	Smooth	Constricted
Position of flowers	Axillary	Terminal
Colour of seed coat	Coloured	Colourless

Q. Why did Mendel select pea plants for his experiments?

Ans. Pea plants have the following favorable characteristics.

- These plants can be cultivated in a pot or field.
- The duration of the life cycle of this plant is very short.
- This plant has a variety of characters with their contrasting forms.
- Naturally this is a self pollinating plant.
- Cross pollination can be performed by some artificial methods.
- This plant produces fertile hybrids.

MENDEL'S LAWS OF INHERITANCE

- Law of segregation
- Law of independent assortment

1. LAW OF SEGREGATION

Statement:

"The hybrids of F1, generation have both the characters of their parents in these characters one is dominant and the other is recessive. They may remain together for a long time but never mix with each other and always keep their identity. They are separated or segregated during the gametogenesis".

Explanation: (inheritance of a single trait):

Mendel crossed pure or true breeding pea plants having yellow seeds (YY) with a true breeding pea plants having green seeds (YY). He termed this parental generation as P1. generation. All the offsprings obtained in the next generation designated as F1 or first filial generation was having yellow seeds. The green seed character was not appeared in the F1 progeny. This held true whether the pollen grains came from the plants with yellow seeds or plants with green seeds. The yellow trait which found its expression in F, progeny was termed as dominant the green trait that was masked was termed as recessive.

Mendel next allowed the F1 plants with yellow seeds (Yy) to be self fertilized then F2 progeny was raised. In these progeny, unlike F1, some plants had yellow seeds like the original yellow seed parent and other having green seed like green seed parents. There was 3:1 ratio between yellow & green seeds plants.

2. LAW OF INDEPENDENT ASSORTMENT:

Statement:

"When two contrasting pairs of traits are brought together in the F generation they first segregate and than assort alleles in each pair are independent of each other".

Explanation: (Inheritance Of Two Traits)

Mendel crossed a pea plant having yellow and round seeds (YYRR) with a plant having green & wrinkled seeds (yy rr). All the F1 offsprings had yellow and round seeds (YyRr). Mendel allowed the F1 plants to self fertilize. The F2 plants consisted of not only the parental combinations but plants showing seeds with yellow-winkled & green round traits had also appeared. The F2 progeny appeared in the ratio of 9:3:3:1 for the four types.

Yellow – Round	=	9
Yellow – Winkled	=	3
Green – Round	=	3
Green – Winkled	=	1

It demonstrated that the genes for seed colour & seed shape did not necessarily stay together in the same combination in which they occurred in the parental generation. Instead they assorted independent of each other.

TEST CROSS

Definition:

A cross in which a phenotypically dominant individual is fertilized with a homozygous recessive individual is called test cross.

Significance:

This cross tells us about homozygosity and heterozygosity of a dominant character.

Example:

Phenotypically tall plants.

Case 1:

Phenotypically dominant individual is homozygous parents.

Case 2:

Phenotypically dominant individual is heterozygous parents.

Conclusion:

If an individual is homozygous dominant, then it forms all dominant individuals by the test cross. While in case of heterozygous dominant, 50% dominant and 50% recessive individuals are produced.

INCOMPLETE DOMINANCE
(Blending Inheritance)

Definition:

The condition which is found in heterozygotes in which the phenotypes is the intermediate form of two homozygotes is called incomplete dominance.

Example:

Colour of flowers in four O'clock (*Mirabilus jalapa*) plant when true breeding red flowers and true breeding white flowers of four O'clock plants are crossed, all the plants in F carry pink coloured flowers. The pink coloured flowers on self fertilization produce red, pink and white flowered plants in the ratio of 1:2:1.

CODOMINANCE

Definition:

The condition found in heterozygotes where both the members of allelic pair contribute for the phenotype of individual is called codominance.

Example:

Coat colour in cattle.

Explanation:

In a cross between true breeding red cattle and true breeding white cattle, the off springs have roan colour. A close examination of the skin of roan coloured animal shows that the animal does not possess an intermediate shade of skin but it appears so because of mixture of red hair and white hair. It is that none of the two genes is dominant over the other. Such pairs of alleles of a gene are said to be codominant and the phenomenon as codominance.

MULTIPLE ALLELE

Definition:

Three or more contrasting forms of a gene for a trait are called multiple alleles.

Example:

In human beings ABO blood group is a common example of multiple alleles.

ABO BLOOD GROUP SYSTEM:

- In 1902, Land Steiner classified the human blood into three groups on the basis of two types of antigens that are antigen A and antigen B. These blood groups are A-group, B-group & O-group.
- Later on, two of Land Steiner's students Von De Castelli & Sturlli discovered a fourth group i.e., AB-group.

Blood Group	Genotype	Phenotype	Antigen	Antibodies
A – Group	IA IA	A-homozygous	A	B
	IA i	A-heterozygous	A	B
B – Group	IB IB	B-homozygous	B	A
	IB i	B-heterozygous	B	A
O-Group (universal donor)	i i	O	-	AB
AB – Group	IA IB	AB-heterozygous	AB	O

Antibodies:

Antibodies are such proteins which are found in plasma. Each antibody has the ability to destroy a specific antigen.

A-GROUP:

In this blood A-antigen is present on RBCs while B antibodies are found in serum.

B-GROUP:

In this blood the RBC contains B-antigen and the serum has A-antibodies.

O – GROUP:

In this blood RBCs have no antigen whereas the serum contains both A & B antibodies. Due to the absence of antigens, this blood can be given to any person. Therefore this blood is called universal donor.

AB- GROUP:

The RBCs of this blood have both A & B antigens but the serum has neither A nor B antibodies. Due to the absence of antibodies this blood can accept all types of blood. Therefore it is called universal recipient.

Agglutination:

The reaction between antigen and antibody is called agglutination. In this reaction the antibody destroys the antigen.

- During blood transfusion, agglutination takes place between the antigens of donor and the antibodies of recipient.

MR	MRS
A (hetero)	B (hetero)
A (hetero)	O
AB	O
B (homo)	AB
B (hetero)	O

RH-ANTIGEN

Weiner and Levine (1940) discovered a third antigen on RBCs of Rhesus monkey which is also related with the blood groups. This antigen is produced due to the presence of a dominant gene (Rh). Such a blood is called Rh positive when Rh gene is present in recessive form (rh), then Rh antigen does not develop on RBC. Such a blood is known as Rh negative 85% people have positive blood and 15% people have –ve blood.

GENOTYPES:

Rh Rh = +ve (homozygous)
Rh rh = +ve (heterozygous)
rh rh = -ve

ERYTHROBLASTOSIS FOETALIS:

- This is a disease which is found in new born babies which is caused when the mother is Rh –ve and the foetus is Rh +ve
- In this disease Rh antibodies invade the fetus and attach is its red blood cells causing the child to be born severally anaemic.

EPISTASIS:- (Genic Interaction & Modified Ratios)

- The term "Epistasis" was introduced by Bateson.
- Epistasis is an interaction b/w the alleles of non homologous chromosomes. In this interaction one allele (epistatic) prevent the second allele hypostatic) to express itself due to this interaction the dihybrid phenotype ratio 9:3:3:1 is modified.

CONTINUOUSLY VARYING TRAIT (Polygenic Traits)

Definition:

Those traits which are controlled by two or more pairs of genes located on different pairs of chromosomes are called polygenic traits and the inheritance of these traits is known as polygenic inheritance.

Example 1:
Kernal colour in wheat

Example 2:
Milk production in cattle

Example 3:
Intelligence, height, colours of skin in human.

PLEIOTROPY

Definition:

The multiple effects of a single gene or allele are termed as pleiotropy.

Example:

Phenylketonuria in humans

Symptoms of Phenylketonuria:

- Light hair of light skin pigmentation
- High level of phenylalanine in blood & urine.
- In fruit fly, the recessive allele responsible for white eye colour also influences the colour of testes & even the shape of the sperm.
- In cats, the genetic factor responsible for white & blue eyes also results in deafness.

CROSS OVER

Definition:

The exchange of genetic material between homologous chromosomes in the form of small fragments of chromatids is called crossing over.

Mechanism of crossing over:

This process is completed in following four steps:-

- Synapsis
- Duplication of chromosomes
- Crossing over
- Terminalization

Synapsis:

- Pairing of homologous chromosomes is called synapsis.
- This process takes place in the zygotene stage of prophase-I.
- As a result of synapsis, the pairs of homologous chromosomes are called bivalents.

Duplication of chromosomes:

- After synapsis each chromosomes of a bivalent splits itself longitudinally to form two sister chromatids.
- In this way the bivalents are converted into tetrads.

Crossing over:

- The process of crossing over between the homologous chromosomes always takes place in tetrad condition.
- In this process small fragments of non sister chromatids of homologous chromosomes are separated by the activity of endonuclease enzyme (DNA cutter enzyme).
- These fragments change their position & again connect with their chromosomes by the action of ligase enzyme.
- In this process a bridge is formed between homologous chromosomes which are known as chiasma.

Terminalization:

- This is a process by which the homologous chromosomes are separated after crossing over.
- This is actually a specific type of movement of Chiasma in a zipper fashion away from the tetrad.
- This process takes place in diakinesis of prophase – I.

LINKAGE

Definition:

The tendency of genes in a chromosome to remain together is called linkage.

Example:

Wings & colour of body in Drosophila

SEX DETERMINATION & SEX CHROMOSOMES:

SEX CHROMOSOMES:

Definition:

Those chromosomes in a cell by which the sex of an individual can be determined are called sex chromosomes.

AUTOSOMES:

Definition:

All the chromosomes in a cell except the sex chromosomes are called autosomes.

SEX DETERMINATION MECHANISM

There are two main types of sex determination mechanism.

- Heterogametic male
- Heterogametic female

Heterogametic male:

In these organisms the female organism has two x-chromosomes in addition with autosomes. Therefore it forms similar types of gametes having one chromosomes. Whereas, the male organism has only one x-chromosomes. Therefore it produces two types of gametes i.e. half gametes with an x chromosome and half gametes without an x chromosome. Such type of male is heterogametic. There are two types of these organisms:-

- XX - XO type
- XX – XY type

(i) **XX – XO TYPE:**

In these organisms the female organism has 2x chromosomes and male has only one x chromosome. In this way the female organism an additional chromosome as compared to the male.

Example: Grasshopper
Male (23 chromosome)
Female (24 chromosome)

(ii) XX – XY TYPE:

In this type male and female have equal number of chromosomes. The female contains two x – chromosomes while the male individual has one x one chromosome.

Example: This condition is found in man, Drosophila, etc.

Heterogametic Female: (Abraxas mechanism of sex determination)

In many animals, the female organism has only one x–chromosome. Therefore, it is called heterogametic whereas the male individual contains two x-chromosomes. So it is called homogametic. In these cases x-chromosome is represented by z & y chromosome is denoted by W.
There are two types of these individual:-

- ZO – ZZ Type
- ZW – ZZ Type

ZO – ZZ Type:

In these organisms the male has an extra chromosome as compared to the female organism which indicates that male contains ZZ chromosomes and the female has only one Z chromosomes.

Example: moth, butterflies, domestic chicken.

ZZ – ZW TYPE:

In this type the female organism has two non-identical sex chromosomes. One is called Z chromosome and the other is called W chromosome.

Example: Certain insects, fishes, reptiles, birds

SEX LINK INHERITANCE

Definition:

If the genes of a trait are found on the sex chromosomes then the trait is called the sex linked trait and the inheritance of such trait is known as sex link inheritance.

SEX – LINK INHERITANCE IN DROSOPHILA:

In 1910, TH Morgan, discovered that colour of eyes is an example of sex linked trait in Drosophila. The red colour of eyes is dominant over white colour.

Genotypes for colour of eyes:

R = Red eyes
r = White eyes

Female:

X^RX^R = red eyes (homo)
X^rX^r = white eyes
X^RX^r = red eyes (hetero)

Male:

$X^R y$ = red eyes
$X^r Y$ = white eyes

Male	x	Female
1. Red		Red (hetero)
2. White		Red (hetero)
3. Red		White
4. White		Red (homo)

SEX – LINKED INHERITANCE IN MAN

- Colour blindness
- Haemophilia

COLOUR BLINDNESS:

- Colour blindness is a sex linked hereditary disease.
- A colour blind person is unable to distinguish between red & green colours.
- The gene which is related with this trait is only found on x-chromosome. Therefore, this disease is common in males.

Normal gene = N
Colour blindness = n

Genotypes:

Females:

$X^N X^N$ = Normal vision
$X^n X^n$ = Colour blind
$X^N X^n$ = Normal vision (carrier)

Males:

$X^N Y$ = Normal vision
$X^N Y$ = Colour blind

Mr.	x	Mrs.
Colour blind		Normal
Normal		Colour blind
Normal		Normal (carrier)
Colour blind		Normal (carrier)

HAEMOPHILIA:

- Haemophilia is a sex linked hereditary disease.
- In this disease, the human blood is unable to clot in case of external or internal injury.
- The gene which is related with this trait is only found on x-chromosomes. Therefore, this disease is common in males.

Normal gene = H
Haemophilic = h

Genotypes:

Females:

$X^H X^H$ = Normal

$X^H X^h$ = Normal (carrier)
$X^h X^h$ = haemophilic

Males:

$X^H Y$ = Normal
$X^h Y$ = haemophilic

Mr.	x	Mrs.
Haemophilic		Normal
Normal		haemophilic
Normal		Normal (carrier)
Haemophilic		Normal (carrier)

DIABETES MELLITUS

Introduction:

Due to the deficiency or absence of insulin, the glucose level is increased in blood. This condition is called diabetes mellitus.

- Insulin dependent diabetes. (Type – I)
- Non insulin dependent diabetes. (Type – II)

INSULIN DEPENDENT DIABETES:

It is an auto immune disorder in which the immune system attacks on the cells of pancreas. This type of diabetes can be treated by insulin injections.

NON-INSULIN DEPENDENT DIABETES:

This diabetes is commonly produced by reduced responsiveness in target cells due to some change in insulin receptors. This diabetes cannot be treated by insulin injections. The only treatment of this diabetes is exercise and dietary control.

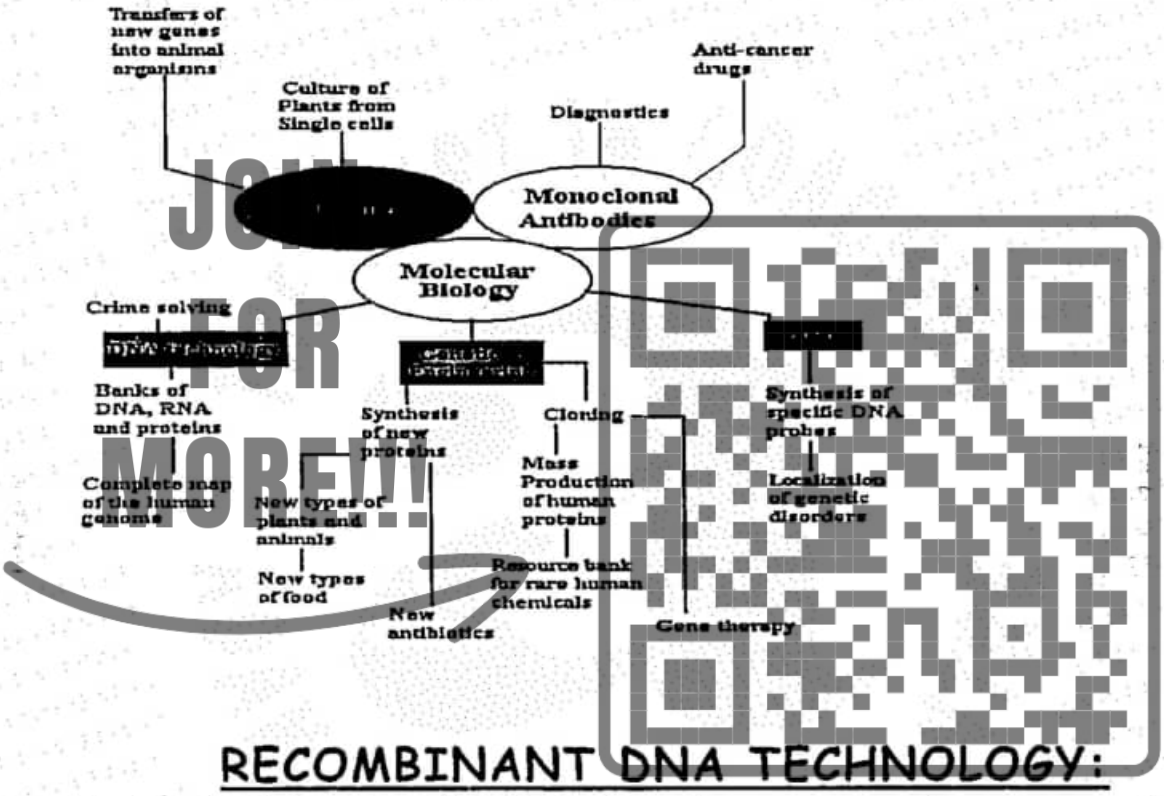
Chapter 09 BIOTECHNOLOGY

GENETIC ENGINEERING
(DNA Recombinant Technology)

Genetic engineering is the manipulation of genetic material for practical purpose.

BIOTECHNOLOGY:

Biotechnology is the manipulation of living organism or their components to perform practical task or provide useful products.



RECOMBINANT DNA TECHNOLOGY:

The basic steps in recombinant DNA technology are: -

- Preparation of recombinant DNA (rDNA) molecule.
- Insertion of rDNA into host cell.
- Multiplication & production of numerous copies of host with rDNA in it Selection of Bacteria with required gene.

PREPARATION OF RECOMBINANT DNA MOLECULE:

The preparation of this type of DNA requires some basic tools: -

(1) Vector
(2) Restriction enzyme
(3) DNA ligase enzyme

(1) VECTOR:

It is a DNA molecule into which a gene is inserted to construct a recombinant DNA molecule. It is capable of replication in host organism. It acts as a vehicle to transport rDNA into host cell.

Examples:

Vectors used in this technology are bacterial plasmids & bacteriophage.

(2) RESTRICTION ENZYME:

This is a group of enzyme, which is required to cut a source DNA molecule into small pieces & to cut plasmid to make a gap where foreign DNA fits into it.

(3) DNA LIGASE ENZYME:

DNA ligase is a key enzyme that seals the restriction fragment with sticky ends of vector.

INSERTION OF DNA INTO HOST CELL:

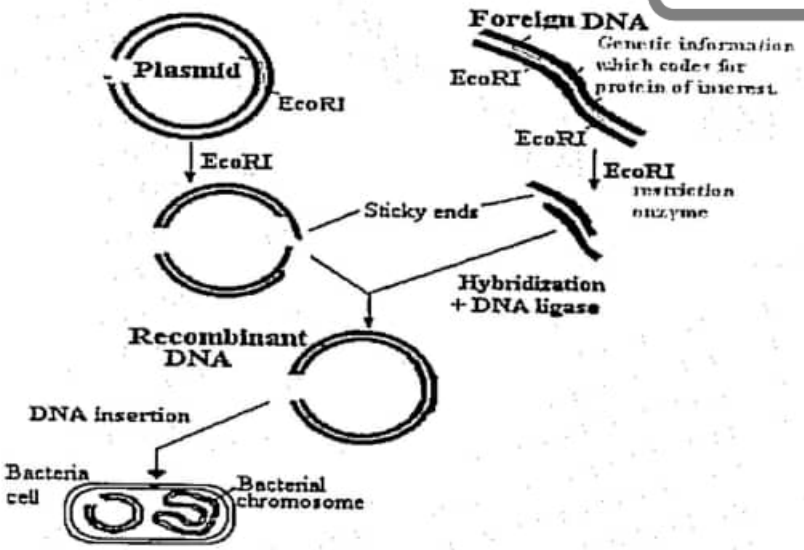
Usually the bacterial cells are used as host in recombinant DNA technology. Bacterial cells take up rDNA when they are treated with $CaCl_2$ to make them more permeable.

MULTIPLICATION OF HOST WITH rDNA:

When the host cell divides & redivides, copies of the recombinant DNA molecules are passed to the progeny & further replication of vector takes place. After a large number of cell divisions, a colony or clone of identical host cells is produced. Each cell in the clone contains one or more copies of rDNA molecules.

APPLICATION OF GENETICALLY ENGINEERED BACTERIA:

Genetically engineered bacteria can be used in the environment for serving in the field of agriculture. These bacteria can also be used to promote the health of plants to make them resistant towards insect as bioremediation (pollution cleaner), to synthesize organic chemicals, to detect metals, to enhance genetic research to produce pharmaceutical products.



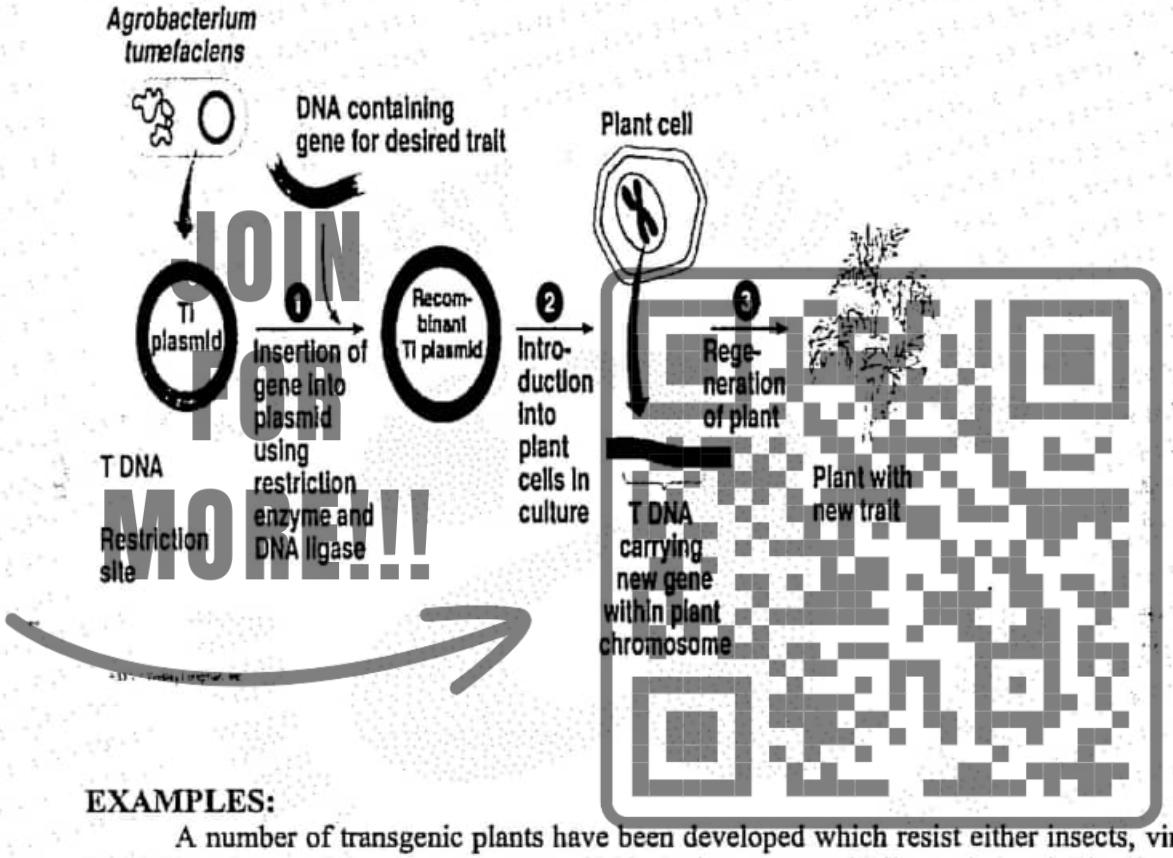
TRANSGENIC PLANTS:

Free-living organisms in the environment that have a foreign gene inserted into them are said to be transgenic organisms or genetically engineered organisms.

The only plasmid for transgenic plant cell is Ti – plasmid (Ti = tumor inducing) transferred by a bacterium called ***Agro bacterium_ tumefacians*** to many plants.

The main aims for developing transgenic plants are: -

- To cultivate more nutritious plants.
- Plants require less fertilizer.
- Plants grow under unfavorable conditions.



EXAMPLES:

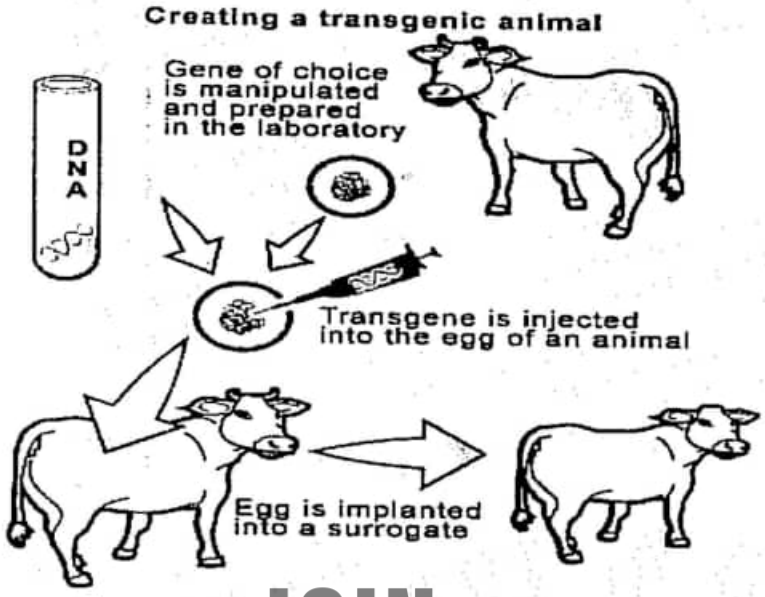
A number of transgenic plants have been developed which resist either insects, viruses or herbicides. Crops of Soya bean, cotton, alfalfa & rice are genetically engineered. Plants are being engineered to produce fructose, human hormones, clotting factors & antibodies in their seeds.

TRANSGENIC ANIMALS

Animal cells usually do not take plasmids. But it is possible to micro inject foreign genes into eggs before they are fertilized. This procedure has been used in fishes, chicken, cows, pigs, rabbits & sheep.

EXAMPLES:

A transgenic calf has been produced that carries a gene for the production of human lactoferin in cow milk (human lactoferin is a protein that is involved in iron transport & has antibacterial activity.



ISOLATION OF EUKARYOTIC GENES FOR TRANSGENESIS

Eukaryotic gene or DNA cannot be cleaned directly from its genome because it often contains long non-coding region & bacterial cells are unable to express these genes. To avoid this problem an artificial gene can be made which lack introns.

- In 1st step transcription of an intron containing gene in the cell nucleus produces a pre-RNA molecule.
- In the next step intron RNA are removed & spliced the exon RNA together to produce mRNA.
- This mRNA molecule is isolated from the cell & used as template to synthesize a complementary DNA (c DNA) strand.
- This synthesis of cDNA on mRNA is the reverse transcription being catalysed by an enzyme reverse transcriptase obtained from Retro viruses.
- The second DNA strand using is made by DNA molecule is synthesized which has no intron.
- This DNA is called complementary DNA (cDNA)

GENE SEQUENCING

Gene sequencing is a method of determining nucleotide sequence of a gene developed in late 1970s by Friedrich singer.

DNA FINGER PRINTING:

About 30% of human DNA does not code for protein & repeated frequently in genome of that individual. Each of such repetitive DNA sequences are of 20 - 40 bases long.
These highly variable & usually unique length of non-functional DNA are passed onto the offsprings. The differences in DNA electrophorosis patterns among individuals are called restriction fragments length polymorphism (RFLP).

Since RFLPs of each human are unique analogous to the finger prints which are used as marks of identity so RFLPs can be termed as DNA finger prints.

Uses of DNA finger prints:

(i) This technique is used to settle dispute are parentage & other relationships.

(ii) It is also used to identify criminals from blood, semen, saliva, hair follicles etc.

(iii) It is also used to detect hereditary diseases.

GENOMIC LIBRARY

It consists of copy of genetic information of a species in a preferred environment. This library provides easy access to a preferred gene for its further copying or manipulation.

HUMAN GENOME PROJECT (HGP)

This project was started in 1990 to discover all the estimated 30,000 to 35,000 human genes located on 23 pairs of chromosomes. Another project goal was to determine the complete sequence of 3 billion DNA sub units.

In April 2003, the DNA sequence of 99.99% of human genes with 99% accuracy was accomplished. About 99.0% nucleotide sequence is the same in all humans.

Significance of human genome project:

It will reveal the methodology for early diagnosis better treatment & even prevention of genetic disease.

The genomic information of human & other species will greatly help to understand the genomic organization the control of gene expression, cellular growth & differentiation & evolutionany biology.

DETECTION & TREATMENT OF SOME GENETIC DISEASES:

There are three types of genetic diseases:

(i) Chromosomal abnormalities.

(ii) Uni factorial defects.

(iii) Multi factorial defects.

(i) CHROMOSOMAL ABNORMALITIES:

In the chromosomal defect (e.g., Down's syndrome) a child is born with structurally or numerically abnormal chromosomes.

(ii) UNI FACTORIAL DEFECTS:

Unifactorial diseases e.g. (Huntington's diseases, cystic fibrosis etc) are caused by a single defective gene or pair of genes.

(iii) MULTI FACTORIAL DEFECTS:

Multi factorial disorders (e.g, asthma, insulin dependent diabetes) one caused by the additive effects of several genes along with environmental factors.

HUNTINGTON'S DISEASE

(i) It is due to an autosomal dominant allele on chromosome 4

(ii) The affected individuals are almost certainly heterozygous for the defective gene.

(iii) Appearance of symptoms is usually delayed until the age of 40 to 50 years.

Symptoms of Disease:

(i) Progressive mental deterioration
(ii) Involuntary muscle movements

CYSTIC FIBROSIS

It occurs due to an autosomal recessive allele.

Symptoms:

It is characterized by a tendency to chronic lung infection & inability to absorb fats & other nutrients from food.

Treatment:

Most patients can be helped by daily physiotherapy for their lung problems.

ROLE OF BIOTECHNOLOGY IN THE DIAGNOSIS OF DISEASE:

The use of PCR & DNA probes is providing an excellent tool for the diagnosis of genetic diseases even before the on set of symptoms.

Medical scientist can non diagnose more than 200 genetic diseases using such technologies.

GENE THERAPY:

One of the potential benefits of genetic engineering is to treat genetic diseases in an individual.

Example:

Severe combined immunodeficiency disease (SCID)

SCID

- This disease is characterized by a very poor immune system so the victim cannot resist infections & consequently dies due to infections like pneumonia, influenza etc.
- In this condition the cells of the bone marrow cannot produce an enzyme called adenosine deaminase (ADA)

Treatment of SCID:

In the treatment of SCID, the defective bone marrow cells are removed from the patient & the normal gene for the ADA enzyme is inserted into these cells & then these cells are again inserted into the patient's bone marrow. In this way the patient's bone marrow starts to synthesize ADA itself.

AMNIOCENTESIS:

It is a diagnostic procedure in which a small amount of amniotic fluid is with drawn from the amniotic sac. The amniotic fluid contains cells & chemicals from the fetus that can be analyzed to detect fetal abnormalities such as Down's syndrome, hemophilia etc. It is usually performed between the sixteenth & eighteenth week of gestation.

TISSUE CULTURE

Introduction:

Tissue culture is a test tube method used to create and clone novel plant varieties. Haberlandt (1902) is called the father of tissue culture.

Chapter 10 EVOLUTION

DEFINITION I:

"The gradual development of something is called Evolution."

EXAMPLE:

Evolution of Earth, Evolution of Man, Evolution of Plant etc.

DEFINITION II:

"The evolution of living organism is called Organic Evolution."

DEFINITION III:

According to Zimmerman (1953)

"Evolution is the transformation of the form and mode of existence of an organism. In such a manner that the descendants differ from their ancestors."

THEORIES OF EVOLUTION:

1- THE THEORY OF SPECIAL CREATION:

INTRODUCTION:

This theory was put forward by Father Suarez (1548-1613), Spanish Priest.

STATEMENT

"God created all animals & plants. All living things came into existence in their present form especially & specifically created by nature & no change has occurred."

SUPPORTERS OF THE THEORY OF SPECIAL CREATION:-

Carolus Linnaeus (1707 – 1778) was also believed in this theory. People believed in this theory till the middle of 19th century.

NATURE OF EARLIEST ORGANISMS:-

The Holy Quran provides evidence for the formation of earliest organisms.

" Allah hath created every animal of water. Of them is (a kind) that goeth upon its belly & (a kind) that goeth upon two legs & (a kind) that goeth upon four Allah createth what he will. Lo! Allah is Able to do all things. " (Sura Al-Nur, Ayth 45)

* It is believed that life may have begun deep in the water especially in hot spring called hydrothermal vents.
* A group of bacteria called Archaebacteria that tolerate temperature upto 120^0C.
* The Eukaryotic cell might have evolved when a large anaerobic amoeboid prokaryote ingested small aerobic bacteria & stabilized them instead of digesting them.
* It is believed that the prokaryotes may have arisen more than 1.5 million years ago.
* Another hypothesis for the evolution of Eukaryotic cells proposed that the prokaryotic cell membrane folded inward to enclose copies of its genetic material.
* This imagination resulted in the formation of membrane-bounded organelles in a single cell.

III- THEORY OF ORGANIC EVOLUTION:-

According to this theory species are not immutable but once the life appeared on earth, it slowly evolved i.e. a species may slowly changes into new species.

INTRODUCTION:-

This concept is called Organic Evolution. Following are the theories, which explained the process of organic evolution.

(i) Lamarck's theory. (Inheritance of acquired characters)
(ii) Darwin's theory. (Theory of Natural selection).
(iii) Weismann's theory. (Germinal continuity theory).
(iv) De Vries.

(i) LAMARCK'S THEORY:-

Introduction:-

This theory uses coined by a French Zoologist Jean Baptiste de Lamarck (1774 - 1829) in 1809.

POSTULATES OF LAMARCK'S THEORY:-

His theory was based on following postulates:
(1). Effects of environment.
(2). Use & disuse of organs.
(3). Inheritance of acquired characters.

(1) **EFFECTS OF ENVIRONMENT:-** When some animals under changed condition of environment require new needs & as such acquire new characters (new organs) to better meet with the changed situation of food habit, physiology or shelter seeking. *Prep. By :- Raza Mehdi*

(2) **USE OR DISUSE OF ORGANS:-** In the new environment these organisms use some organelles constantly & disuse others so the efforts of an individual of greater use & total disuse of organs strengthens & develop an organ & disuse result in its degeneration & ultimate disappearance. Lamarck believed that such small changes through successive generation promote the origin of new organs & characters which are transmitted to its off spring in the next generation this is called " Inheritance of acquired characters".

(3) **INHERITANCE OF ACQUIRED CHARACTERS:-**

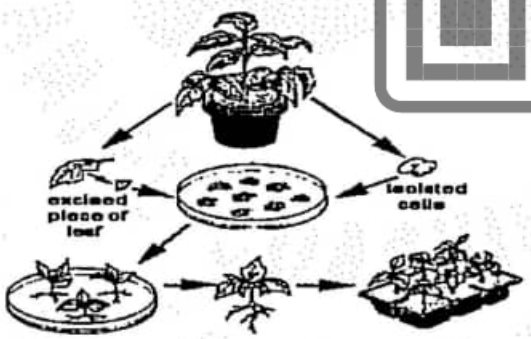
Due to the inheritance of acquired character for many generations, such organism started to develop, which are totally different from their ancestors therefore they are considered as the new species.

Totipotency:

- Plant cells are totipotent i.e., a cell with full genetic potential of organism.
- In 1950 a carrot was produced by Fredrich Steward from a single carrot phloem cell, which was grown in nutritive medium containing sugar, minerals & vitamins with coconut milk.

SOMATIC EMBRYOS

- Cultured plant of certain plants gives rise to embryo like structure that is small & simple than plantlets.
- They are called somatic embryos because they are derived asexually from somatic cells.



ANTHER CULTURE

Another type of tissue culture in which anthers are cultured in an artificial medium is called anther culture.

In this method the haploid tube cell within the pollen tube divide producing pro-embryos consisting of as many as twenty to forty cells.

Finally the pollen grains rupture releasing haploid embryos, which develop into haploid plant.

CLONING

Definition:

Cloning is the production of duplicate copies of genetic material, cells or entire multi cellular living organism occurring naturally in the environment. These copies are called clones.

Examples:

* Identical twins
* Asexual reproduction in plants & animals.
* Regeneration
* Development of tumours & cancer cells.

ARTIFICIAL CLONING:

Dolly, unlike any other mammal that has ever lived, is an identical copy of another adult and has no father. She is a clone, the creation of a group of veterinary researchers. That work, performed by Ian Wilmut and his colleagues in 1997 at the Roslin Institute in Edinburgh, Scotland, has provided an important new research tool and has shattered a belief widespread among biologists that cells from adult mammals cannot be persuaded to regenerate a whole animal.

APPLICATIONS OF BIOTECHNOLOGY IN AGRICULTURE

MEDICINES

- Vaccines were made from treated bacteria & viruses.
- Cotton, corn, potato & Soya bean plants have been engineered to be resistant to insects, predation or herbicides which are also environmentally safe.
- The proteins which are being produced by biotechnology give the hope that some troublesome & serious diseases like hemophilia can treated successfully (Clotting factor VIII will be available for hemophilia).
- Biotechnology also made some progress in enhancing food quality of crops like Soya beans developed which mainly produce oleic acid (an unsaturated fatty acid)

EXAMPLES

(i) **EVOLUTION OF GIRAFFE:-**

The ancestors of giraffe were horse like & lived in Africa having enough grass & herbage to eat, when forced to graze upon foliage leaves of trees, thus by continuous effort of stretching of neck & forelimbs increase in each generation to reach this food.

(ii) **EVOLUTION OF SNAKE:-**

In order to escape from attacks of many mammals, the snakes (lizard like ancestors) developed the habit of gliding over the ground and creeping through narrow holes as a result, their bodies become elongated and limbs disappeared due to their disuse after a large number of generations.

OBJECTIONS ON LAMARCKISM:-

(i) Mutilations as a result of accidents or diseases arenot inherited.
(ii) Boring of holes in ears and nose in mothers is not inherited in new born child.
(iii) The greatest set back to Lamarckism was Weismann's theory of germinal continuity in 1892.

(ii) WEISMANNS' THEORY:- (Germinal continuity theory)

By the fusion of male & female gametes zygote is formed which produces two types of cells during its development.

(a) Somatic cells. (b) Germ cells.

(a) SOMATIC CELLS:-

Those cells which are differentiate into various tissues and form different organs of the body.

(b) GERM CELLS:-

These cells give rise to egg cell & sperm cells.

Only the germ cells take part in the formation of new organism therefore any change in these cells is transferred into the coming generation whereas those changes which develop in somatic cells never transmitted into the new generation.

(iii) DARWIN'S THEORY OF NATURAL SELECTION:-

INTRODUCTION:- Charles Darwin wrote a book " The Origin of Species " published in 1859, in it he gave the theory of organic evolution based on natural selection, therefore called "Theory of Natural Selection"

EXPLANATION:-

Important features of this theory are

1. Over Production
2. Struggle for existence

3. Variation & heredity.
4. Natural Selection or survival of the fittest of the fittest
5. Formation of Species or Origin of species.

(1) OVER PRODUCTION:-

All Organisms usually have very high reproductive rate therefore they produce a large no. of offspring's

Examples:-

- A single cod fish lays eggs 5 – 7 millions in a single season
- A housefly lays about 120 eggs 6 times in every summer.
- Starfish produces a million eggs in a year.
- The slowest breeder like elephant in its life time (100 years) produces 6 offspring.

According to Darwin after 750 years 1 million elephants will be produced by 1 pair of elephant.

(2) STRUGGLE FOR EXISTENCE:-

A logical result of over production is the severe competition for food & space & other necessities of life. It is called "Struggle for existence"

Types of Struggle:-

(i) Interspecific struggle.
(ii) Intraspecific struggle.
(iii) Environmental struggle.

(i) INTERSPECIFIC STRUGGLE:-This struggle takes place among the members of different species.

(ii) **INTRASPECIFIC STRUGGLE:-**This struggle takes place among the individuals of same species.

(iv) **ENVIRONMENTAL STRUGGLE:-** The struggle against the extreme environment is called environmental struggle.

"Those organisms of a species which, are succeeded in this struggle may be able to reproduce"

(3) VARIATIONS & HEREDITY:-

All the individuals of the same species are different from each other even the two offsprings of the same parents are not exactly alike. These minor variations may help in the survival of individuals & those organisms which possess suitable variations are not only able to survive but also they produce their new generations. *Prep. By :- Raza Mehdi*

(4) NATURAL SELECTION OR SURVIVAL OF THE FITTEST:-

The offsprings with desirable traits are selected for each generation for breeding purposes. While offsprings lacking such traits are prevented from reproduction. This is called "Natural selection or the survival of the fittest"

Darwin believed that natural selection is the driving force behind the evolution. He also believed that the environment plays the role for the breeder in natural selection

which generates populations whose members are better adopted to the environment. While the other species become extinct.

(5) **ORIGIN OF SPECIES:-**

According to Darwin some organisms show variations in one direction and others in other direction due to different environmental conditions in which they live & try to survive. Continuation of these variations gradually produce new & different types which are considered as different species.

OBJECTIONS ON DARWINS'S THEORY:-

1. Darwin did not clearly differentiate b/w heritable & non-heritable variations.
2. He could not tell the cause of variations.
3. He emphasized the role of minor variations where as mutations which appear suddenly & without
   Reference to the parents; really play role in evolution phenomenon.
4. Darwin had no explanation for the presence of neutral variations which have neither useful nor
   harmful effects.
5. Natural Selection theory cannot account for the presence of vestigial organs.
6. This theory explains the survival of the fittest but it doesnot explain the arrival of the fittest.

(v) DE VRIES THEORY (MUTATION THEORY):-

INTRODUCTION:- De vries (1848 – 1935) was one of the three persons who discovered Mendel's work. He is also known for his Mutation theory.

Main Postulates of Mutation Theory:-

- ❖ According to Devries new races & species originate discontinuously & non-gradually. He called Mutation to discontinuous variation.
- ❖ Mutations are sudden heritable changes.
- ❖ They are not caused by environmental effects or cross breeding.
- ❖ Permanent changes take place spontaneously out of the internal conditions & are not necessarily adaptive to nature. Majority of them get destroyed. Only those mutations that are adaptive survive in nature.

EVIDENCES OF ORGANIC EVOLUTION

1. EVIDENCE FROM FOSSIL RECORDS (PALEONTOLOGY):-

FOSSILS:-

A fossil is any trace of life from the past.

Examples:

- ❖ Archaeopteryx is a fossil bird was discovered in 1861 in Bavaria (Germany)
- ❖ This bird had lived 150 million years ago.
- ❖ Unlike the modern birds it had teeth, a long tail having 20 vertebrae, wings containing moveable fingers with downs.
- ❖ All these characteristics show link with reptiles.

CONCLUSION:- Scientists believe that Archaeopteryx is a good evidence of an evolutionary pathway leading from reptiles to birds.

2. EVIDENCE FROM TAXONOMY:-

TAXONOMY:-

"The study of the identification, classification and naming of different organisms is called Taxonomy."

UNIT OF CLASSIFICATION:-

(i) **SPECIES:-** A group of similar type of organisms which can interbreed with each other is called species. This is the smallest unit of classification.
(ii) **GENUS:-** It is a group of related species.
(iii) **FAMILY:-** A group of related genera is called family.
(iv) **ORDER:-** Different families unite to form an order.
(v) **CLASS:-** A class consists of different orders.
(vi) **PHYLUM / DIVISION:-** A group of different classes is called phylum or division.
(vii) **KINGDOM:-** It is a group of different phyla or division

Example :- All the members of phylum chordata have a notochord, nerve cord & gill slits atleast in their embryonic stages.

CONCLUSION:- These resemblance in different group of chordates like fishes, amphibians, reptiles, birds & mammals can be assumed because of their common ancestor in the past

3. COMPARATIVE ANATOMY OR EVIDENCE FROM HOMOLOGY:-

4.

ANATOMY:- "The study of internal structure of the body is called Anatomy."

HOMOLOGY:- "The study of homologous organs is called homology." Those organs of the body which have common origin but may have different functions are called homologous organs.

EXAMPLE:- Skeletal system in the wing of bird or bat, forelimbs of turtle, forelegs of horse, flippers of whole & arms of man is very similar internally having same type of bones & muscles.

CONCLUSION:- Biologist assume that the presence of Homologous organs in different groups of animals provide evidence of evolution. *Prep. By :- Raza Mehdi*

4. EVIDENCES FROM VESTIGIAL ORGANS (VESTIGES):-

VESTIGES:- Vestiges are those organs which have no functions in the body but they persist in reduce form generation after generation.

EXAMPLES:-

(i) In whales & snakes pelvic bones are present in the reduced form.
(ii) Wings of Kiwi & Ostrich are reduced & serve no useful function.
(iii) Splint bones of foot of horse are the remnants of their toes.
(iv) Vestigial Organs in man like:

(a) **COCCYX**:- It is a tailbone which is well developed in other vertebrates.
(b) **VERMIFORM APPENDIX:-** It is a small finger like caecum. It is an important organ in grating mammals because it contains cellulose digesting bacteria.
(c) **NICTITATING MEMBRANE:-**It is well developed in birds to clear their eyeball but in human it is highly reduced in the form of semi lunar fold.
(d) **EAR MUSCLES:-** These muscles are well developed in dog & horses helping them to move their pinnae to collect sound waves from different directions but in human body they are present as vestigial organs.

CONCLUSION:- Vestiges explain that natural selection accounts for the elimination of structures that are no longer needed by an organism.

5. EVIDENCE FROM COMPARATIVE EMBRYOLOGY:-

EMBRYOLOGY:- The study of the stages from a zygote to a complete individual, is called embryology.

EXAMPLE:- Vertebrates history shows that fishes, salamanders, tortoises, birds, mammals including man hold a common ancestor (probably some type of primitive fish).

CONCLUSION:- The study of embryonic development provides one of the best tools to understand the evolution in animals.

6. EVIDENCE FROM BIOCHEMISTRY:

BIOCHEMISTRY:- The study of the chemical nature of life & different chemical reactions going on inside a living body is called Biochemistry.

EXAMPLE:-

- The blood sera of man & apes show relationship between their proteins.
- The blood proteins of carnivores like cats, dogs & bears are closely related but those of herbivores like cow, goat, sheep & deer are closely related.

CONCLUSION:- The presence of related blood proteins in different animals indicates that they have a common ancestor.

7. EVIDENCE FROM DOMESTICATION:-

DOMESTICATION:- Domestication means artificial selection in breeding.

EXAMPLE:- Vast diversity has been achieved in domestic dogs & pigeons by artificial selective breeding procedure.

CONCLUION:- Those Organisms which are developed by domestication have variations. These variations indicate that evolution is possible.

V IMPORTANCE OF NATURAL SELECTION AS A POSSIBLE MECHANISM FOR EVOLUTION:-

1. ACTION OF NATURAL SELECTION OF GENES:-

All the processes that encourages the transmission of favourable genes & block the transmission of unfavourable genes contribute towards evolutionary progress.

EXAMPLE:- An animal with unfavourable characteristics in any way prevented from breeding, the genes of this individual will be prevented from transmitting to next generation. It is sometimes called genetic death.

2. **NATURAL SELECTION AS AN AGENT OF CONSTANCY AS WELL AS CHANGE:-**

Natural selection is responsible both for maintaining the constancy of species & changing them. It is destructive for weaker individuals & favours the powerful organisms. This kind of selection is called stabilizing selection.

3. **NATURAL SELECTION & POPULATION GENETICS:-**

- To produce a long term evolutionary change, the forces of natural selection do not act on individual gene, but on population.
- A more or less genetically isolated unit of population is known as Deme.
- The sum total of all the different genes in population is known as gene pool.
- The evolutionary future of an individual organism depends on its gene pool.

VI **ARTIFICIAL SELECTION & ITS ROLE:-**

- Breeding of domestic plants & animals to produce specific desirable features.
- The plants & animals use grow for food bear little resemblance to wild ancestor.
- The various breeds of dogs provide a striking example of artificial selection.

VII **GENE FREQUENCIES & THEIR ROLE IN EVOLUTION:-**

(i) Population genetics:- Population genetics is a branch of Genetics that deals with the frequency, distribution & inheritance of alleles in population.
Each particular gene can also be considered as gene-pool consists of all the alleles of that specific gene occur in population.
Example: In a population of 100 pea plants the gene pool for flower colour would consist of 200 alleles. The relative proportions of different alleles for colour, these numbers are called allele frequency or gene frequency.

HARDY – WEINBERG LAW

INTRODUCTION:- In 1908, an English Mathematician G.H. Hardy & a German Physician W. Weinberg gave relationship between frequencies of alleles & genotypes in population. This relationship is known as Hardy – Weinberg Equilibrium.

STATEMENT:- " The frequencies of dominant & recessive alleles in a population will remain constant from generation to generation provided certain conditions exist."

Mathematical Representation:-

$$(P + q)^2$$

where: P = frequency of one allele
q = frequency of another allele.

OR $\boxed{P^2 + 2Pq + q^2 = 1}$

SUPPOSE

$P = 0.9$

$q = 0.1$

$\rightarrow (0.9)^2 + 2(0.9)(0.1) + (0.1)^2 = 1$

$0.81 + 0.18 + 0.01 = 1$

$\boxed{1.00 = 1}$

ENDANGERED SPECIES:-

In Pakistan, cheetah, Tiger, Asian Lion, Indian Rhino, Crocodile, Gazzal have been declared extinct. While Indus dolphin, Black buck, common Leopard etc are among the animals near to extinction.

CONSERVATION OF HABITAT & ENDANGERED SPECIES:-

1. A global system of national parks to protect large tracts of land & built life that allow movement b/w natural areas.
2. Protection of Landscapes that allow controlled activity.
3. Zoo's, Safaris, & botanical gardens to save species whose extinction is imminent

Chapter 11

ECOSYSTEM

ECOLOGY:

The scientific study of various relationships of living organisms with each other & their environment is called ecology.

The term ecology was first introduced by a German biologist Earest Hackel in 1869. It was derived from a Greek word "Oikos", meaning "home-life", & logos meaning study.

LEVELS OF ORGANIZATION

1. **SPECIES:**

A group of closely related organisms which can interbreed with each other is called species.

2. **POPULATION:**

Total number of individual of a species at a particular place is called population.

3. **COMMUNITY:**

A group of different population in a habitat is called community.

4. **HABITAT:**

The type of environment in which a particular organism or population lives is its habitat e.g. fresh water pond.

5. **ECOSYSTEM:**

A community interacts with a non living environment and both function together to form an ecosystem.

6. **BIOSPHERE:**

The different ecosystems link together & collectively form a giant ecosystem, which is called biosphere or ecosphere.

ECOLOGICAL NICHE:

Each organism plays an important role in particular habitat, its activities, requirements and effects are collectively called ecological niche.

BIOME:

The biological regions are further differentiated on the basis of complex interaction of climate and biotic factors into large easily recognizable community units called biomes.

OR

Large ecosystems are called biomes.

FLORA:

The nature and types of plants in a biogeographically region is called flora.

FAUNA:

The nature and types of animals in a biogeographically region is called fauna.

APPROACHES TO ECOLOGY

POPULATION APPROACH (AUTECOLOGY)

This approach is based on the study of individual species.

COMMUITY APPROACH (SYNECOLOGY):

This approach is based on the study of whole community its environment it is also called biocoenotics.

ECOSYSTEM APPROACH:

This approach is based on two things, the flow of energy cycling of matter b/w living and non living component

HABITAT APPROACH:

This approach is related with the habitat of the organism. The habitat has a particular physical condition which is adopted by an organism.

EVOLUTIONARY APPROACH:

This approach is linked with evolutionary trend. This study needs the use of fossil records.

HISTORICAL APPROACH:

It deals with changes associated with the development of tools in man's history.

ECOSYSTEM

Definition:

The interaction between a community and its physical environment is known as ecosystem.

This term was first used by Tansely in 1935.

COMPONENTS OF ECOSYSTEM

There are two main components of an ecosystem.

- Abiotic components
- Biotic Components

ABIOTIC COMPONENTS:

All the on living components of an ecosystem are called Abiotic components.

There are three types of abiotic components.

- Climatic factors
- Topographic factors
- Edaphic factors

1. CLIMATIC FACTOR:

The climate of an ecosystem depends on the weather conditions such as light, temperature, wind, water etc.

2.TOPOGRAPHIC FACTORS:

The study of surface structure of earth is called topography.

There are three main factors which affect the Topography of earth.

- Altitude
- Slope
- Exposure

3.EDAPHIC FACTOR:

Edaphic factors are related with the conditions and the composition of soil. And the scientific study of soil is called pedology.

SOIL:

The top most layer of earth is called soil.

It is the combination of weathered rock particles and minerals organic matter etc.

WEATHERED ROCK PARTICLES:

Gravels	(less than)	2.0 mm
Coarse Sand		2.0 – 0.2 mm
Fine sand		0.2 – 0.02 mm
Silt		0.02 – 0.002 mm
Clay	(greater than)	0.002 mm

LOAM:

A soil sample in which different particles are present in almost equal proportion is called loam. This type of soil is the best one for plant growth because it has maximum water holding capacity and porosity.

BIOTIC COMPONENTS:

The biotic components of an ecosystem are living things. There are three types of biotic components on the basis of nutrition.

- Producers
- Consumers
- Decomposes

PRODUCERS:

1. The producers are mainly green autotrophic plants which are present in both aquatic and terrestrial ecosystems.
2. Chlorophyll containing organisms convert carbon dioxide and water the energy rich carbohydrates by a process known as photosynthesis.
3. Plants also prepare proteins and other chemical substances. For this purpose they absorb various nutrients of abiotic components.

CONSUMERS:

- The consumers are heterotrophic organism, which are mainly animals. These are unable to manufacture then own food.
- There are three main types of consumers.
  - Primary consumers
  - Secondary consumers
  - Tertiary consumers

Primary Consumers:

- Primary consumers are herbivores
- Primary consumers of terrestrial ecosystem.
  - Grass-hopper
  - Leaf-hopper
  - Goat
  - Sheep
  - Cow
  - Rabbit
  - Dee
- Primary consumers of aquatic ecosystem.
  - Zoo planktons
  - Crustaceans
  - Herbivorous fishes

Secondary Consumers:

- They are carnivorous animals which feed upon herbivores primary consumers.
- Some secondary consumers are omnivores e.g. cat, dog, carnivorous fishes, mice, crow, man etc.

Tertiary Consumers:

These animals are predators or scavenger e.g. lion, leopard, eagle, crocodile, shark etc.

DECOMPOSERS:

They are microscopic saprotrophs mostly fungi and bacteria. They are found inside the soil where they decompose the dead organisms.

BIOGEOCHEMICAL CYCLES

The circular path of different chemical compounds or elements in an ecosystem is known as biogeochemical cycles.

Examples:

- Carbon, hydrogen & oxygen cycles
- Phosphorus cycle
- Nitrogen cycle

NITROGEN CYCLE

Introduction:

Nitrogen is an essential component of amino acids, chlorophyll nucleic acid etc. It constitutes main bulk of atmosphere where it is present in about 78% in ratio. It is cycled from environment to organisms and back to environment. This process is known as nitrogen cycle.

Explanation:

The nitrogen cycle comprises of the following steps:-

- Nitrogen fixation
- Decomposition
- Denitrification

NITROGEN FIXATION:

The process in which the atmospheric nitrogen is brought into the soil in the form of simple compounds is called nitrogen fixation. There are three types of nitrogen fixation.

* Non symbiotic nitrogen fixation
* Symbiotic nitrogen fixation.
* Thunder storms

Non – Symbiotic Nitrogen Fixation:

This nitrogen fixation is carried out by non symbiotic organisms such as non symbiotic bacteria. Example:- *Azotobacter*.

Symbiotic Nitrogen Fixation:

This nitrogen fixation is performed by symbiotic organism such as:- Cyanobacteria.

The cyanobacteria or blue green algae contain heterocysts in their filaments. These heterocysts are responsible for nitrogen fixation.

NODULATION:

Rhizobium radicicola are those bacteria which form root nodules in leguminous plants. These are symbiotic bacteria which are responsible for nitrogen fixation.

THUNDER STORMS:

When the thunder storms are produced, the atmospheric nitrogen reacts with oxygen due to high temperature to form nitrogen oxides. These nitrogen oxides fall on the ground with rain water.

DECOMPOSITION:

The decomposition of organic compounds takes place in two steps:-

Ammonification:

The organic compounds are broken down into ammonia. This process is known as ammonification.

Nitrification:

Ammonia is converted into nitrites by the action of *Nitrosomonas* bacteria and *Nitrobacter*.

DENITRIFICATION:

In soil, there is another type of bacteria which converts nitrates into free atmospheric nitrogen. These bacteria are called denitrifying bacteria such as pseudomonas. This process is called denitrification. They reduce soil fertility. Good drainage and the ploughing restrict their activity and helps in increased soil fertility.

INTERDEPENDENCE OF ORGANISMS AND THEIR SIGNIFICANCE

In an ecosystem, organisms are interdependent which is called interaction. There are two types of interaction:-

- Positive interaction
- Negative interaction

POSITIVE INTERACTION:

In this type of interaction organisms help one another to get food or other benefits e.g. symbiosis.

NEGATIVE INTERACTION:

This type of interaction causes harm to one of the species e.g. parasitism, predation, grazing.

1.PARASITISM:

It is an association in which one organism, the parasite lives on another organism called host. In this association, parasite is benefited whereas the host is at loss. There are two types of parasite.

- Ectoparasite
- Endoparasite

Ectoparasites:

These parasites live on the body surface of the host e.g. fleas and leeches.

Endoparasites:

These parasites live inside the body of their host e.g. *Plasmodium*, *Taenia* etc.

2.PREDATION:

Predatons are those animals which take their food by preying upon other animals e.g. hawks, lion, eagle, crocodile etc.

3.GRAZING:

The herbivores in an ecosystem feed upon green parts of plants. These animals are called grazing animals. For e.g. rabbit, sheep, cattle, horses, elephants, etc.

4.SYMBIOSIS:

It is an association b/w two different living organism but neither is harmed. There are two types of symbiotic association.

- Mutualism
- Commensalisms

Mutualism:

It is a relationship b/w two organisms for mutual benefits.

Examples:

In leguminous plants, root nodules are inhabited by nitrogen fixing bacteria. These bacteria fix atmospheric nitrogen for the plant in turn get shelter. So both partners are benefited.

Commensalisms:

In this relationship one organism the commensal gets benefit from host but host does not get benefit nor it is harmed.

Examples:

The orchids and mosses are common epiphytes which grow on the trunks of other plants.

ECOLOGICAL SUCCESSION

Definition:

The ecosystem has ability to change simpler forms into more complex forms and thus a community may change. The process of orderly community change is called succession.

EFFECT OF SUCCESSION:

The succession results in increase in total number of species in particular area and a stable community is developed for a certain period of time. This stable collection of plants and animals is known as climax community. There are two types ecological succession.

- Primary succession
- Secondary succession

PRIMARY SUCCESSION:

The areas never having living things before can develop life activities teaching to a community. This is called primary succession. The initially establishing plants in such areas are called pioneers or primary community.

SECONDARY SUCCESSION:

This type of succession occurs on places which were previously occupied by living things but were destroyed by fire or any other climatic or biotic change.

TYPES OF PRIMARY & SECONDARY SUCCESSION

On the basis of habitat primary and secondary succession are divided into three types.

Hydrosere: This occurs in water.

Mesosere: Which occurs in an area where adequate moisture is present.

Xerosere: It occurs on dry terrestrial places like rocks.

HYDROSERE OR HYDRACH

Primary succession in open water like ponds, lakes pools which are ultimately connected to land community constitute hydrosere. The seral stages of hydrosere in a pond are as follows:

- Phytoplankton stage
- Submerged stage
- Floating stage
- Reed swamp stage
- Sedge meadow stage
- Wood land stage
- Climax stage

Phytoplankton Stage:

The phytoplanktons are unicellular or colonial free floating plants. These are the pioneer species. For e.g. cyanobacteria, spirogyra, diatoms, bacteria, protozoan, etc.

Sub – Merged Stage:

The death and decay of phytoplanktons and zooplanktons make the soil suitable and softer for the growth of rooted plants. The sub merged hydrophytes like ***Hydrilla***, ***Vallisnaria***, ***Potamageton***, etc. first inhabited a pond.

Floating Stage:

The death and decay of sub merged hydrophytes and their accumulation decrease water level up to few feet. Therefore ponds become suitable for other types of plants which are rooted in soil but their leaves float on the surface of water. These species include ***Nymphea***, ***Eichornia***, ***Trapa***, etc.

Reed – Swamp Stage:

This stage is also referred to as amphibious stage. At this stage most of the species, through rooted in soil but have most of their parts above water table. The representative plants of this stage are ***Typha***, ***Polygonum***, ***Phragmites***, ***Sagittaria***, etc. while animals like ***Lymnea***, ***Physae***, scorpion, giant bug are present.

Sedge – Meadow Stage:

The continuous decrease in water table and favorable changes in substratum make the ponds suitable for plants. They have much branched rhizome system. The representative plants species of this stage are ***Juneus***, ***Cyperus***, ***Carex***, etc. The animals of this stage are snails.

Wood Land Stage:

The soil at this stage becomes more and drier. Thus, the marshy vegetation disappears and area becomes rich by terrestrial plants like ***Salix***, ***Populs***, etc. The animals of this stage are deer and zebras.

Climax Stage:

The woodland community is finally invaded by trees. If there is heavy rainfall then tropical rainforest is developed but if there is moderate rainfall, the mixed forest is developed.

XEROSERE

It occurs on a bar rock or land where there is lock of water and organic matter, through having some minerals. The stages of xerosere are as follows:-

Crustose – Lichen Stage:

A bare rock or land does not possess moisture and organic matter but lichens are such plants which form pioneer species in this area. They produce acids which help in the weathering of rocks and thus produce better substratum for other species e.g. ***Rhizocarpon***, ***Rhinodine***, ***Lecanora***, etc.

Foliose & Fructiose Lichen Stage:

Lichens of this stage have large, leafy structures. They have ability to absorb moisture and retain. They also hold up soil particles and make substratum richer. The examples of these lichens are ***Pasmelia***, ***Dermatocarpon***, etc. Animals of this stage are mites, ants and spiders present in cracks.

Moss Stage:

The thin soil layer favours the growth of mosses which requires little water. The examples of this stage are ***Polytrichum***, ***Selaginella***, animals like mites & spiders increase their number at this stage.

Herbs Stage:

In this stage annual and perennial herbs are developed. The xeric conditions are also changed and shallow rooted grasses are developed such as

Aristida and *Poa*. This stage also favours animals like nematodes, larval insects, aunts.

Shrub Stage:

At this stage, the habitat becomes more suitable for the growth of shrubs. The soil becomes rich with moisture and minerals. The plants of this stage are *Rhus*, *Phytocarpus*, while the animals of this stage are slugs, snail, centipede, millipedes, frog, reptile, birds & mammals.

Climax Stage:

The accumulation of soil & humus favours the growth of some xerophytic trees. These trees change the climate for xerophytic trees. In this way a climax community is formed.

Chapter 12

SOME MAJOR ECOSYSTEMS

ECOSYSTEM:-

Definition:- An ecosystem is a basic functional unit in ecological studies which is composed of living organisms interacting with each other & with the non-living environment in a given area.

LIFE IN FRESH WATER

There are two forms of fresh water

(1) Lentic water.
(2) Lotic water.

(1) LENTIC WATER:- It is the stagnant water e.g. Ponds and lakes.
(2) LOTIC WATER:- It is the running water e.g. Rivers, Springs and Streams.

POND ECOSYSTEM

POND:- A pond exhibits an example of fresh water ecosystem. It may develop behind a dam or near a river & its life span ranges from few weeks to several hundred years.

Components of pond ecosystem:-

There are two basic component of Pond Ecosystem.

(1). Abiotic components.
(2). Biotic components.

(1) ABIOTIC COMPONENTS:- The pond is a balanced system of water & nutrients. The nutrients are mostly in solid state & they enter in a pond from surrounding ground or streams. The nutrients are very important because they regulate the rate of functioning of entire ecosystem.

TYPES OF NUTRIENTS:- There are two types of nutrients.

(1) **Macronutrients:-** Carbon, Hydrogen, Oxygen, Potassium, Magnesium and Sulphur.
(2) **Micronutrients:-** Iron, Manganese, Copper, Zinc etc.

(2) BIOTIC COMPONENTS (LIVING COMPONENTS):-

There are three types of biotic components.

(i). Producers. (ii). Consumers. (iii) Decomposers.

(i) PRODUCERS:-

- ❖ The producers are green plants & they can manufacture their own food.
- ❖ The pond favours particular type of plant growth.

(a) MICROPHYTES OR PHYTOPLANKTONS:-

The microphytes or phytoplanktons generally consist of free floating algae.
EXAMPLES: *Chlamydomonas, Spirogyra*, diatoms, *Nostoc* etc.

(b) MACROPHYTES:-

Macrophytes are rooted or large floating plants, which grow in shallow water. There are two types of Macrophytes.

1. Totally Submerged Plants:-
   e.g. *Hydrilla* , *Potamageton, Vallisnaria*, *Trapa* etc.
2. Partially Submerged Plants:-
   e.g. water lily, *Nelumbium* (lotus), *Eichornia* etc.

(ii) CONSUMERS:-

Consumers are animals which are unable to synthesize their own food.

TYPES OF CONSUMERS:- There are three types of Consumers.

1. **PRIMARY CONSUMERS:-**
   The Primary consumers are herbivores which include crustaceans, Molluscs & zooplanktons, herbivore fishes and young insects.
2. **SECONDARY CONSUMERS:-**
   The secondary consumers feed on Primary consumers.
   Examples:- Diving beetles , fishers & carnivore fishes.
3. **TERTIARY CONSUMERS:-**
   The tertiary consumers are also carnivores & they feed upon secondary consumers.
   Examples:- Turtle.

(iii) DECOMPOSERS:-

The decomposers of pond ecosystem are saprotrophic bacteria & fungi. They bring about the decomposition of dead organic matter of plants & animals.
Examples:- *Aspergillosis, Penicillium* , *Rhizopus*.

LIFE IN MARINE WATER

- ❖ The ocean is the greatest reservoir of living organisms along with nutrients.
- ❖ It covers about 70% of earth surface.
- ❖ Generally sea consist 3.5% salt, while average temperature is about 32°C.
- ❖ The Salt concentration of red sea is 4.6% & that of Baltic Sea is 1.2%
- ❖ **UP-WELLING:-** The water of deep sea is brought to coastal surface by the action of wind, which moves surface water away, while deeper water come to the surface. This phenomenon is called upwelling.

ZONATIONS IN SEA

Horizontally a sea can be divided into two parts.

(i) Neritic region. (ii) Oceanic region.

NERITIC REGION:-

- ❖ It consists of shallow water present at the edge of continental shelf.
- ❖ It's depth may be up to 180 meters.
- ❖ This region is further divided into following zones.

(1). High tidal (Supratidal) zone.
(2). Low tidal (subtidal) zone.
(3). Intermediate (Intertidal) zone.

The Neritic zone is the most productive zone of the sea.

PRODUCERS OF NERITIC ZONE:-

Phytoplankton, Diatom & other algae like *Caulerpa*, *Ectocarpus*, *Cladophora*, *Dictyota* & *Laminaria*.

ANIMALS OF NERITIC ZONE:-

Shrimps, Clams, zooplanktons, various fishes, crustaceans, turtles, seals etc.

Plants of intertidal zone possess a jelly like substance called Agar which absorbs large quantity of

OCEANIC REGION:-

The Oceanic region mainly consist of two major zones.

(i). Euphotic zone.
(ii). Aphotic zone.

(i). EUPHOTIC ZONE:-

- ❖ In this zone light is present.
- ❖ It contains large number of phytoplanktons in a unit area.
- ❖ In this zone species are lesser in number than coastal area.

(ii). APHOTIC ZONE:-

- ❖ This is the dark zone of sea.
- ❖ It comprises of Bathyal (upper) & Abyssal (lower) zones.

(a). Bathyal zone:- The Bathyal zone is the continental slope reaching up to two thousand meter . The animals of this zone are filter feeder.

(b). Abyssal zone:- This zone is rich in organic remains & shells. Plant life is totally absent in this area. In this region decomposers & scavengers are present. The fishes are small in size, which have large mouth & they possess luminescent organs. Their eyes may be enlarged or absent.

TERRESTRIAL ECOSYSTEM (BIOMES)

DEFINITION:- "The biogeographical regions are differentiated on the basis of complete interaction of climate & Biotic factors into large easily recognizable units called Biomes."

FOREST ECOSYSTEM OR FOREST BIOME:-

* Forest Occupies about 35 – 40% of the land surface of the earth.
* In Pakistan the forest occupies about 6% of the total land area.
* The forests of the world have been classified into 3 kinds.

(a). Tropical rain forest.
(b). Coniferous forest.
(c). Temperate forest.

(a) TROPICAL RAIN FOREST:-

The tropical rain forest grows in equatorial region where humidity is high rainfall is heavy & annual average temperature is about 28^0C.

(i) ABIOTIC COMPONENTS:-

High quantity inorganic & organic substances are present in soil & atmosphere.

(ii) BIOTIC COMPONENTS:-

(a) PRODUCERS:-

- Flora is highly diversified.
- The forest is three storeyed.
- The upper canopy consists of very tall trees of about 40 meters in height.
- The intermediate storey consists of trees having, 30 meters height.
- The lower storey consists of small trees do not exceeding 20 meters in height.
- Due to less light forest floor is covered by Hygrophytes such as ferns.
- The epiphytes like orchids grow onto the branches of other trees. These forests are great source of timber. *Prep. By :- Raza Mehdi*

(b) CONSUMERS:-

Primary consumers

- Herbivores feeding on plants include ants, beetles, leaf hoppers, bugs, spiders, monkeys, shrews, bats etc.
- About 85% of living species of birds are found in these forests, which feed on seeds, fruits & nectar of plants.

Secondary Consumers

❖ The secondary consumers of these forests are aboreal i.e. they live on trees. Examples: snakes, Predatory birds, frogs etc.

Tertiary Consumers

* Snakes & predator birds are the tertiary consumers.

(c) **DECOMPOSERS:-**

The micro-organism fauna of a forest soil is very rich. This includes a wide variety of bacteria & fungi.

(B) CONIFEROUS FORESTS:-

❖ The conifers are evergreen, cold resistant plants which belong to gymnosperms.
❖ They are found at high altitudes & also at high latitudes.
❖ Coniferous forests cover more forests in northern hemisphere as compare to southern hemisphere.

CLIMATIC CONDITIONS:-

The winter is very severe & is characterized by heavy snow so the conditions become xerophytic, therefore the leaves of these plants are needle like.

Example: Pine, Fir & Spruce (Gymnosperms) *Bisch willow* & *Populus* (Dicotyledonous).

CONIFEROUS FOREST OF PAKISTAN

❖ In Pakistan coniferous forest are found in Kaghan, Swat, Dir, Murree hills & Chilas etc
❖ The main plants of these areas are:
Pinus exelsa, Pinus girardiana, Cedrus deodara , Taxus baccata etc.
❖ **Ground flora:-** It consists of Mosses, Lichens & Members of family Ericaceae & Rosaceae.
❖ **Herbivorous Animals:-** Sheep, deer, wild goat, squirrels, many insects & birds.
❖ **Carnivorous Animals:-** Wolves, leopards & lynx etc.

(C) TEMPERATE DECIDUOUS FORESTS:-

❖ The term deciduous is applied to those plants which shed off their leaves during winter season.
❖ The deciduous forest may be dry, monsoonal & moist semideciduous.
❖ In Northern hemisphere they are found in parts of North America, South America, Eastern Asia, China, Japan & Central Europe. Whereas, in Southern hemisphere typical deciduous forests do not exist.

Prep. By :- Raza Mehdi

CLIMATIC CONDITIONS:-

Moderate temperature & average rainfall of about 100cm. In these regions winter & summer seasons are also found therefore these areas are largely used for cultivation.

TEMPERATE DECIDUOUS FOREST OF PAKISTAN:-

FLORA:-

- The temperate deciduous forests are characterized by broad leaved plants like Beech, Oak & Maple.
- In Shogran & Neelam valley of Azad Kashmir *Pinus wallichiana* & *Taxus baccata* are dominant.
- The ground flora is also much richer.
- In summer the ferns & mosses grow in shades whereas during spring, flowering plants develop.

FAUNA:-

- Many kinds of insects, birds & mammals feed upon plants.
- The predators of deciduous forest are owls, foxes, bears etc.

GRASSLAND ECOSYSTEM / GRASS LAND BIOME

INTRODUCTION:-Grasslands are open land communities with limited moisture conditions, irregular rainfall, sharp seasonal variations & very high radiations. Grassland covers about 19% of earth's surface.

(i) ABIOTIC COMPONENTS:- These are the inorganic & organic substances found in the soil & atmosphere.

(ii) BIOTIC COMPONENTS

(a) **PRODUCERS:**

- They are mainly grasses of various sizes & kinds.
- Most of the cereal crops like corn, wheat, oat.
- Therefore these areas are called **"Bread basket"** of the world.

(b) **CONSUMERS:-**

(i) **Primary Consumers:-** In grassland grazing mammals are dominant such as Buffalo, Cow, Sheep, Deer, Rabbit, etc.

(ii) **Secondary Consumers:-**These are the carnivores which include frogs, lizards, snakes, birds, foxes, jackals, leopards etc.

(iii) **Tertiary Consumers:-** Large carnivores of cat & dog families are common.

(c) **DECOMPOSERS:-** These are bacteria & fungi of various kinds.

SAVANNAH BIOME

INTRODUCTION:- The term Savannah is applied to the tropical grass lands. It covers large areas of North & South of Amazon forest, East African high lands, South America, South India & Australia.

(i) ***ABIOTIC COMPONENTS*:-** Rainfall in such areas is up to 125cm per year but the dry season is very long & temperature ranges generally more than 18 ^{0}C throughout the year. The fire play a very important role in ecology of these areas.

(ii) ***BIOTIC COMPONENTS*:-**

(a) PRODUCERS:-
In these areas forest cannot develop. Land is mostly flat & dominated by grasses which in summer may attain a height of 15 feet. The trees are scattered & base patches of land can also be seen. Some of the trees like *Danellia Oliveri*, and *Afzelia africana*, are fire resistant but grasses usually catch fire.

(b) CONSUMERS:-

(i) **Primary Consumers:-** The primary consumers of these areas are world's large herbivores such as Zebras, Antelopes, Giraffes, Elephants & Rhinoceroses.

(ii) **Secondary & Tertiary Consumers:-** The carnivores include lions, leopards & vultures.

DESERT ECOSYSTEM OR DESERT BIOME

INTRODUCTION: Deserts are those lands where evaporation exceeds rainfall. They may found at any latitude where ever rainfall is below 25cm per year. Deserts occupy about 17% of land surface of the earth.

TYPES OF DESERT

(1) HOT DESERT:- Sahara is the hot & largest desert which lies in across North Africa to Arabian Peninsula.

(2) COLD DESERT:- Gobi desert of Mongolia (China) is the coldest desert. Another cold desert found in America is Idaho.

DESERTS IN PAKISTAN

- In Pakistan three deserts are more famous i.e. **Thar, Cholistan** and **Thull**.
- Deserts in Pakistan consist of sandy hills & plains.

Vegetation:- (Vegetation of hills & plains in b/w two hills differ from one another). Vegetation of sandy hills consists of plants like *Acacia, Euphorbia, Capparis, Calatropis, Commiphora* etc. The plants found in plains are *Prosopis, Capparis* and *Lycium*.

Fauna:- Desert animals avoid heat by becoming nocturnal in their habits, by seeking shady places or by spending day in underground burrows.

THAR DESERT:- Thar desert is found in Sindh & it is composed of the following components,

(a) **PRODUCERS:-** (Plants are mostly Xerophytic) like *Acacia, Prosopis, Salvadora, Capparis* etc.

(b) **CONSUMERS:-** Most common animals are Beetles, Mantis, Grasshopper, centipedes & spider like arthropods. Frogs & toads like amphibians.

Reptiles like Lizards, Uromastic, Calotes. Snake like Vipers, Cobras, Kraits & Boas. Few birds like quail, bustard, partridge etc are also present. Mammals include anteaters, hedgehogs, porcupines, bats, burrowing rodents, wildcats, wild boars & foxes.

(c) Decomposers:- These are very few as due to poor vegetation the amount of dead organic matter is scanty. They are mostly thermophilic bacteria & fungi.

TUNDRA BIOME

INTRODUCTION:-

- Arctic tundra consist of very large area of land about 5 million acres across Northern North America, Northern Europe, & Siberia.
- The Arctic Tundra in Northern Hemisphere is in the form of a wide land which surrounds the Arctic Ocean.
- Whereas in Southern Hemisphere there are small patches of land around the Antarctic Ocean.

ENVIRONMENTAL CONDITIONS:-

- The environmental conditions of tundra are not much favourable for produces & consumers both.
- The temperature is very low all the time. The temperature of warmest months do not exceed more than 10 0C while it falls very low in winter and reaches upto -57 0C.
- In Arctic Tundra there is constant day light in mid summer. Whereas constant dark in mid winter.
- The subsoil in tundra below 10 to 20 cms is permanently frozen, which is known as PERMA FROST.

(a) PRODUCERS:- The producers of Tundra Ecosystem consist of small perennial herbs & shrubs. The pre-dominant plants are grasses, mosses, sedges & lichens. *Prep. By :- Raza Mehdi*

(b) CONSUMERS:- The productivity of these areas is very low. Hence consumer birds & animals are generally migratory.

Primary Consumers:- e.g. Lemmings, hares, reindeers, oxen, arctic foxes.

Secondary Consumers:- e.g. snowy owls, foxes & weasels etc.

MAN'S ROLE IN ECOSYSTEM

Man's role in ecosystem is of great importance in the following ways.

1. USE OF PESTICIDES:-

- A Pesticide not only kills pests, but also their predators.
- The development of new strains is very common in pests, which are harmful.
- Malaria is very common in most countries which may be controlled by draining swamps or by spray of oil, but introduction of such predators which feed on mosquito larvae is the best **biological control.**

PHYTOPLANKTONS:-Phytoplanktons are responsible for production of large quantities of oxygen. If pollutants make Oceans unfavorable for them, then a large source of oxygen will not be available to maintain oxygen & CO_2 ratio, which will have negative effect on human & other living organism.

2. EFFECTS OF PESTICIDES:-

- After use of pesticides, pests may be developed in an ecosystem, but their natural enemies are not there to control their population & so they cause harm to community.
- Some pesticides like DDT is now banned as it incorporate in human tissues.
- The organic chlorine 1.0 part per million reduces the fertility of eggs while 30 – 40 parts per million are lethal to birds.
- The excessive use of pesticides is not only harmful for birds but also for plants & animals.
- Pesticides also effect the biogeochemical cycle.
- Pesticides kill the bacteria which convert ammonia into nitrites & nitrates.

Chapter 13 MAN & HIS ENVIRONMENT

RENEWABLE RESOURCES OF ENERGY:

Renewable resources are those which can be replenished by physical or biological means.
Examples: Air, water, soil, wildlife, forests, agricultural products, fish & live stocks, sunlight, wind, rain, tides and geothermal heat.

NONRENEWABLE RESOURCES OF ENERGY:

Non renewable resources are those which once used cannot be reused.
Examples: Fossil fuels (oil, coal & natural gas), metals, nuclear fuel, timber etc

AIR

The air is a layer of gases surrounding the planet Earth that is retained by the Earth's gravity. Dry air contains roughly (by volume) 78.08% nitrogen, 20.95% oxygen, 0.93% argon, 0.038% carbon dioxide, and trace amounts of other gases. Air also contains a variable amount of water vapor, on average around 1%. The atmosphere protects life on Earth by absorbing ultraviolet solar radiation, warming the surface through heat retention (greenhouse effect), and reducing temperature extremes between day and night. Except the inert gases all the components of air serves as raw material for living organisms. Nitrogen is useful for plants to build proteins and nucleic acid. These are transferred into the food chain.

WATER

Water is a common chemical substance that is essential for the survival of all known forms of life. In typical usage, *water* refers only to its liquid form or state, but the substance also has a solid state, *ice*, and a gaseous state, *water vapor* or *steam*. Water covers 71% of the Earth's surface. On Earth, it is found mostly in oceans and other large water bodies, with 1.6% of water below ground in aquifers and 0.001% in the air as vapor, clouds (formed of solid and liquid water particles suspended in air), and precipitation. Saltwater oceans hold 97% of surface water, glaciers and polar ice caps 2.4%, and other land surface water such as rivers, lakes and ponds 0.6%. A very small amount of the Earth's water is contained within biological bodies and manufactured products. Other water is trapped in ice caps, glaciers, aquifers, or in lakes, sometimes providing fresh water for life on land.

LAND

The land is divided into a number of biomes, inhabited by broadly similar plants and animals. On land primarily latitude and height above the sea level separates biomes. Terrestrial biomes lying within the Arctic, Antarctic circle or in high altitudes are relatively barren of plant and animal life, while the greatest latitudinal diversity of species is found at the Equator.

The Earth provides resources that are exploitable by humans for useful purposes. Some of these are non-renewable resources, such as mineral fuels, that are difficult to replenish on a short time scale.

Large deposits of fossil fuels are obtained from the Earth's crust, consisting of coal, petroleum, natural gas and methane clathrate. These deposits are used by humans both for energy production and as feedstock for chemical production. Mineral ore bodies have also been formed in Earth's crust through a process of Ore genesis, resulting from actions of erosion and plate tectonics. These bodies form concentrated sources for many metals and other useful elements.

The Earth's biosphere produces many useful biological products for humans, including (but far from limited to) food, wood, pharmaceuticals, oxygen, and the recycling of many organic wastes. The land-based ecosystem depends upon topsoil and fresh water, and the oceanic ecosystem depends upon dissolved nutrients washed down from the land. Humans also live on the land by using building materials to construct shelters.

WILD LIFE

Wildlife includes all non-domesticated plants, animals, and other organisms. Domesticating wild plant and animal species for human benefit has occurred many times all over the planet, and has a major impact on the environment, both positive and negative.

A **non-renewable resource** is a natural resource that cannot be produced, re-grown, regenerated, or reused on a scale which can sustain its consumption rate. These resources often exist in a fixed amount, or are consumed much faster than nature can recreate them. Fossil fuels (such as coal, petroleum and natural gas) and nuclear fuel are some examples.

FOSSIL FUEL

Natural resources such as coal, petroleum, and natural gas take millions of years to form naturally and cannot be replaced as fast as they are being consumed.

Coal is a fossil fuel by geological processes applies pressure to dead biotic matter over time, under suitable conditions. Coal is extracted from the ground by coal mining, either underground mining or open pit mining (surface mining). If we use the reservoir of coal abruptly than these come to an end very soon.

Petroleum or crude oil is a naturally occurring, flammable liquid found in rock formations in the Earth consisting of a complex mixture of hydrocarbons of various molecular weights, plus other organic compounds.

Natural gas is a gas consisting primarily of methane. It is an important fuel source, a major feedstock for fertilizers, and a potent greenhouse gas.

The major oil and gas fields in Pakistan;
1. POTOHAR (KHOR) 2. BADIN 3. SUI

NUCLEAR ENERGY

Nuclear Energy is released by the splitting (fission) or merging together (fusion) of the nuclei of atom(s). The conversion of nuclear mass to energy is consistent with the mass-energy equivalence formula $\Delta E = \Delta m.c^2$, in which ΔE = energy release, Δm = mass defect, and c = the speed of light in a vacuum (a physical constant). Nuclear energy was first discovered by French physicist Henri Becquerel in 1896, when he found that photographic plates stored in the dark near uranium were blackened like X-ray plates, which had been just recently discovered at the time 1895.

Nuclear energy is released by three *exoenergetic* (or exothermic) processes:

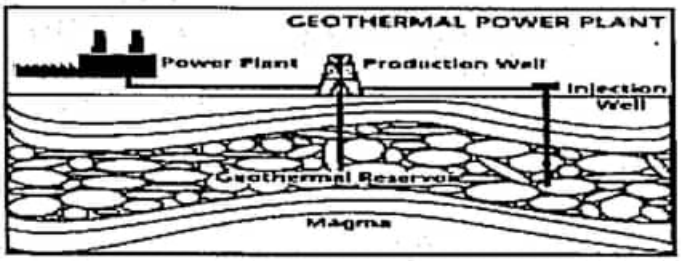
- **Radioactive decay**, where a neutron or proton in the radioactive nucleus decays spontaneously by emitting either particles, electromagnetic radiation (gamma rays), neutrinos (or all of them)
- **Fusion**, two atomic nuclei fuse together to form a heavier nucleus
- **Fission**, the breaking of a heavy nucleus into two (or more rarely three) lighter nuclei.

GEOTHERMAL ENERGY

The word **geothermal** comes from the Greek words geo (earth) and therme (heat). So, geothermal energy is heat from within the earth. We can use the steam and hot water produced inside the earth to heat buildings or generate electricity.

Some applications of geothermal energy use the earth's temperatures near the surface, while others require drilling miles into the earth. The three main uses of geothermal energy are:

1) Direct Use and District Heating Systems which use hot water from springs or reservoirs near the surface.
2) Electricity generation in a power plant requires water or steam at very high temperature (300 to 700 degrees Fahrenheit). Geothermal power plants are generally built where geothermal reservoirs are located within a mile or two of the surface.
3) Geothermal heat pumps use stable ground or water temperatures near the earth's surface to control building temperatures above ground.



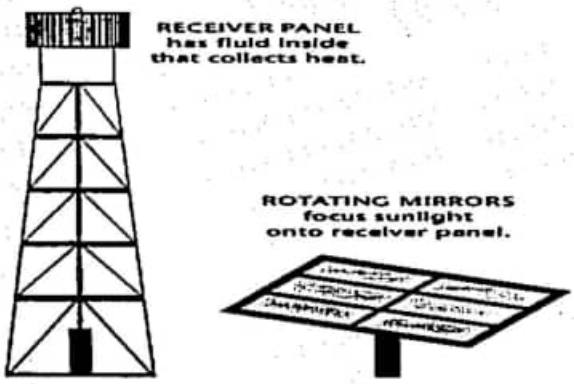
SOLAR ENERGY

The sun has produced energy for billions of years. Solar energy is the sun's rays (solar radiation) that reach the earth.

Solar energy can be converted to electricity in two ways:

- **Photovoltaic** (PV devices) or "solar cells" – change sunlight directly into electricity. PV systems are often used in remote locations that are not connected to the electric grid. They are also used to power watches, calculators, and lighted road signs.
- **Solar Power Plants** - Indirectly generate electricity when the heat from solar thermal collectors is used to heat a fluid which produces steam that is used to power generator. Out of the 15 known solar electric generating units operating in the United States at the end of 2006, 10 of these are in California, and 5 in Arizona. No statistics are being collected on solar plants that produce less than 1 megawatt of electricity, so there may be smaller solar plants in a number of other states.

Solar energy is free, and its supplies are unlimited. Using solar energy produces no air or water pollution but does have some indirect impacts on the environment. For example, manufacturing the photovoltaic cells used to convert sunlight into electricity, consumes silicon and produces some waste products. In addition, large solar thermal farms can also harm desert ecosystems if not properly managed.



SOLAR POWER TOWER

SOLID WASTE

These are discarded cartoons, tins, polythin material, cracked bottles, agricultural and industrial waste. These form an important threat to man by pollution of air and water and many times by breading bacteria and other animals that cause human health problems. These amounting millions of ton in each country. It is necessary to make arrangements for waste disposal.
There are several methods for the disposal of waste like:

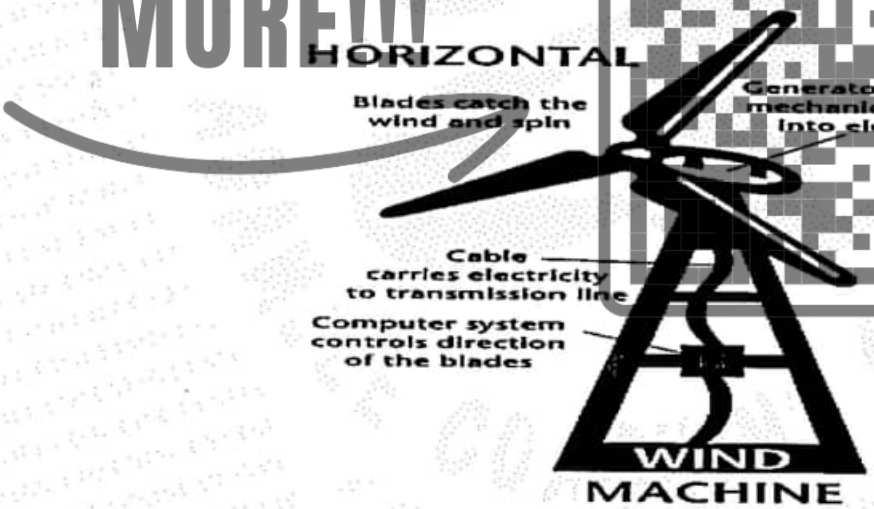
(i) Properly operated landfills.
(ii) Incineration i.e. burning electric furnance to make ash.
(iii) Recycling of material.

Certain kind of waste material such as form and animal manure, crop residue and sewage however can be converted into fuels, called bio gas. Bio gas plants are being utilized on small scale in Pakistan and third world.

WIND, WAVE AND OCEAN THERMAL GRADIENTS

The wind, wave and ocean thermal gradients are indirect source of solar energy. It has been estimated b/w 250 to 2500 billion kw. But the 1% of this energy could be effectively put to human use.

Ocean thermal gradient energy is elaborate solar technology based on the difference in temperature b/w surface and deep water. The thermal gradient difference is use to run ammonia turbine for the production of energy.



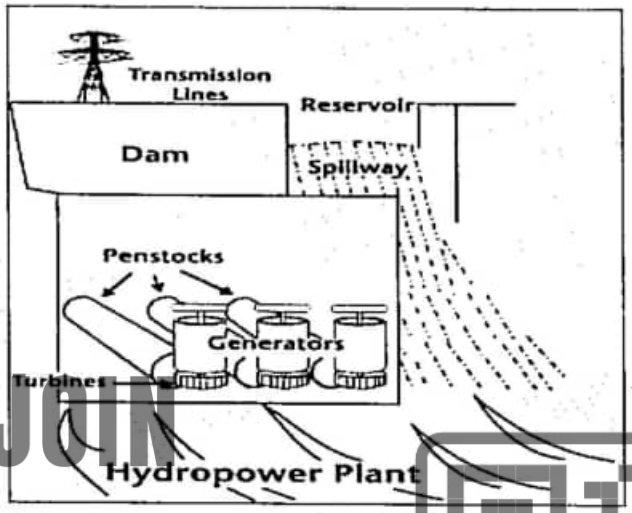
TIDAL POWER

Tides have been in use for a long time as a source of energy for operating small mills e.g. for grinding corn in costal area in some countries. Power plant had been functioning in smaller scale since 10 to 15 yrs back in France and USSR. According to one estimate, the total energy flow due to tides in shallow seas is about 1.1 billion kW, of which 13 million kW can be harnessed with existing technology.

HYDRO ELECTRIC POWER

A small amount of water falling a great distance or a great volume of water falling a short distance for generating hydro electric power. The hydro electric power is produced more economically in mountain region of the world.

The world capacity of generating hydro electric power has been estimated to be around 2900 million electrical kW, where as at present only 250 million kW has been developed. In Pakistan a major part of power requirements are supplied by terbela, mangla and some extent by warsak and dargai hydro electrical scheme. At present WAPDA is generating 4300 mega watts of powers at peak period in Pakistan.



IMPORTANT INFORMATIONS FOR OBJECTIVES

- More than 390 nuclear reactors are in operation around the world.
- In Pakistan, the population is increasing at the rate of 3% per annum.
- In 1947, the human population in Pakistan was 32.5 million.
- In 1986, the human population in Pakistan was 98-100 million.
- In 2004, the human population in Pakistan was 150-160 million.
- In 2025, the human population in Pakistan will be 260-300 millions.
- World population is 6 billion.
- World population will be 13 billion in 2090.

DEFORESTATION: Cutting of forest for agriculture, firewood, etc is called deforestation. The deforestation is responsible for degradation.

AFORESTATION: The growing of new forest is called aforestation.

POLLUTION

The pollution is an undesirable change in the physical, chemical or biological characteristics of air, water, land, etc that may harmfully affect human life or that of desirable species. There are two types of pollutions:

MATERIAL POLLUTION:

1. Soil pollution
2. Water pollution
3. Land pollution.

NON-MATERIAL POLLUTION:

1. Radiation pollution
2. Noise pollution.

AIR POLLUTION

Air pollution is one of the most dangerous & common type of environmental hazard that is reported in most industrial cities of the world. The air pollution is produced due to the particulate & gaseous matter released by the burning of fossil fuels such as coal, petroleum, etc.

PARTICULATE POLLUTANTS:

These pollutants include carbon smoke, road dust, particles of metals, minerals dust, pollens, aerosols, oxygen compounds, halogen compounds, etc.

GASEOUS POLLUTION:

In this group carbon monoxide, sulphur dioxide & some other gases are included.

✓ ACID RAIN

Those industrial units which are run by burning of coal emit carbondioxide, sulphurdioxide and nitrogen oxide into the air. In the atmosphere these gases react with moisture to form dilute acids

$$SO_2 \xrightarrow{\text{water vapour}} H_2SO_4$$

$$NO_2 \xrightarrow{\text{water vapour}} HNO_2 \text{ (nitrous acid)}$$

$$CO_2 \xrightarrow{\text{water vapour}} H_2CO_3$$

These acids return to the earth with rain water and are known as acid rain.

EFFECTS OF ACID RAIN:

- It destroys many man made structures, metals, & statues of archaeological importance.
- It increases the acidity of environment & may kill many animals & also destroys the agricultural land.

✓ GREEN HOUSE EFFECT OR GLOBAL WARMING

IMPORTANCE OF CO_2:

CO_2 plays an important role in regulating the earth surface temperature. CO_2 allows the sunrays to pass through the atmosphere but prevents the long wave radiations to escape from the earth. Thus temperature of the atmosphere increases due to the increase in the concentration of CO_2. This rise in temperature of atmosphere is known as green house effect.

IMPACT OF GREEN HOUSE EFFECT:

The green house effect has an adverse impact on agriculture & on the sea levels because of melting of polar ice, it also causes heavier rains, floods etc.

✓ DEPLETION OF OZONE LAYER

OZONE (O_3):

The harmful ultraviolet radiations of the sun are filter out by the layer of ozone, which acts a protective coat for life on earth.

DEPLETION OF O_3:

Chlorofloro carbons (CFC) are widely used as refrigerants, industrial foaming agents etc. These inert gases release chlorine atoms endless the influence of UV radiations at high altitude. Each atom of chlorine reacts with more than 1,000,00 molecules ozone.

EFFECTS OF DEPLETION OF O_3:

Due to the depletion of O_3, UV light penetrates & reaches at the earth's surface & causes skin cancer & many other lethal effects on living organism.

✓ PHOTOCHEMICAL SMOG:

Nitrogen dioxide (NO_2) is a common pollutant, which is released during combustion. In the presence of sum light it is combined with gaseous hydrocarbons to form a variety of secondary pollutants called photochemical oxidants. These oxidants together with solid & liquid particles in the air are very effective in the scattering of light that causes the milky gray haze characteristics of photochemical smog. This smog causes irritation of lungs & eyes.

WATER POLLUTION

The term water pollution is referred to any type of aquatic contamination. Pollution of fresh and sea water is caused by 3 major sources.

(a) **Industrial pollution:** Industries play an important role to pollute the water many of the ways discharge by industries are toxic, particularly those from paper, leather, chemical, petroleum and steel industries.

(b) **Domestic pollution:** Sewage contaminates the water. It includes mostly bio degradable pollutants such as human fackle matter, animal waste and certain dissolve organic compound and inorganic salt. Under natural process most of the bio degradable pollutants sewage are rapidly decomposed, but, when they accumulate in large quantity they create problem.

(c) **Agriculture pollution:** Poultry feeding operations, animal waste and fertilizers are source of agriculture pollution of water. In agriculture there is common use of insecticide, herbicide and fertilizer for increase in crop production. These substances ultimately reach the water table and reuse the soil water thus become injurious for health.

EUTROPHICATION OR ALGAL BLOOM

The lakes on the basis of there production of organic matter can be divided into two type i.e eutrophic and oligotrophic lakes. The eutrophic lakes contain abundant supply of minerals and organic matter. The oxygen requiring organisms rapidly utilize the available oxygen and thus the oxygen level is very low in such lakes the oxygen depletion also convert sulphates and nitrates.

NOISE POLLUTION

The unwanted sounds are called noise. Noise levels are measured in decibels. According to decibel scale, sound above 80 decibel is considered as noise.

CAUSES OF NOISE:

- ✓ Factories, industries & mills.
- ✓ Different kinds of auto & motor vehicles, aircrafts, motorboats, ships, loud speakers, social gatherings, loud pop music.

ADVERSE EFFECT OF NOISE:

- ✓ Permanent damage of hearing due to high intensity sound.

✓ Headaches, fatigue nausea & loss of memory make a person irritable.

DISEASES

The condition in which a person is not feeling comfortable it means he is suffering from a disease. They are of two types:

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